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CONTENTS.

Notes of the Week.

An I.E.E. Commemoration.

Readers of The Electrician will be interested to hear that the first meeting of the Society of Telegraph Engineers, which was held on Feb. 28, 1872, will be commemorated by the Institution of Electrical Engineers holding a series of functions on dates approximately corresponding to that of the original meeting These functions will include the gastronomical exercise which is inseparable from a celebration of any sort, or, in other words, the annual dinner will take place at the Hotel Cecil on Tuesday, Feb. 21. To emphasise the popular appeal not only of electricity, but of the Institution, a lecture on "Michael Faraday and the Foundations of Electrical Engineering" will be delivered by Prof. J. A. Fleming on Tuesday, Feb. 21, at 4 p.m., and will be repeated on Wednesday, Feb. 22, at 8.30 p.m. To these lectures admission will be by ticket, and a limited number of these will be reserved for guests.

The Industry Historically Considered.

On Thursday, Feb. 23, matters of more particular interest to electrical engineers will be dealt with when, from 4 to 6 p.m., and again from 8 to 10 p.m., a number of members of the Institution, and others closely connected with the early development of electrical engineering, will "reminisce" and discourse on their experiences. The speakers will deal with matters of both scientific and technical interest, as well as with the effect of legislative action on the progress of the industry. No better method of celebration could have been devised. The functions will be anticipated with the greatest interest, and the Council are to be congratulated on the way in which they have felt the pulse of the industry in this matter. It is a great occasion, to which we hope all concerned will do their best to make a success by their attendance.

Scottish Electricity Supply Reorganisation.

Having made a survey of the electricity supply resources in the principal industrial areas of England and Wales, and having provisionally determined the boundaries of thirteen electricity districts, the Electricity Commissioners have now turned their attention to Scotland, where a start is being made with the West of Scotland district, the home of the Scottish shipbuilding and engineering industries, including the city of Glasgow, the county of Renfrew, and parts of the counties of Ayr, Dumbarton, Lanark, and Stirling. From the electrical point of view, this is a most promising area to deal with, for, apart from the staple industry of shipbuilding, there are important coal mines, textile mills, engineering works and factories in certain portions of the district, and, although electricity supply has already reached an advanced stage of development, especially in Glasgow, there is room for still greater progress. The majority of the existing generating stations are owned and operated by municipal authorities, but there are three supply companies, apart from the Clyde Valley Electrical Power Company; and, as might be expected, a variety of systems, pressures and frequencies

Existing Organisation Inadequate.

We are not, therefore, surprised to learn that the Commissioners are not satisfied with the existing organisation, and notify that they will hold a local inquiry. The unusually long period of twelve months is allowed to the authorised undertakers and others interested for submitting improvement schemes, including proposals for the formation of a Joint Electricity Authority or for altering or adjusting the boundaries of the district. In view of the numerous interests involved, and particularly when we consider the outstanding position of the Glasgow Corporation and of the Clyde Valley Electrical Power Company, the time allowed may not be too long; at all events, the experience gained from some of the Lancashire and Midland districts proves that the technical, administrative and financial details of a Joint Authority cannot be prepared and adjusted in three or six months. If this is the case where preliminary schemes have for long been under consideration, it is the more likely to be true where fresh ground has to be broken.

Electric Traction and the Designer.

In the early days of electric traction it was not unnatural that any discussion of its qualities should be prefaced by a statement of the advantages which its employment would make possible as compared with the older methods of operation. But now that electric traction is firmly established, the same policy, unfortunately, still too often holds, and time that might be more usefully employed is wasted in dealing with a question which, seeing that human nature is what it is, must always be more or less a matter of opinion. The time taken up by Sir Vincent Raven in the Paper on "Railway Electrification," which he read recently before the North-East Coast Institution of Engineers and Shipbuilders, is, therefore, welcome, both as a new departure and as an example. For, while he discussed at some length the relative advantages of electric and steam traction for British railway working, he went on to deal with questions of the design of electric traction equipment and to give full details of the electric passenger and goods locomotives which are being built at Darlington by British labour from British designs. As we have pointed out before, British electric traction has up to now depended for its development on the activity of foreign brains. That must be changed, and Sir Vincent Raven has shown that there is no reason why it cannot be changed.

1921.

The year 1920 was remarkable for the sharp change from boom to depression which occurred during its summer months. Nevertheless the repeal of the Excess Profits Duty gave rise to the opinion that trade would revive, probably slowly but none the less surely. Events in 1921 proved that optimism unjustified. With a few exceptions the year, industrially speaking, was the very worst within living memory.

1921 in Prospect.

It is only fair to add that optimism of early 1921 was not quite so unjustifiable as it now appears. At the beginning of the year under review the slump had apparently reached bottom, Government control was slackening, and prices were falling. But all hopes of recovery were soon killed by the coal strike, which, beginning on April 1, lasted no fewer than thirteen weeks, and brought in its train an unparalleled amount of human suffering and industrial depression, of which we are still feeling the effects.

A Bad Year for the Electrical Industry.

Under these conditions it is not surprising that the electrical industry has had far from a good year. In fact, the best that can be said is that it has not suffered so much as many other industries. There has never been a complete cessation of output, as in the coal industry, nor has it reached those depths of depression which have been prevalent in the iron and steel industry. At the same time, the coal strike, by cutting off a vital commodity, imposed great expense and required much ingenuity from those working on the supply side of the industry, while the general uncertainty as regards the future has placed a considerable check on development on the manufacturing side. It is therefore not surprising to find that outstanding electrical events during 1921 have been few and far between.

The Reorganisation of Electricity Supply.

The passing of the Electricity Supply Act at the end of 1919 encouraged the hope that an early reorganisation of the electricity supply industry would be followed by wide developments on the manufacturing side and in the making available for the general public a convenient commodity whose wider use would have been equally beneficial to them and to the electrical industry itself. Unfortunately, progress in this direction has been slow in spite of the almost superhuman efforts of the Electricity Commissioners. These Commissioners have now been in office for nearly two years. They have up to now provisionally delimited thirteen of the districts in England and one in Scotland, thus practically covering the whole of industrial England with the exception of the North-East Coast, which, in many ways, is already operating as an electricity district.

The Enquiries.

During 1921 six enquiries were held into the various schemes that were put forward for the engineering and financial conduct of these districts, beginning with the abortive West of England scheme in January, and including the Mersey and West Lancashire district, the Aire and Calder district of Yorkshire, the North Wales and Chester district, the London and Home Counties district, and the South-West Midlands district. In all of these, except the West of England and South-West Midlands, the provisional decisions of the Commissioners have been published, but so far little progress has been made with the settlement of the necessary orders. Enquiries have still to be held into the schemes put forward for the South-East Lancashire, the North Lancashire and South Cumberland, and the East Midlands districts, while schemes are still awaited for the Mid-Lancs, the North-West Midlands, the North-East Midlands, and the West of Scotland districts, in the last of which the area has only just been delimited.

The Commissioners' Duties.

At first sight, therefore, it appears unnecessary delay is taking place in bringing about the required reorganisation, and much criticism on these lines has been directed against the Commissioners. The fault, however, cannot be entirely laid at their door. The annual report of their work, which was published in October, shows that, whatever else they may be, they are not idle, for, in addition to their more spectacular duties, all the other legislative work connected with electricity supply, formerly carried out by other Government Departments, is now undertaken by them, and under these headings alone a large amount of official work has been necessary to meet post-war conditions.

On the other hand, delay has been caused by the inability of those concerned in the various areas to reach a decision. This has not been the fault of the engineers, who, in nearly every case, have produced an agreed scheme. There has, however, been a regrettable tendency on the part of some municipalities to play for their own hands and for their own aggrandisement rather than for the good of the district.

Agreemen[illegible]sential.

It has been pointed out with a good deal of justice that upon the reorganisation of electricity supply depends the development of the industry as a whole. That development is held in check until we know what is going to happen, and unemployment and poor trade are the inevitable results. Agreement with regard to this question is therefore, from all points of view, highly desirable, and in this connection the Commissioners themselves have set a good example, for the decisions which they have so far published show that they are adopting a policy of compromise in nearly every case, and that they show no inclination to favour either a pure municipal policy or to permit the uncontrolled expansion of private enterprise.

Technical Progress.

Technically speaking, progress has been slow. Extensions in most places were unnecessary, the additional plant added to meet war-time conditions being amply sufficient to deal with the load during the past year. What will eventually be a large station was, however, opened at Blackburn in October, with a preliminary capacity of 20 000 kW, while the Mersey Power Company also began operations with a station at Runcorn with a present capacity of 25 000 kW. A new station at Sheffield, with a present capacity of 35 500 kVA, was opened by the Duke of York in November, though it had already been working for some time. In many places obsolescent plant was replaced by larger and more efficient machinery, as, for instance, at Bolton, Bury, Darlington, Halifax, Hull, Salford, Sunderland, Warrington and Wigan; while satisfactory progress was made with the Barton station of the Manchester Corporation, the Nechells station of the Birmingham Corporation, and the Portobello station of the Edinburgh Corporation. Plans are in readiness for a large station at Agecroft, Salford, and for the famous Barking station, a start on which we hope will shortly be made. Progress has also been made in linking up the London stations, while additional plant has been installed at Hackney, Hammersmith, Marylebone, and Stepney.

Water-Power Resources.

Much attention was paid during the year to the problems of water-power utilisation for the generation of electrical energy. This examination was stimulated in the early months of the year by the publication of an extraordinary scheme by the Minister of Transport for employing the tidal power of the Severn for this purpose. The scheme as it stood was too grandiose and wanting in engineering soundness to receive much approbation in technical circles, but it is obvious that the utilisation of this source of power is a question which must be examined side by side with that of the employment of waterfalls.

The Water Power Resources Committee, which was appointed in 1918 by the Board of Trade, published its final report during the year, and details were given in a recent issue. Among other important conclusions they called attention to the necessity of discovering exactly what water power is available in Britain and how this can best be utilised. The obstacles to doing this are well known, but, at the same time, the difficulties with regard to present methods of coal utilisation are, in their way, almost equally profound. There are certainly cases where the employment of water power, even when it is situated in remote parts of Scotland, will be an undoubted advantage. In countries like Switzerland, Austria, Norway, Sweden, France, Spain, India, New Zealand, Tasmania, Canada, certain parts of the United States and South America, matters are far otherwise. Here coal is often unobtainable, or, where available, is very expensive, while water power is found sufficiently contiguous to industrial areas to make its employment highly desirable. For these reasons considerable development in the use of water power may be expected shortly, and it is therefore necessary that British electrical engineers shall be ready to play their part in dealing with the technical problems which will arise.

Distribution and Utilisation Problems.

The public work of the Commissioners has naturally drawn the greatest attention to the generation side of the electricity supply problem, but on the distribution and utilisation side the difficulties are just as important and equally interesting. Those responsible for electricity supply in most towns are faced with a growing demand from domestic consumers and with the problem of supplying that demand over an inadequate distribution system. These conditions will soon have to be met either by increasing the copper employed in the cable network, by the use of mercury vapour rectifiers, or by a return to the house-to-house system of supply. As a matter of fact, all three solutions are being employed with success in various parts of the country, and it remains to be seen which will receive the widest application.

Finance and Tariffs.

The financial devastation caused by the war has had a disastrous effect on the fortunes of the smaller electricity supply undertakings, especially where these are in private hands. To improve this a determined effort has been made to obtain the Commissioners' consent to a compulsory two-rate tariff. We hope this consent will not long be withheld, as it is most inequitable that these pioneer undertakings, which operate mainly in residential areas and have never paid their promoters for the work and money that has been sunk in them, should continue to be conducted on a non-paying basis.

The question of the best tariff for domestic purposes is one which can only be solved locally, but in general it is agreed that a two-part scale with a fixed charge depending on the amount and class of apparatus installed, together with as small a running charge as possible per unit, is one which is not only most favourable to the undertaking itself, but is likely to give the consumer most encouragement to develop the use of domestic electrical apparatus.

The Domestic Field.

In entering 1922 it must be reiterated that it is in the domestic field that the electrical engineer must look for much of his success in future. It is a field that is almost illimitable, and though as yet many difficult problems have to be solved before it is fully developed, if electricity is really to be an aid to civilisation, it is here that it can give the greatest help and provide the greatest comfort. In supply circles this is now generally recognised, and such enterprises as the electric restaurant of the Brompton and Kensington Accessories Company, and the interesting and up-to-date showrooms and energetic business methods displayed in such places as Newcastle and Glasgow, are sufficient examples of a realisation of present difficulties and a guerdon of future success.

Electric Traction.

From the point of view of actual accomplishment, stagnation was as complete in the electric traction world as in that of electricity supply. The Advisory Committee appointed by the Minister of Transport at the beginning of 1920 issued a final report in 1921, in which certain details of the equipment were standardised. Until the latter part of the year no schemes for the electrification of the railways of this country were even suggested, though it was understood that the North-Eastern Railway were working on the electrification of their main line between York and Newcastle. In November, however, a number of schemes which had been under consideration by the directorates of the various railways saw the light, principally as a result of the Government's proposals for dealing with unemployment by putting in hand work which was likely to be in the national interest. In this way we were made acquainted with the plans of the South-Eastern and Chatham Railways for the electrification of their London suburban lines within a radius of 20 miles of Charing Cross, and for a further scheme for ultimately including such towns as Chatham, Tonbridge, and Dorking within the electrified area. The

London, Brighton and South Coast Railway also put forward a scheme for the electrification of their main lines as far as Eastbourne, while details of the proposed electrification of the Great Eastern Railway's main and suburban lines in the London area were published. In addition to the electrification of trunk systems the City and South London tube railway is to be widened and connected to the London Electric Railway at Camden Town. The Hampstead and Highgate Railway is to be extended to Edgware, and the Central London Railway is to be connected to the London and South-Western Railway at Shepherd's Bush.

All these schemes, we are told, merely await the coming of easier financial conditions. They are, in fact, a tribute to the economic and engineering advantages of electric traction—advantages which are equally recognised not only in Continental countries such as Switzerland, Austria, and Norway, where electrification is to be pushed on as quickly as possible, but in South Africa, India, and South America, where comprehensive schemes have reached a stage when work could be started at any time.

No Agreement as to System.

On the technical side no agreement has been reached as to the best method of operation to employ. Working results largely obtained from the United States show that there is not much to choose, either financially or technically, between the various systems. In this country we are now apparently committed to high-tension direct current, but in France and in Switzerland the single-phase system is favoured. In most other countries no definite decision has been reached, though both India and South Africa are following our example, and the same is true of the Argentine and Chile.

Tramway Troubles.

It is common knowledge that the results obtained by employing electric traction on railways have been generally most satisfactory. Unfortunately, the same thing cannot be said of tramways, where bad finance and an uninspired policy are now bearing fruit in the generally depressed condition of these undertakings. In an attempt to counteract this fares were increased, with the result in many cases of making matters worse. So much has this been the case that the London County Council have adopted the wise policy of reducing their fares, and although it is a little early to say what the result of this will be, we hope that it will be most successful. Improved results are also expected from the use of the railless trolly system, trailer cars and the carriage of parcels and goods. With more attention to improved methods, more careful finance and general reorganisation, a great deal can be done to put these undertakings on a sounder basis.

The Institution of Electrical Engineers.

The outstanding event in the history of the Institution of Electrical Engineers during the past year has been the granting of a Royal Charter. It is interesting to note that this grant took place during the Jubilee year of the Institution. A further event of the past twelve months was the return to the building on Victoria Embankment, which was temporarily vacated in 1917 owing to Government requirements. The war and pressure of recent events have led to a general realisation that if the Institution is to serve electrical engineers in the best possible way it can no longer confine itself solely to technical problems. It must play its part in impressing on the Government and the people of the country the views of electrical engineers in matters which concern them. Its increased status should be of great benefit from this point of view, and it has made an excellent start by its representations to the Prime Minister on the question of German reparations in kind. On the more domestic side it has still to consider the question of professional conduct, the admission to its ranks only of duly qualified men, and the abuse of the term electrical engineer by those who are not entitled either by education or experience to apply that name to themselves. The Institution of Electrical Engineers is now the largest and most progressive of the great technical bodies in this country, and its democratic character was further exemplified by the meeting which took place early in the year on the question of increasing the subscriptions.

Telegraphy.

In the Diamond Jubilee issue of The Electrician we gave an account of telegraphic development during the past sixty years, and it is therefore hardly necessary to deal with the events of the past twelve months except to say that both commercially and technically progress was satisfactory. In subsequent issues we shall review wireless telegraph and telephone developments during the past twelve months and deal with the advances that have taken place in electrical science.

Telephony.

In the telephone world a superficial glance would make it seem impossible to say that progress in that field has been great. As usual, there was much criticism of Post Office methods and much comparison of its methods and their results with what was being done in other countries. Nevertheless, some interesting developments took place, notably the inauguration of the London Toll Exchange, and, as in other fields, a good deal of preliminary work has been carried out, which, during the coming months, should give satisfactory results. Censure was mainly directed to administrative work, but in the discussion which took place on Mr. E. S. Byng's Paper on "Telephone Line Work in the United States," which was recently read before the Institution of Electrical Engineers, the same sort of criticism was made on what the Engineering Department of the Post Office are doing or not doing. The unbiassed view, however, is that, in spite of numerous difficulties, satisfactory progress is being made. When no profit has to be earned enterprise and self-examination are difficult. Still, however, some advantage is being taken of improved apparatus and methods, and there is no doubt that the result will be a more efficient telephone service, if not one that is ideal.

In the Labour World.

Disorganisation from labour disputes was less in evidence and, except for the coal strike, its effect during 1921 was less serious than during the preceding two years. Though at one time it seemed as if strikes would actually occur among the organised engineering trades, in the tramway industry, and in sections of the electrical industry, fortunately, in every case, an actual stoppage of work was averted, and it now seems as if the pressure of economic conditions and the regaining of control over their organisations by the saner elements in the trades union world will bring about a greater employment of collective bargaining, with the relegation of the strike weapon to the background.

A Co-operative Success.

The success of Joint Industrial Councils was not equal in all trades, but in the electrical industry the work of these bodies was highly satisfactory, so much so that on at least one occasion they were able to go outside the specific purpose and as a body make representations to Government authorities on matters which, though not directly connected

with conditions of labour, were likely to have a great effect on those conditions, if not wisely dealt with. This was particularly the case in the representation made to the Chancellor of the Exchequer on the proposals that the German reparations should be paid in kind.

Organisation of the Middle Classes.

Another interesting development in the organisation of workers was the recognition amongst the salaried classes that they, like both employers and employed, must combine for their individual and class good. After a good deal of preliminary work the Society of Technical Engineers put forward a policy which in general was greatly to be commended, while smaller bodies, such as the National Association of Supervising Electricians and the Electrical Power Engineers' Association, are equally concerned in maintaining the status of the middle-class worker against aggression both from above and from below.

Legal Decisions.

The past year's legal actions were above the average in number and importance. The most important commercial case was the appeal to the House of Lords against a decision of the Court of Appeal which pronounced the well-known Langmuir gasfilled lamp patent of 1913 invalid on account of ambiguity in the statement of claim and of insufficiency in the directions. The appeal was heard by a strong bench, headed by Viscount Haldane, and the result was a unanimous judgment in favour of the validity of the patent. Whatever views may be held of the noble lord's capacity to expound the Einstein Theory, there can be no doubt of his ability to construe correctly a patent which involves the application of an abstract principle to a method of manufacture, and to reconcile the conflicting interests of law and equity. His lucid and convincing judgment in the gasfilled lamp case will be read with pleasure by those interested in patent law, and it will undoubtedly be looked upon as a leading case. Another interesting patent was dealt with in the application made in March for the prolongation of the Poulsen arc patent of 1903. The history of the patent was somewhat involved. It had expired in July, 1917, but it was only in 1920 that the petition for the prolongation was filed. Owing to this lapse of time and to the practical amalgamation of the company with their rivals, the Marconi Company, the petition was dismissed.

An Important Electricity Supply Judgment.

A judgment of the greatest interest to electricity supply consumers was given by a Divisional Court in November on the appeal of the Hackney Borough Council against a decision of the North London magistrate. The latter had convicted the Council of having made default in giving a supply of electricity to an intending consumer named Dore, who had had his house wired by non-union labour. In consequence of this the Council's jointers refused to connect the house to the supply mains, and the magistrate held that the plea of *force majeure* urged on behalf of the Council failed, although he found that the *probable* effect of the dismissal of the jointers would be a strike of the whole of the employees of the electricity department. The Divisional Court agreed with the magistrate's views and dismissed the appeal. Throughout the case the term *force majeure* was much discussed, but no general principle can be extracted from it, and the decision of the Divisional Court is only of limited authority. The case has undoubtedly created a prejudice against municipal electricity supply, as well as against the autocratic methods of the Electrical Trades Union.

Municipal Trading and Activities.

An important point in municipal trading was raised in the action brought by the Attorney-General on the relation of several local contractors to restrain the Liverpool Corporation from carrying on business as wiring contractors and dealers in electrical fittings. The Corporation acquired in 1896 and 1902 two local electricity supply companies which had carried on electric wiring and fitting, and the transfer acts contained specific power to carry on this business. Under the circumstances, the judge distinguished the Leicester and Sheffield cases, which decided that a local authority working under a provisional order had no power to undertake wiring. He therefore dismissed the action.

In January the Stepney Borough Council failed in their appeal against a judgment granting an injunction to restrain them from committing a nuisance by the discharge of grit and ashes from their Limehouse power house. The Court felt bound by the judgment in Shelfer's case, and the appeal was entered mainly with a view to a further appeal to the House of Lords. The case has, however, been settled in the meantime, and the Council are now applying for a special order to exempt them from the liability for a nuisance in the ordinary use of the station.

In Sheppard *v.* Glossop Corporation, the Court of Appeal allowed the appeal of the Corporation against a judgment of Mr. Justice Greer, awarding the plaintiff damages for personal injuries sustained owing to their failure to light a lamp on private land for illuminating a dangerous place on a public highway. The Court held that as Sec. 161 of the Public Health Act, 1875, gave the Corporation authority to light their district, but created no obligation to do so. This decision is unsatisfactory and has aroused considerable criticism.

Valuation of Tramways.

The method of assessing the value of tramway buildings in Bristol was raised in February in a special case on an arbitrator's award. In 1875 the Bristol Tramways and Carriage Company leased buildings from the Corporation, and the point at issue was the meaning of "the then value" of the buildings, which the Corporation covenanted to pay on the expiration of the term. The company contended that the proper value was the cost of the construction of the buildings less depreciation, but Mr. Justice Sankey held that the value was what anyone would pay for them in the open market, and that the matter did not come under Sec. 43 of the Tramways Act, 1870. The question of the "then value" was also raised in the arbitration on the value of the Oldham, Ashton and Hyde Electric Tramway, and the Court of Appeal decided that there must be allowed as part of the then value (1) the remuneration of the engineer, subject to depreciation; (2) interest on capital during construction, subject or not to depreciation according to whether the money was spent on depreciating things such as rails, or on non-depreciating things such as excavation work; and (3) preliminary expenses, but the cost of raising capital was disallowed.

Obituary.

The obituary list for 1921, though not quite so lengthy as in previous years, is sufficient indication that the pioneers of the electrical industry are gradually passing away, and that the after effects of the war are also making themselves felt in a most unfortunate manner among the younger men. We may mention among those whose loss will be felt by a wide circle of friends and whose work has left a lasting impress on electrical progress. Lord Moulton of Bank, Sir James Pender, Dr. E. A. Budde, Mr. T. E. Gatehouse, Mr. A. E. Mavor, Dr. E. B. Rosa, and Mr S. A. Varley.

Electric Winding Engines and Mine Hoists.*

Some Notes on Double Helical Gearing.

By H. H. BROUGHTON.

The author has collected a series of notes on the strength of helical gearing, as well as particulars of a number of individual gears, with the idea of providing the user of such gears with data by which he can check the designs of the gearing manufacturers. In the first part of the article published below typical calculations of the working loads and a chart for determining the horse-power rating of gearing are given.

Accurately-cut solid gears of the double helical type have played an important part in the development of the three-phase geared winder, and in the application of the three-phase motor to heavy engineering.

Such gears are applicable to cases involving large velocity ratios and high speeds, and are well suited for withstanding heavy and rapidly fluctuating loads. Denoting the maximum permissible speed of machine-cut spur-gearing by unity, then a double-helical solid gear may be run at a speed of 1·7, and for a herring-bone gear the permissible speed is 2·0. The maximum gear ratio with ordinary spur wheels is 6 : 1. With double-helical gears a ratio of 10 or 12 : 1 may be used, and for herring-bone gears this can be increased to 15 : 1.

Strength of Helical Gearing.

It is the purpose of this article to place before the reader in a convenient form notes on the strength of helical gearing

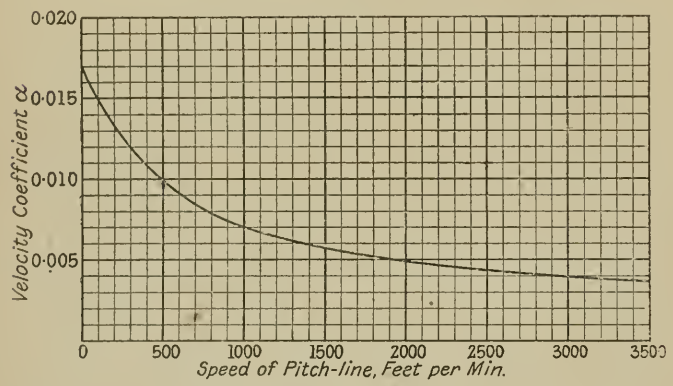


Fig. 1.—Curve Connecting Velocity Coefficient α and Pitch-line Speed S.

as well as particulars of a number of typical gears. Theoretical discussion has been eliminated in order to make room for matters likely to be of immediate assistance to those who, like the author, have to consider proposals put forward by the gear specialists and to give decisions upon them at short notice. At the outset it should be mentioned that the manufacture of double helical gearing is in the hands of half a dozen or so specialist firms and, although the design is best left to the specialist, the user should, nevertheless, be in a position to make a few simple check calculations for himself, so as to determine the relative merits of different designs.

Working Load.

The safe load that may be applied to a pinion or wheel depends upon and is proportional to the circular pitch and width of the teeth. It is also a function of the number and shape of the teeth and depends upon the material of which the pinion is made. The pitch-line speed has an important bearing on the allowable working load. Although often neglected, both accuracy of workmanship and ratio of maximum load and average load are factors for which proper allowance has to be made in order to secure durability. Another factor to be taken into consideration is the intermittency of the load.

The effect of speed on the allowable load can best be shown by means of an example. If a certain gear when running at a pitch-line speed of 500 ft. per min. will transmit 250 H.P., then the same gear run at a pitch-line speed of 2 000 ft. per min. will transmit 500 H.P. In other words, at the higher speed the allowable load on the teeth is only *one-half* that at the lower speed.

A convenient expression for determining the horse-power which a double helical pinion will transmit is that recommended by D. Brown & Sons. It is of the modified Lewis form, and reads :—

$$\text{H.P.} = P\,b\,S\,\beta\,v\,\alpha \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

wherein P is the circular pitch in inches, b is the width of the gear in inches, S is the speed of the pitch-line in feet per minute, β is a constant depending upon the material, v is a velocity coefficient, and α is a coefficient depending on the shape and number of teeth.

Suitable values of β are : 1·0 for cast iron ; 1·6 for phosphor bronze ; 2·2 and 3·0 respectively for cast steel and mild steel ; 3·7 for 0·4 per cent. carbon steel ; and 4·0 to 5·0 for special pinion steel.

The relation between the velocity coefficient v and the speed is plotted in Fig. 1. The rapid variation of the coefficient at low speeds up to 1 000 ft. per min. will be noted. At higher speeds, from 1 000 ft. per min. to 3 500 ft. per min. the variation is less rapid, but the reader is warned against extending the curve for obtaining the coefficients for higher speeds† than those given in Fig. 1. For winders and haulage gears, however, the pitch-line speed of the gearing is well within the limits given in the diagram.

Values of the tooth-shape coefficient α, between wide practical limits, are set out in Table I.

Table I.—*Values of Tooth-shape Coefficient α.*

No. of Teeth.	14½ deg.	20 deg.	No. of Teeth.	14½ deg.	20 deg.
12	0·67	0·78	27 to 29	0·99	1·20
13	0·71	0·84	30 „ 33	1·01	1·24
14	0·75	0·89	34 „ 37	1·04	1·27
15	0·78	0·93	38 „ 42	1·06	1·30
16	0·81	0·97	43 „ 49	1·08	1·33
17	0·84	1·00	50 „ 59	1·10	1·36
18	0·86	1·03	60 „ 74	1·13	1·39
19	0·88	1·06	75 „ 99	1·15	1·42
20	0·90	1·08	100 „ 149	1·17	1·45
21 and 22	0·92	1·10	150 „ 299	1·20	1·48
23 „ 24	0·94	1·14	300 „ 400	1·22	1·51
25 „ 26	0·97	1·18	Rack	1·24	1·54

Example.—A cast-steel double-helical pinion, running at 380 revs. per min., has 20 teeth of No. 1½ diametral pitch (2·1 in.) of 20 deg. obliquity, and is 13½ in. wide. It is required to determine the horse-power such a pinion will transmit.

Knowing the number of teeth and the pitch, the diameter of the pinion can be found. From this diameter and the speed, the pitch-line speed S is determined. Having found the pitch-line speed, the corresponding velocity coefficient v is ascertained from Fig. 1. Thus :

$$\text{Diameter} = 20 \div 1\tfrac{1}{2} = 13{\cdot}33 \text{ in.}$$

$$\text{Pitch-line speed } S = \pi \times 13{\cdot}33 \times 380 \div 12$$
$$= 1\,310 \text{ ft. per min.}$$

From Fig. 1, when $S = 1\,310$ $v = 0{\cdot}006$; β for cast steel $= 2{\cdot}2$; and, from Table I, for a 20-tooth pinion of 20 deg. obliquity $\alpha = 1{\cdot}08$.

† In certain applications, outside the scope of this article, the pitch velocity may be as much as 7 000 ft. per min.

Inserting these values into equation (1) we get :

$$\text{H.P.} = 2{\cdot}1 \times 13{\cdot}5 \times 1\,310 \times 2{\cdot}2 \times 0{\cdot}006 \times 1{\cdot}08$$
$$= 530.$$

This figure must not be confused with the maximum allowable horse-power. For winder service, not only is the duty intermittent but the peak load is usually about 1·5 times the normal load and, moreover, the peak load occurs for only a relatively small fraction of the total running time. The pinion under consideration would give excellent service on ordinary winder duty for a cycle requiring a 500 H.P. motor provided that the peak load does not exceed 700 to 750 H.P.

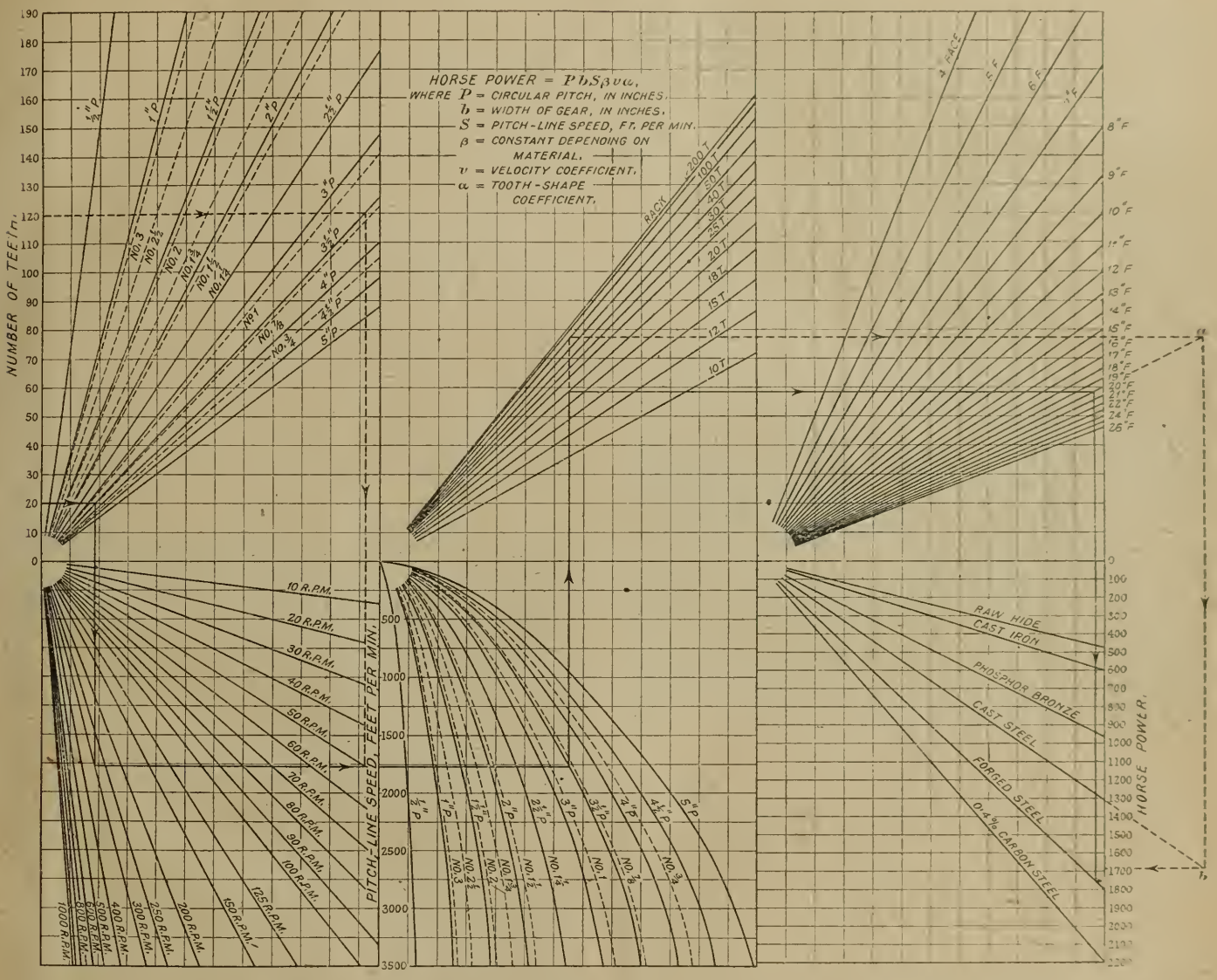


Fig. 2.—Chart for Determining the Horse-Power Rating of Double Helical Gears having 14½-deg. Involute Teeth.

Chart for Determining Horse-Power Rating.

From an inspection of equation (1) it is evident that the form is such as to lend itself to the construction of a simple chart from which the rating of any pair of wheels can be read off by inspection.

Such a chart for 14½ deg. involute gears is depicted in Fig. 2. In the first group of curves, teeth are plotted vertically and circumferences horizontally for wheels having teeth of various pitches. In the second group of curves, immediately below the first group, pitch-line speeds are plotted downwards on the first base line for the several angular speeds indicated. The third group takes velocity coefficient and pitch into account, and the fourth group of curves, immediately above the third group, applies the tooth-shape coefficient. Width is taken into consideration in the fifth group, and material in the sixth group. Finally, the horse-power rating is indicated by the vertical scale on the extreme right of the diagram. The reader should have no difficulty in constructing the diagram for himself, and, making use of the figures given in Table 1 and Fig. 1, he is advised to prepare a chart for 20 deg. involute gears.

To show how the chart is intended to be used, take, for example, a pair of gears running at 300 and 50 revs. per min. and having 20 and 120 teeth, 3½-in. pitch, 20 in. wide, forged-steel pinion and cast-steel wheel. Taking the pinion first, a full zigzag line, marked with arrowheads, will be observed in Fig. 2, which takes into account, progressively, each of the constants of the pinion. This line terminates on the horse-power scale and indicates that the pinion will transmit 1 760 H.P. The dotted zigzag line on the diagram refers to the wheel, and on the extreme right it will be noticed that the diagram has been extended by lengthening two of the vectors to a and b, the horse-power rating of the wheel being 1 690.

It should be noted that the drawing from which the diagram, Fig. 2, has been prepared is about 30 in. in length, and in actual use a sheet of tracing paper is pinned to the drawing, and the rating lines are drawn on this paper and not on the diagram itself.

(To be concluded.)

An American Arc Radio Transmitter.

By C. R. LEUTZ.

This article describes a panel type of arc transmitter which has been designed by the Liberty Electric Corporation for either ship or land work. Details of a 5 kW transmitter which has been installed at the New York Radio Station, Babylon, N.Y., are given. It is claimed for this apparatus that it is much more compact than the earlier models.

Last November the first panel type arc transmitter was placed on the American market by the Liberty Electric Corporation. Two sizes are made, 2 kW and 5 kW (input rating), adapted to either ship or land installation. Fig. 1 shows a 5 kW complete

Fig. 1.—5 kW Transmitter at the New York Radio Station, Babylon.

transmitter installed at New York Radio Station (WSE) Babylon, N.Y. Fig. 2 shows the rear view of the same transmitter. Fig. 3 gives a complete wiring diagram of the high frequency and direct-current equipment.

Ordinarily the motor generator is self contained and mounted within the frame at the bottom, but in the station a separate source of high voltage direct-current is used. The panel occupies a space of 6 ft. high, 2 ft. wide, and 20 in. deep, and contains all the apparatus with the exception of the cooling water tank and lightning switch. The low voltage direct-current leads are confined to the lower control panel as far as possible, the upper panel handling the high potential direct-current and high frequency leads.

Sending Arrangements.

Referring to Fig. 3, it will be noted that the ship's mains are brought to the main switch. To transmit it is only necessary to throw the "send-receive" switch to the send position. This automatically starts the motor generator, closes the main line contactor, closes the generator field circuit and operates the arc striking mechanism through an arc striking relay. This arc striking relay has a current coil and a potential coil. The potential coil first operates, drawing the armature and working the auxiliary contacts, which, in turn, operate the mechanism which strikes the arc mechanically. As soon as the arc is struck, current passes through the current coil of the relay, drawing the armature on the opposite side and releasing the arc-striking mechanism. It is obvious that if the arc does not stay ignited, current will stop flowing through the current coil of the relay, the potential coil will operate again, and the performance repeated over and over again until the arc stays ignited. The carbon cathode can be regulated for distance in relation to the copper anode while the relay is in operation. The cathode is drawn to the anode very quickly by the electro-magnetic mechanism and returns slowly, as an oil dash-pot is provided for that purpose.

Protective Devices.

An overload relay is provided in the low tension direct-current lines for protection. In case of heavy surges the relay operates and stops the motor generator automatically. To start the machine again it is first necessary to open the main line switch.

Another overload relay is provided to protect the high voltage direct-current line in a similar manner. However heavy surges instead of shutting down the motor-generator, simply open the generator line through the main line contactor. A blow-out magnet is provided at the contacts of the contactor to help extinguish a short circuit. A field rheostat is provided to vary the generator voltage, and can be regulated from 200 to 600 V normally. These various devices can be plainly seen on the lower panel in the front of Fig. 1.

Another function of the arc striking relay and striking mechanism is to place the arc starting resistor in series with the arc circuit when the anode and cathode are struck, otherwise there would be a dead short circuit. The striking mechanism automatically attends to this, and after the arc is burning the starting resistor is again short circuited. In addition to an overload relay protecting the generator there is also a fuse in the circuit.

The Arc Chamber.

To the right centre of the panel can be seen the arc chamber, which is a casting, in two pieces, split where the cathode is shown. The field coils are wound with asbestos-covered square section wire allowing space between coils and castings for ventilation. The upper section has one field coil and the lower section three field

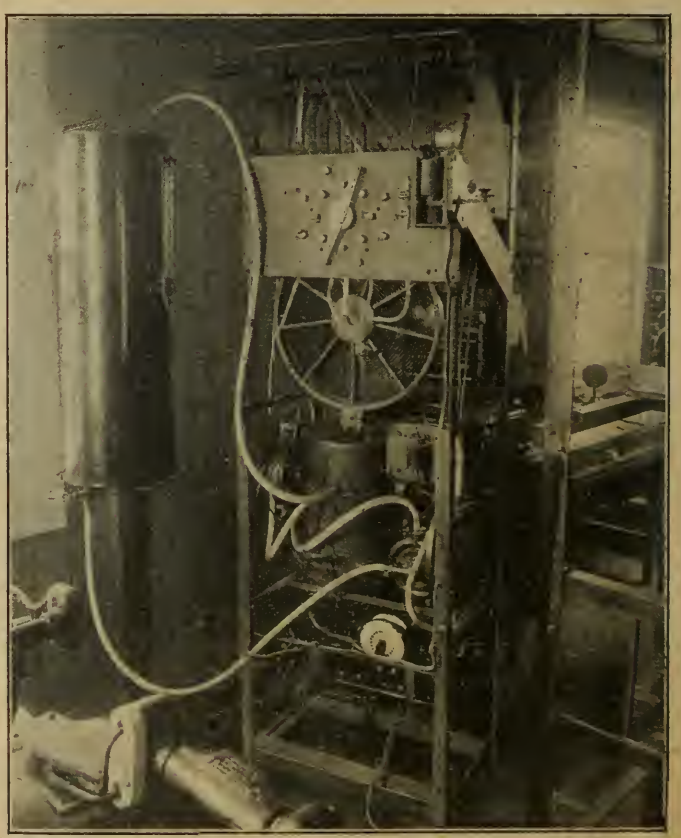


Fig. 2.—A Rear View of the Transmitter.

coils; all these are connected in series. To the left may be seen the poppet valves which protect the arc chamber from explosions and the pipe running to the pressure regulator which keeps the gases in the arc chamber at a constant pressure and insuring a steady flame. The motor which drives the water circulating pump also drives the cathode rotating mechanism through worms and worm

gears. The cathode makes one revolution in three seconds and keeps the tip burning off even. The cathode is earthed to the arc chamber. The anode is, of course, insulated from the chamber and consists of a solid copper tip inserted in a large copper tube. A smaller copper tube squirts a steady stream of cool water into the inside of the tip, and the water returns through the larger tube. From there the water is circulated through a duct making one complete turn around the arc chamber; this duct is cast right in the chamber. The water then returns to the top of the cooling tank and back to the centrifugal pump. The cooling tank holds approximately 2 cub. ft. of water, and during the winter alcohol is mixed with the water to prevent freezing, and, of course, salt water can never be used as it would short circuit the anode to earth through the rubber connecting hoses carrying the salt water.

To maintain the arc steadily and prevent bubbling in addition to the field magnets, alcohol is fed into the arc chamber and quickly vaporises, giving a supply of hydro-carbon, and, besides making the arc very steady, allows a greater amount of power to be handled, in some cases as much as 50 per cent. more. The hydro-carbon supply is automatic, as the alcohol valve is

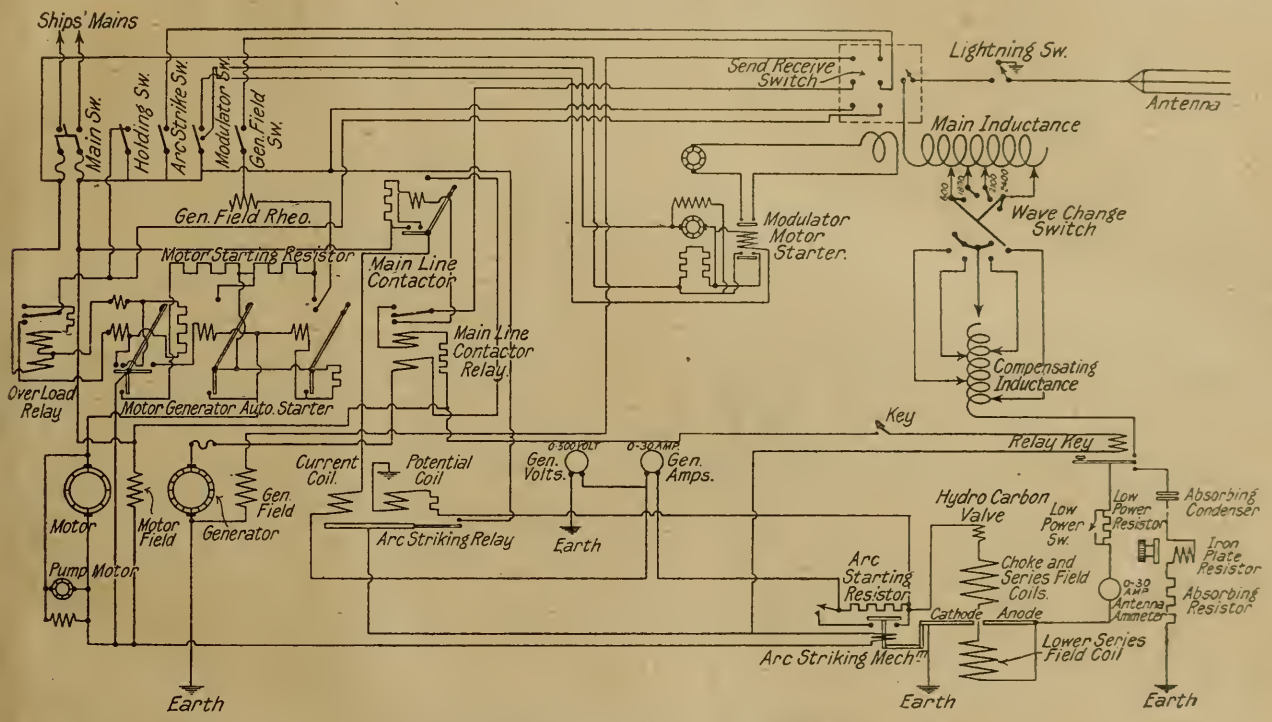


Fig. 3.—Wiring Diagram of the Equipment.

controlled electro-magnetically when current flows to the arc electrodes, likewise when the arc is shut down the supply of alcohol is stopped and the chamber does not flood.

The Absorbing Circuit.

This transmitter was designed to have no compensating wave and an absorbing circuit was used. This consists practically of an artificial antenna, having approximately the same characteristics as the ship's antenna with which the transmitter was installed. A special two-way key was provided, in the down position connecting the arc to the antenna and in the up position connecting it to the absorbing circuit. It is, of course, obvious that when this key is working the centre contact must never be disconnected from both the antenna and absorbing circuit, or the arc would go out. In other words, when passing from the absorbing circuit to the antenna the centre contact first touches the antenna contact and then leaves the absorbing circuit or lower contact. The potentials at this point of the circuit are not very high, being of the order of 3 000 V, and easily broken with a $\frac{1}{32}$ in. gap. With proper adjustment of the arc there is no flaming over at the contacts. The key is operated electro-magnetically, but an auxiliary handle protrudes through the panel for hand operation in case of an emergency. The absorbing circuit consists of a mica condenser, resistor bank of heavy current carrying capacity, and an iron plate resistor, so that the characteristics of the circuit can be varied to allow the same power consumption on the absorbing circuit as on the antenna. In practice, this can be made exactly the same in both positions, and there is no variation in the meter readings when sending, except possibly in the antenna current.

Main Inductance.

The main inductance consists of heavy Litzendraht nearly $\frac{1}{2}$ in. in diameter. This is bankwound in three layers and in sections of 15 turns. A compensating inductance is also provided for close adjustments. Referring to the wave-change switch, it will be noted that there are two positions of each wave length. When the switch is on a half-way tap, the compensating inductance is thrown into the circuit and the wave length adjusted closely, using the lower wheel on the panel. The switch is then returned to the permanent position and a permanent lead substituted in exactly the same place as the variable contact was on this compensating inductance. This inductance can be seen in the rear view, and consists of a spiral of copper strip at right angles to the main inductance.

The usual wave lengths are 600, 1 800, 2 100, and 2 400 m. To provide a decrement for the 600 m wave length, allowing reception with a non-oscillating receiving circuit, a rotary modulator is used. This consists of a motor-driven commutator which has every sixth bar short-circuited. The two brushes from this commutator run to a three-turn loop of inductance which is coupled to the main inductance. When the loop is short-circuited periodically, the resultant note is approximately 400 cycles, the wave length is thrown off about 7½ per cent., the decrement is very small and gives extremely sharp tuning. The modulator is provided with a special starting device, and it is impossible to short-circuit the loop without having the motor running. Three meters are provided: a 0 to 500 voltmeter to read the generator voltage; a 0 to 30 direct-current ammeter, which is in the generator arc electrode circuit, and a 0 to 30 radio frequency ammeter to read the antenna current. In practice with a 5 kW installation, 20 A is a fair antenna current at 1 800 meters on an antenna having a high frequency resistance of 5 Ω at that wave length.

In case it is desired to run the motor generator while receiving, a holding-switch is provided which keeps the machine running even, though the antenna switch is thrown to the receive position. It is also possible to close the generator field switch and arc-striking device from the panel independent of the antenna switch contacts. This transmitter is considerably more compact than early models, and is gaining great favour with the steamship companies. The writer will be glad to give European engineers any additional data they may be interested in.

The current number of the Industrial League and Council Journal contains a special article by Lord Burnham on "The Coming of an Industrial World Parliament." Lord Burnham, who presided at the International Labour Conference held at Geneva, quite frankly admits that things which during his thirty years' experience as a Member of Parliament he regarded as impossible in his time are coming to pass if only good sense and good temper prevail on those issues which are not vital in a political sense, but vital having regard to the well-being of humanity and the improvement of social conditions not only in Europe, but in all the continents which are now being brought so much closer together in industrial competition. He predicts that in the International Labour Conference, by reason of it being so democratic in character and representative of Capital and Labour, there are the germs of a world-wide parliament of industry.

Recent Progress in Electric Locomotive Design.

This article, which is an abstract from a Paper read by Sir Vincent Raven before the North-East Coast Institution of Engineers and Shipbuilders, is principally interesting from the details it gives of the electric freight and passenger locomotives which are now being built for the North-Eastern Railway. Comparative tests between the latest type of heavy goods steam locomotive and the electric locomotives used on the Shildon and Newport line are also given. These tests indicate that the electric engine handled the load more economically than the steam, and in other ways was more advantageous.

In the course of a Paper on "Railway Electrification" read before the North-East Coast Institution of Engineers and Shipbuilders last Friday, Sir Vincent Raven, chief mechanical engineer of the North-Eastern Railway, said there was a great advantage in being able to build a locomotive which, by its tractive effort, would keep a more even speed over the railway. In order to do this it was necessary to design a machine which would give the power required within the limits of the present load gauge. He showed the difficulty of increasing the power of a steam locomotive without exceeding present limits, though an electric locomotive capable of exerting a pull of 15 tons which would haul a train of 1 000 tons up a gradient of 1 in 100 at 30 miles per hour would fall within the limits. Although electric traction would not get over the difficulty of dealing with larger coaches, it would therefore overcome the difficulty of designing more powerful locomotives without increasing the gauge. Continuing, he gave some details of the design of electric freight and passenger locomotives for the North-Eastern Railway and of comparative tests between them and steam locomotives which have recently been undertaken.

Modern Electric Freight Locomotive.

The electric freight locomotives on the North-Eastern Railway are arranged to haul trains weighing 1 400 tons at a speed of not less than 25 miles per hour on the level. They may be described as articulated truck locomotives in which the tractive effort is transmitted through the truck frames. The motor equipment of each locomotive consists of four totally-enclosed motors, each driving an axle through single reduction twin gearing. The motors are suspended by means of a cross beam suspension bar with bearings and reaction springs. These, with the motor suspension bearings on the axle, provide the motors with four points of suspension.

The four main motors are fitted two on each bogie, and are wound for 750 V each, the pair of motors on each bogie being connected permanently in series. The four main motors of each locomotive thus form two units, which are controlled on the usual series parallel system. Each motor is capable of developing 275 B.H.P. at a speed of 20 miles for one hour with forced ventilation. The motor equipment is capable without injury of exerting a torque sufficient to skid the wheels on any conditions of rail, and will exert an average pull of 28 000 lb. at the tread of the wheels when starting under normal conditions of rail. The maximum pull at the tread of the wheels is, of course, considerably greater than this. The driving wheels are eight in number, measuring 4 ft. in diameter; wheel arrangement, 0—4 + 4—0; length of fixed wheel base 8 ft. 9 in. per truck; total of both trucks 27 ft. There are four axles and the total weight is 75 tons. The horse-power of motor for one hour rating is 275, and for continuous rating, 182. This design of locomotive appears to be generally suitable for dealing with goods and mineral traffic up to the necessary speed.

Equivalent Steam Locomotive.

The latest type of heavy mineral and goods steam locomotive built on the North-Eastern Railway in 1919, usually known as the 0—8—0 class, is a three-cylinder engine with 200 lb. boiler pressure. It has a maximum tractive effort at 85 per cent. boiler pressure of 41 070 lb. or 18·3 tons. Weight on coupled wheels, 71 tons, 12 cwts. Total weight ready for running, 115 tons, 14 cwts. This engine was brought before the public by trials carried out on the North British Railway, between the Bridge of Earn and Glenfarg, where a load of 755 tons was hauled up a gradient of 1 in 75 at an average speed of 12·8 miles an hour, through a distance of 7 miles.*

Comparative Tests.

Some trials have been made between this engine and the electric locomotive. These were carried out on the Shildon and Newport line with the following results: The heaviest gradient was 1 in 103, and the total weight hauled in each case was 1 003 tons, as shown in the accompanying diagram. These tests were arranged with a dynamometer car attached to the load as follows: (1) A through run without a stop; (2) three stops at the bottom of the heaviest gradient; (3) made with three stops with the whole train up on the heaviest gradient. The results are shown below:

	Steam.	Electric.	Average Draw Bar Horse Power. Steam.	Electric.
Distance	17½ miles	17½	—	—
1st Test (time) ..	56¼ minutes	54	862	870
2nd „ „ ..	77 „	53	602	883
3rd „ „ ..	68 „	66	682	716

* Full details of these trials were given in the "Railway Gazette," September 9th, 1921.

The relative maximum strength of the two engines is in proportion to the weight on the driving wheels: Weight on drivers of electric locomotive, 75 tons; weight on drivers of steam locomotive, 72 tons. It will be seen that the two are practically equal so far as adhesive force is concerned, and the adhesion determines the maximum possible pull. The turning effort of the motors on the electric locomotive produces tractive effort up to the limit permitted by the adhesive weight. In the case of the steam engine, the steam pressure, acting on the piston, produces similar results.

It may, therefore, be said that the two locomotives were designed to be of equal strength. From the tests made, it will be seen that the electric locomotive handled the load better than the steam; there was less time taken. The steam engine was not able to maintain itself, owing to the fact that it was not able to keep up steam. The fire had to be cleaned out after the second trip, consequently terminal time was wasted. The electric locomotive, after completing the three trips, could have gone on doing this work indefinitely.

Electric Passenger Locomotive.

The North-Eastern Railway have also designed an electric passenger engine which is being built and erected in their Locomotive Works at Darlington, the electrical equipment being provided by the Metropolitan-Vickers Company. This engine is arranged to haul a 450-ton express passenger train at an average speed of 65 miles per hour. The running gear is designed for a maximum safe speed of 90 miles per hour, without doing damage to the mechanical portion of the locomotive, which is of the 4—6—4 type, and consists of main frames mounted on three driving axles with three pairs of driving wheels 6 ft. 8 in. in diameter, and a four-wheel bogie at each end; cab and sloping ends are rigidly fixed to the main frames, and are provided with the necessary supporting members for carrying the auxiliary and control equipment. The current is collected from the overhead trolley by means of pantagraphs mounted on the roof at each end of the centre compartment.

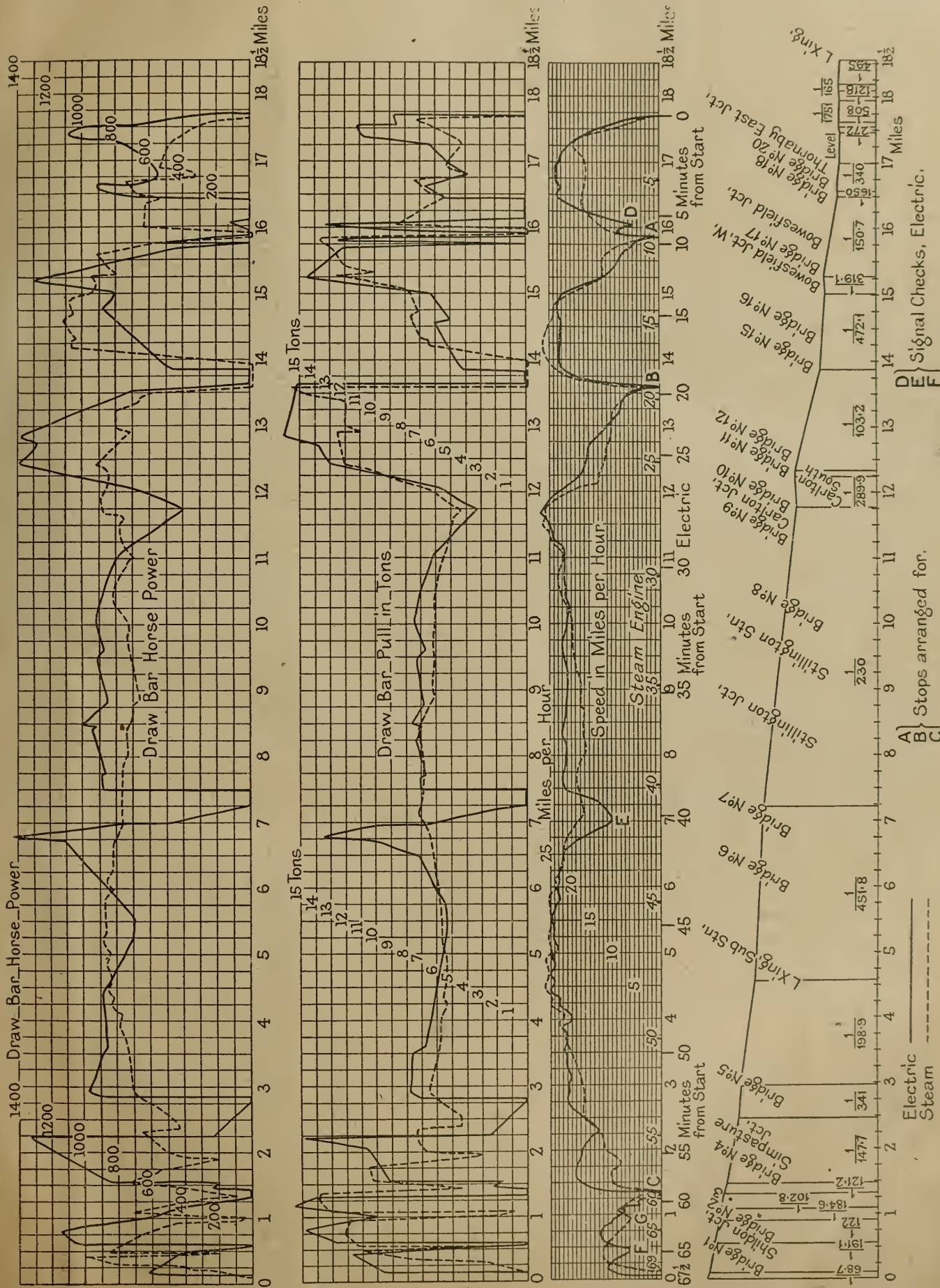
The main traction motors, which are of the twin armature type, are rigidly fixed to the main frame of the locomotive, and transmit the torque to a gear wheel mounted on a hollow shaft or quill drive. The high tension apparatus is located in one of the sloping ends; the other sloping end contains an electric boiler for supplying steam for train heating. The capacity of the locomotive will be 1 800 H.P. one hour rating, or 1 260 H.P. continuous rating.

DISCUSSION.

In the course of the discussion on the above Paper, Mr. Roger T. Smith (Electrical Engineer, Great Western Railway) said that the electric passenger locomotive referred to in the Paper, now being built at Darlington, was the first passenger locomotive to be constructed for running at a speed of above about 65 m.p.h. The comparison of steam and electric locomotives undoubtedly left a large balance in favour of the latter, but it was necessary for each railway to consider its own case. The pooling of electric locomotives would be essential if full advantages of their increased running time were to be obtained. With an electric passenger locomotive it was possible to obtain an annual mileage of from 40 000 to 60 000 miles, whereas a steam passenger locomotive mileage never reached 30 000 miles. In the case of freight locomotives, the annual mileage of steam locomotives was more than doubled with electric locomotives. The power of an electric locomotive was only limited by the temperature of the motors, and its overload capacity could, therefore, be utilised considerably to increase the average train speed. The practice of direct coupling or gearing the motors to the axles had been standardised in this country because it had been found less troublesome and much cheaper than the connecting-rod design. The latter design was developed because the use of a single-phase a.c. supply necessitated larger motors than could be accommodated between the wheels on the standard gauge. The strength of the present standard draw gear imposed a limit on the power of the locomotive, in view of which locomotives were not likely to be required of more than 1 500 to 2 000 H.P. for many years, and, with this size, it was an easy matter to accommodate the motors in the space available between the wheels. On the North-East coast a cheap supply of electricity could be obtained. The North-Eastern Railway were, therefore, in a favourable position to consider electrification, which it was to be hoped would soon be proceeded with.

Mr. J. Dalziel (Midland Railway) agreed that electrification would make enormous savings on running, maintenance, and operating costs, but it was difficult to show sufficient advantage to warrant the present capital costs of conversion. Undoubtedly there were many direct savings which would be effected which it was

difficult to estimate, but it was necessary to proceed with caution. The direct or gear drive was much preferable to the connecting-rod drive, and it was much less complicated. It was difficult to see the object of converting the rotary motion to reciprocating motion and then back again. With a d.c. system it was possible to use a 750 H.P. motor to drive direct or through gearing one axle, whilst, with single-phase a.c., a 600 H.P. motor could be so accommodated. The use of single-phase a.c. was not the sole cause for the development of the connecting-rod drive, because gear-driven locomotives were already operating on single-phase a.c. on American railways.



DIAGRAMS SHOWING GRADIENTS, SPEED IN MILES PER HOUR, PULL IN TONS AND HORSE-POWER ON THE SIMPASTURE BRANCH. LOAD, 1,003 TONS. 140 LOADED WAGONS, 2 VANS AND CAR.

Induction-Type Synchronous Motors.*

By LAURENCE H. A. CARR, M.Sc. (Tech.).

In this Paper the author compares the characteristics and construction of the induction type synchronous motor with those of other polyphase motors. He deals particularly with the self-synchronising feature of the machine so as to present a full conception of the phenomena which occur. A mathematical expression is deduced for the limiting conditions beyond which synchronising is uncertain, and the considerations which determine the selection of the excitation voltage and the method of control are discussed.

The correction of the power factor of a system, to a value approaching unity has attracted much attention. Owing to present high capital costs, it is necessary to utilise existing cables to the fullest extent by obtaining currents as nearly as possible in phase with the pressure. The induction-type synchronous motor, which facilitates power-factor correction, and has also good starting characteristics, therefore merits attention.

Theory of the Motor.

This motor is essentially an induction motor coupled to a d.c. exciter. It is started up as an induction motor. When the exciting

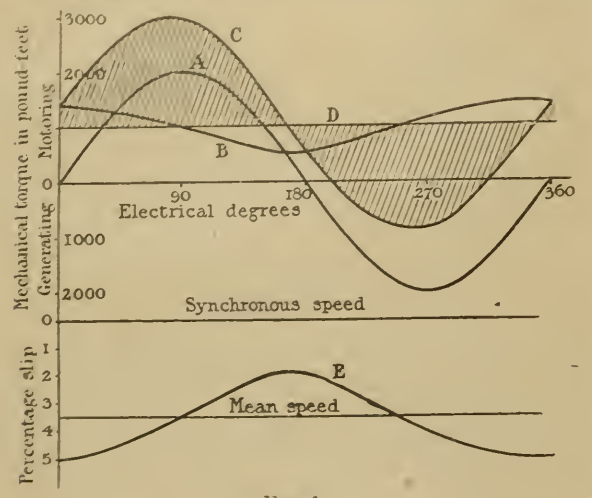


Fig. 1.

current is switched on it synchronises itself and then runs as a synchronous machine whether the machine operates as an induction motor or as a synchronous machine; both stator and rotor must carry "power currents" proportional to the torque; also a magnetising current must be carried by either stator or the rotor, or by both. In the induction motor the secondary carries only power current, which current automatically increases with load, providing within limits a certain overload capacity.

In the synchronous motor the secondary may carry both the "power current" and a part or the whole of the magnetising current; an over-magnetizing current giving a leading component to the primary current may even exist. The secondary current in this case, however, is controlled by external means, and does not increase automatically on overload, which must be met by the normal full-load excitation in either of two ways.

The economical method is to run the motor normally at a leading power factor of about 0·9, thus utilising the extra excitation to

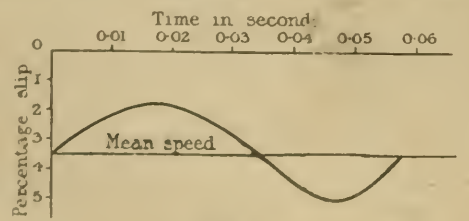


Fig. 2.

correct the power factor of other parts of the system. The uneconomical method is to increase the air-gap of the machine, thus wasting the excitation by using it to drive the flux through this increased air-gap. This method has a further disadvantage in a synchronous induction motor. It impairs the performance of the machine as an induction motor during the starting period, since the magnetising current drawn from the line is increased. As a rule there will be little difference in first cost between a synchronous induction motor arranged for unity power factor and one arranged for 0·9 leading power factor, since, in order to allow for the necessary overload capacity, the same exciting member has to be used in each case.

Comparison with Other Types of Machines.

The principal advantage of the synchronous induction motor over the plain synchronous motor lies in its starting characteristic. The synchronous motor with damper windings for starting will only start against 40 to 50 per cent. of full-load torque, and even then requires a large current at a low power factor for an appreciable time. The synchronous induction motor starts from rest like an induction motor and easily synchronises itself almost instantaneously against full load or over.

Compared with the corrected induction motor, *i.e.*, the induction motor fitted with a phase advancer or vibrator, the synchronous induction motor possesses the following advantages:

(*a*) It may be corrected not merely to unity power factor, but to a leading power factor, for which it is even more suitable.

(*b*) It delivers a leading component of current, which increases slightly as the load decreases; whereas with a corrected induction motor the power factor lags as the load decreases, until at no load the motor takes as much lagging current as a plain induction motor.

(*c*) The action of a phase advancer increases the slip, but the synchronous induction motor runs at constant speed; it has zero slip.

(*d*) The synchronous induction motor commutates low-voltage d.c. instead of a.c. in the case of the phase advancer or vibrator.

In the original Paper the author illustrates, by a vector diagram, the advantages of the synchronous induction motor with leading power factor.

Construction.

Two different types of motor are at present made, both involving a standard induction-motor stator, with semi-closed slots, and either concentric or diamond winding.

In one type the rotor is of the three-phase type with barrel winding

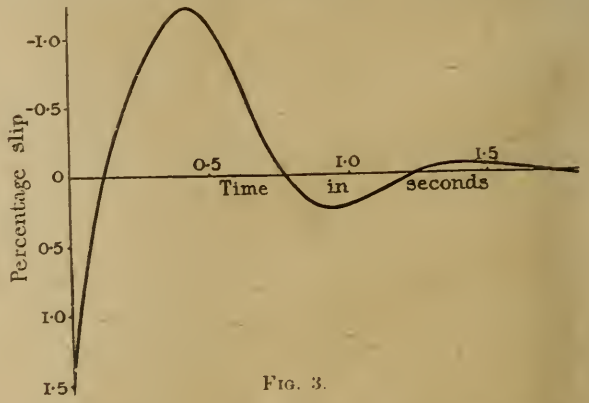


Fig. 3.

of diamond-shaped coils. Two or four bars per slot may be used, but in many cases a higher excitation voltage is provided by winding the rotor with diamond coils each containing several turns of rectangular wire. In this case the slots are of the fully open type. It is usual to make all the conductors of the same size. When running synchronously this three-phase winding has an exceedingly good damping effect.

In the other type, the main rotor winding consists of concentric coils of flat copper ribbon wound in open slots, covering about two-thirds of the rotor periphery. This may be the only winding, the rotor thus being single phase, or the remaining third of the rotor periphery is wound with a second phase of reduced cross-section for starting. In both types each motor has its own exciter.

Starting and Synchronising.

Synchronous induction motors readily start up with a resistance in the rotor circuit and are capable of accelerating against from 2 to 2½ times full-load torque. The self synchronising feature of these machines is their only unusual characteristic, and they can exert a large torque while synchronising.

When direct current is switched on the machine develops torque as a synchronous machine. As the rotor slips back through a pole-pitch, this torque is alternately motoring and generating, and

* Abstract of Paper read before the Institution of Electrical Engineers.

below synchronous speed there exists in the rotor an induced alternating current varying both with time and the speed of the rotor. The resulting varying torque must be added to the synchronous torque to obtain the total torque (*see* Fig. 1). With a cylindrical rotor, the synchronous torque is a sine wave (curve A), the fluctuating induction torque is represented by curve B, and the sum of curves A and B gives the total torque C. If the constant load torque is plotted above the datum line D, the difference between curves C and D (shown cross-hatched) gives the torque causing acceleration and deceleration of the moving masses. The variation in speed produced and the slip are shown by E. The mean speed occurs with maximum synchronous torque, so that only half of the positive lobe of the torque curve is available for acceleration above mean speed. In Fig. 2 the speed curve is transferred to a time basis. If the machine is to synchronise, the oscillation must be large enough to allow the rotor to swing right up to synchronous speed. The position of the rotor relative to the synchronous field at the moment of switching on the excitation has an influence on the commencement of the oscillation and on the sequence of the phenomena. The worst case in practice is that in which the mean speed is passed through when the synchronous motoring torque

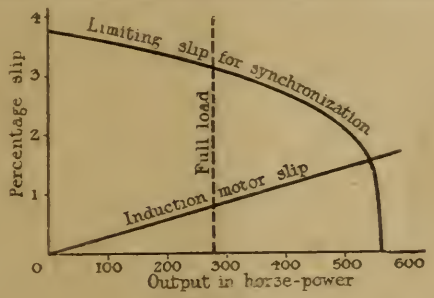


FIG. 4.

is a maximum. If the machine will synchronise under these conditions it will always synchronise.

This case is accordingly assumed in subsequent calculations. A diagram is presented for a motor having constants similar to those assumed in Fig. 1, but lower rotor resistance giving 2½ per cent. slip at full load, The conditions are considered in the original Paper in detail. Fig. 3 is interesting as showing a speed curve when the initial slip is 1½ per cent., and indicates how quickly the oscillation occurring after synchronous speed is reached dies down.

Limit of Synchronisation.

In the subsequent section of the Paper the limit of synchronisation is considered. This is illustrated in Fig. 4. The curve of speed is asymptotic to synchronous speed, the machine synchronising after an infinite time with a pole-lag such that synchronous

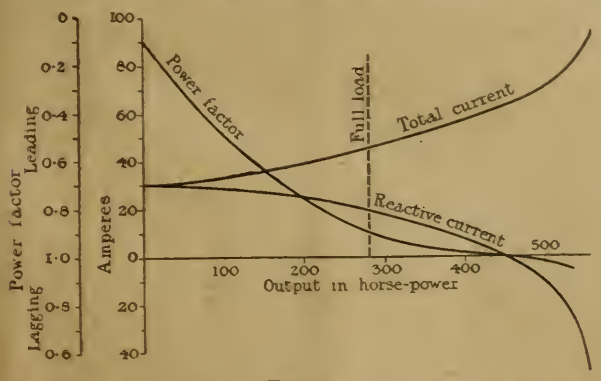


FIG. 5.

torque is just equal to load torque. A mathematical expression for the condition is derived in the appendix to the original Paper, namely :

$$\omega = \sqrt{(1{\cdot}2\phi T_m \mathrm{I})}$$

where ω is the limiting slip in mechanical radians per second ;

T_m is the maximum torque in pound-feet exerted as a synchronous motor with the excitation considered, *i.e.*, torque corresponding to maximum "synchronising kilowatts" ;

I is the moment of inertia $Wr^2 g$ in pounds, feet, and seconds ;

ϕ is the mechanical angle of lag of the rotor pole from the maximum-torque position, measured in radians, when it is exerting a torque equal to T_l, *i.e.*,

$$\phi = (1{\cdot}p) \text{ arc cos } (T_l\ T_m)$$

where p is the number of pairs of poles and T_l is the steady load torque in pound-feet.

Results of practical tests confirm the values for limiting slip calculated from the formula. Fig. 5 gives the performance curves of a 3 300 V three-phase 50 period 250 H.P. motor.

Owing to increased leakage single-phase rotors give rather less starting torque than that obtained with a three-phase rotor. There is also a marked drop in torque at half-synchronous speed ; if rotor starting resistance is cut out too rapidly the machine may "hang" or "crawl" at half speed. It is, however, only necessary to switch in some resistance to enable the motor to pick up speed again. Motors can be arranged for any desired pull-out torque, 75 to 100 per cent. overload being an economical figure for a machine with a leading power factor of 0·9. The pull-out torque for a machine running as synchronous motor may be increased by extra excitation.

Control and Switchgear.

Each motor is provided with its own exciter. The author, in the original Paper, shows in skeleton form the usual arrangements of switches and control for various types of secondary windings. The sequence of operations is as follows : (1) The main switch is closed. (2) The rotor starting resistance is gradually cut out and short-circuited. (3) The rotor circuit is momentarily interrupted. (4) The rotor circuit is closed on the exciter. (5) The exciting current is adjusted, if necessary, to give the desired leading power factor. A special single switch has been designed to provide the right sequence of operations with single-phase motors. With three-phase motors switchgear is built up of standard apparatus comprising liquid starter, rotor change-over switch exciter shunt regulator, &c. It is usual to fit interlocks on both starter and change-over switch so that the main switch cannot be changed unless these are in the starting position. Automatic starting by contactors has also been applied.

Inverted Machines.

Inverted machines, *i.e.*, with supply connected to the rotor and the stator used as secondary have been developed and have certain advantages. The efficiency with 0·9 leading power factor is only slightly (about 1 per cent.) below that of a plain induction motor. The cost would, however, be about 25 to 40 per cent. higher. In view of the power-factor correcting properties of the motor, it is very suitable for use with continuous but varying loads. Amongst drives favoured are compressors, pumps, fans, &c. ; also the driving of generators, line shafts, &c. Although machines of 60 H.P. have been put into commercial use the chief field is for sizes from 150 H.P. upwards. The largest at present in use appears to be 1 125 H.P., though there is practically no limit to the size.

DISCUSSION.

In opening the discussion in London Dr. S. P. SMITH said it was not clear whether the advantages of the synchronous induction motor were due to the large starting torque or to the high power factor. It still, however, possessed the fundamental disadvantages of the ordinary induction motor, small air gap, and the low voltage commutator. The latter trouble could be overcome to some extent by using series parallel arrangements, but the rotor on the induction motor had inherently a fairly low resistance, so that the same satisfactory design for the exciter as on the synchronous motor could never be obtained. An alternative to the induction motor excited by continuous current was the synchronous motor with salient poles wherein the cross flux became roughly equal to the main flux and gave a good starting torque, while laminating the rotor circuits allowed the pulsating flux to traverse the whole circuit. Another alternative was a salient pole machine with a very wide polar arc and a low resistance damping winding, and the rotor connected through the slip rings to a resistance during starting. A second set of slip rings were used for exciting the winding. He wondered whether Mr. Carr had studied the effect of pulling the rotor out of synchronism to rather a slow speed, and then finding out how it behaved with direct current excitation. The salient pole type of motor would run up to speed and would synchronise itself, but it might not pull in correctly.

The Economies of Power Factor Improvement.

Mr. H. M. SAYERS said that the author's methods would lead to an improvement in the power factor, a matter which was of outstanding importance at the present time. On the other hand, a purchaser would want to be convinced that the improved power factor would off set the 33 per cent. increase in cost. The commutator was another disadvantage, and it followed as a result that these machines were hardly commercial in sizes below 100 H.P. In his opinion the use of condensers for power factor should be further considered. He objected to the employment by the author of "designer's shorthand," and also to the title, which he considered a contradiction in terms. A synchronous motor was not an induction motor.

A Comparison of Methods.

Mr. W. E. BURNAND pointed out that while the author's motor was cheaper than a non-synchronous motor with a phase advancer, its sphere was limited by the fact that it was synchronous, so that

if the load pulled out of synchronism there would be bad effects on the line. It was also more expensive than the ordinary synchronous machine, while both its efficiency and pull out torque were lower. Like any other synchronous machine there was a severe rocking when it pulled into synchronism. On the other hand it could start at full load. The author was a little lukewarm towards phase advancers which he (Mr. Burnand) thought could be improved so that a shunt characteristic was imposed on the top of the usual series characteristic, thus giving a perfect power factor compensation over the whole range on load.

Supporters of the Motor.

Mr. M. Ayres criticising Dr. Stanley Parker Smith said that the history of the machine was sufficient guarantee of its future. Its success was in fact due to its high power factor and starting torque. The machine had a considerable compound characteristic, and, with a certain amount of overload, a power factor of unity could be obtained. Motors of the type dealt with were made in many designs, and at least two patents had been taken out which proposed to leave the exciter in circuit during starting. He did not agree with Mr. Carr that the exciter voltage and currents were disconcerting factors. Figures given by the author were not of general application and the cost of such a motor should not be anything like 33 per cent. in excess of the equivalent in induction motors.

Mr. J. H. Johnson thought that the advantage of the motors described by Mr. Carr chiefly resided in their high power factor, and he gave examples showing how an expenditure of about £500 on new feeders had been avoided by their use. To say that they cost 33 per cent. more than the induction type motor was to give too high a figure; the increase might not be more than 3 or 4 per cent.

Mr. W. M. Selvey confirmed Mr. Johnson's opinion that the troubles which speakers had suggested might occur with these motors were not generally experienced.

The Author's Reply.

The Author, in reply, rather damaged his reputation as an original inventor by saying that the motor was of quite an old type, and that the Paper ought to have been read six or seven years ago. He thought that high starting torque was the thing to go for in the design, as improved power factor could be obtained just as well by other means. It was usual for the air gap in these machines to be slightly larger than in an ordinary induction motor. The answer to Mr. Sayers' question as to whether it would pay the customer to give 33 per cent. more for his machine in order to get a leading power factor depended upon the sort of tariff available. He did not think anyone had yet experienced trouble from the rocking strain to which Mr. Burnand had referred.

Manchester Discussion.

Mr. L. H. A. Carr's Paper was also read and discussed in Manchester, and we give below an account of the various speakers' remarks.

Mr. E. P. Hill said that the synchronous induction motor scored over the ordinary synchronous motor on account of the additional starting torque and because the combined induction motor and synchronous torque gave a pulsating effect about mean induction motor speed which enabled it to be pulled into step. With reference to inverted machines, he asked whether the starting performance would be improved by constructing the field system with polar spaces. The low core losses of the synchronous induction motor warranted further investigation. A bibliography would be useful to students.

Should Power Engineers Bear Part of Cost?

Mr. A. B. Mallinson thought that the machine would be installed where big power users who made their own power had cables overloaded due to low power factor, and where supply authorities compelled power users to improve the power factor. He suggested that supply authorities should encourage users to instal these machines by reducing the power bill to the extent of the slightly higher efficiency incurred, and by meeting the difference in cost between this and an ordinary induction motor.

Mr. G. A. Juhlin cited a case in which a rolling mill underestimated the amount of power taken by an induction motor, and thus reduced the power factor below the guaranteed figure of 0·8. An exciter was added and on running the machine as a synchronous induction motor the power factor was brought to 0·9 leading, for which the client should have had a rebate from the supply company. The air gap of the ordinary induction motor was less than that of the synchronous type, and this was the answer to criticism of the small air gap of the latter. He would have liked a comparison between the induction motor with condensers and the synchronous induction motor. He believed the latter would show a saving in first cost and space occupied.

Rotor Widenings.

Mr. W. Stansfield, in a written contribution, said that synchronous induction motors had been made in this country for thirteen years. For some duties 0·8 leading power factor was as high as it was desirable to go, and for others 0·9 was quite suitable; but as low a figure as 0·3 leading had been obtained. For low starting torque, where damper windings were not required, plain single phase winding was applicable. For high starting torque without damper windings the rotor could be wound for two phases out of three, with no winding in the pole portion of the core, the motor being provided with three slip rings and starting as a two-phase motor.

Mr. V. Mallalieu said that some industrial users had put in ordinary synchronous motors for power factor connection, and he thought it would pay much better to instal a machine which would correct power factor and also do useful work as a motor. Some systems had very low power factors, for which oversize and slow-speed motors were responsible in some cases. The systems of charging for power were out of date.

Mr. Browning asked for further information on the effect of damping and thought that power factor should not be allowed to become low, and Mr. D. S. Paxton commented on the absence of power engineers.

Cheapening the Synchronous Induction Motor.

Mr. R. Townend compared the salient pole machine with the induction synchronous type and questioned whether, if a synchronous induction motor were designed as such, it would still be 30 to 40 per cent. dearer than the induction motor. The cost of the machine would be appreciably reduced by using bigger and open slots. He asked whether the author had tried connecting the exciter permanently in one leg of the rotor.

Mr. J. Frith pointed out that, as the rolling mill had been spoken of as a very suitable load, the mill was almost always dependent on a flywheel effect, and a synchronous constant speed motor could not be employed.

Mr. R. G. Kilburne said that with the Kapp vibrator the power factor led in many cases down to quarter load and, with the induction motor, greatly increased the overload capacity. He suggested that induction motor slots might be widened, the motor cheapened and the performance corrected by a phase advancer. He asked whether the cascade motor could be made into a synchronous induction motor.

Mr. T. Baxendale raised some difficulties in applying synchronous induction motors to power station auxiliaries and asked how the principle could be applied to totally enclosed motors.

Discussion at Leeds.

In the course of the discussion on Mr. Carr's Paper at Leeds, Mr. W. B. Woodhouse said that this type of motor was of interest to supply authorities, as idle current not only loaded up the mains, but also had a bad effect on the pressure regulation. It was best to deal with the idle current where it was produced, at the motor. In the early development of this type of motor, troubles had been experienced with the exciter, which was dealing with heavy currents. But recent patterns were very satisfactory. Such a motor was applicable for use for mine fan engines, and installations of this kind benefited the user rather than the supply authorities, because in most instances the founder was paying on a kVA basis, and hence by improving the power factor he reduced his bill.

Mr. W. H. Brown said the price of the machine described varied from 40 to 20 per cent. in excess of that of the ordinary induction machine, so the user had to pay either for the machine or increased charges to the power company. If a cheap supply was to be given it was necessary to improve the power factor of the smaller motors.

Mr. M. Wadeson said that probably more installations of this nature would have been put in had all supply authorities been charging on a kVA basis; but, as legislation now stood, such a charge could only be made by agreement with the user. He had recently been concerned in improving the power factor of a rolling mill motor, and, after consideration of various methods, it was decided to adopt an installation of the type described in the Paper. The motor was a 3 000 V induction motor of 300 h.p. with a pull-out torque of three times full load and an overload capacity of twice full load. The average load on this motor was found to be somewhere about 70 h.p. The alteration consisted in changing the rotor winders to delta, installing a belt-driven exciter and injecting therefrom a direct current into one phase of the delta winders. The machine was found to pull easily into synchronism, and when pulled out on a heavy load pulled back instantaneously as soon as the load fell off. While running synchronously the motor had a leading power factor of 0·9, and when it pulled out and ran as an induction motor on the heavy load it had a power factor of 0·85.

Mr. R. M. Longman said that with a Kapp phase advancer on a machine taking about 200 kW a power factor of 0·95 leading could be obtained.

Mr. Carr, in reply, said with regard to the application of the system to motors under 100 h.p., since the Paper had been written a year ago, smaller motors had been equipped, and they were now made of 50 h.p., or even smaller. The increased cost was proportionately the same with these smaller sizes.

Some Essentials of Automatic Stokers.

By CHARLES ERITH, A.M.I.Mech.E.

In the course of a report to the French Government Commission on the Utilisation of Fuels, Mr. Rauber makes the following interesting comments on the various types of automatic stokers in use. The report has been published in full in "Chaleur and Industrie." We have added the subheadings.

After Mr. Rauber (who is one of the principal Engineers of Union d'Electricité, Paris) had visited England to inspect the Erith multiple-retort stokers, his Company, for their new power station at Gennevilliers, Paris, had four 5-drum double-ended Fives-Lille boilers, specially designed with 45 deg. angle of the tube banks above its single furnace, to suit a pair of 18-retort French-built stokers, identical with the two 18-retort Erith's stokers employed for similar duty at the Edinburgh Corporation Westbank Station, on a pair of three drum Stirling boilers.

The Edinburgh arrangement involves two furnaces for the two boilers; but both stokers are supplied from a central overhead coal bunker.

Two of the four 36-retort stokers are now completely erected on two of the double-ended Fives-Lille boilers at Gennevilliers, and these are expected to start working in February. A detailed description of the Gennevilliers plant will appear in the French technical papers.

Very shortly after the adoption by Union d'Electricité of these huge double-ended boilers, each with 36-retort stoker, teh Cie Parisienne de Distribution Electrique ordered four identical units.

Multiple-retort stokers constructed by Erith's Engineering Company, Ltd., are actually used for all grades of coal having 12 per cent. volatile matter and upwards, and having an ash content up to 40 per cent.

The translation of Mr. Rauber's article in "Chaleur and Industrie" follows:

During the last twenty years mechanical stokers have gradually been introduced into boiler houses. After having been for a long time inferior in working to hand-fired furnaces, they have been so improved that it can be said that at present they meet every requirement. At the same time that they make a notable saving in labour, they ensure, when they are properly regulated, a better combustion in every-day working.

General Arrangements.

Speaking generally, the coal is supplied to the hopper of a mechanical stoker, where it is required to perform as automatically as possible, the following operations: To feed and spread on the grate the coal required for all rates of working; to burn this coal as perfectly as possible, so as to secure good combustion; to discharge the clinker, which, in principle, should be entirely deprived of its carbon.

Further, the stokers should be flexible and easily regulated, and should be able to function with coals as different as possible in quality. This last desideratum is not, however, always realised.

The most widely employed mechanical stokers can be divided into two classes:

Endless Chain Grate Stokers.

In certain endless chain-grate stokers the links of the chain form the grate surface. In other types, the grate bars are supported by transversal articulated bars. The variation of the grate speed is still one of the most important methods of regulating the fire. The grate carries forward by its movement a regulated thickness of coal, and the combustion ought to be completed at the end of its travel, so that the grate should then evacuate, as far as possible, ash alone, without admixture of unburnt fuel.

The regulation of the suction draught, and of the forced draught under the stoker, if used, constitute the other variables, permitting the working to be adapted to the necessities of the load. A good grate should allow for local air regulation under the different parts of the grate, either by dividing the wind boxes or by employing individual dampers.

The ignition of the coal is produced by an arch of refractory material placed above the front part of the grate, this arch being itself heated by the stoker. The form of this arch is of capital importance for ignition, and may vary by over 10 per cent. the amount admissible in volatile matter, all other things being equal. Horizontal and very low arches require the employment of a higher volatile coal than inclined arches.

Advantages of Chain Grates.

Summarizing the results which can be obtained by good industrial regulation of these chain grates: On natural or suction draught chain grates, one can burn with 8 to 10 per cent. CO_2, 100 to 150 kg. hourly per square metre of grate surface (say, 20 to 30 lb. per sq. ft.), of coal having at least 17 per cent. of volatile matter and 5 to 20 per cent. of ash. On forced draught chain grates, but without divided wind boxes, one can burn with 8 to 12 per cent. CO_2, 150 to 200 kg. per hour per square metre of grate surface (30 to 40 lb. per sq. ft.), of coal having 8 to 25 per cent. volatile matter and 10 to 35 per cent. of ash. On forced draught grates, with wind boxes, one can burn with 10 to 15 per cent. CO_2, 150 to 200 kg hourly per square metre of grate surface (say, 30 to 40 lb. per sq. ft.), of coal having from 5 to 25 per cent. of volatile matter and 10 to 35 per cent. ash.

In all cases, excepting with coals or rates of working which are entirely unsuitable, one can succeed in discharging clinker not containing more than 10 to 20 per cent. of carbon, say, 2 to 7 per cent. of the coal supplied.

The Drawbacks of Chain Grates.

This type of grate has the drawback of requiring a screened coal, not exceeding 30 to 40 mm. (1·2 in. to 1·6 in.). The ignition arches and the regulation of fire-bed thickness, although they are constituted of refractory materials, are weak points on account of their sometimes rapid deterioration. Further, for very large boilers, a number of separate grates must be used, the width of such a grate necessarily remaining very limited for mechanical reasons.

The most serious drawback of this system of stokers is in the fact that the transition from a very low to a very forced duty requires an appreciable time. One is obliged, in fact, so as to be sure of a good ignition, not to push too far the lineal speed of the grate. This involves a somewhat long period for changing to a new rate of working. The flexibility, nevertheless, is fairly great, and it may be considered that chain grates constitute a very satisfactory solution, though not yet a perfect one, of the problem of mechanical stoking.

Stokers Fed from Below ("Underfeed").

The raw coal delivered into the hopper is pushed into the stoker below the ignited fuel, generally by means of a mechanically actuated ram. The grate is composed of bars, either fixed or moving, arranged in steps, along which steps the ignited coal progressively descends, being pushed onward by the freshly introduced coal. Very often the bars have a slight reciprocating movement, which assists this travel. On arriving within the furnace, the coal becomes heated, distilled and burnt as it progressively enters the hot zone. The clinker, as it forms, descends along the inclined bars, and is broken up according to the movement of the moving bars. It should arrive at the lower part practically free from carbon.

Here there is no occasion for an ignition arch, as this is formed in the heart of the mass of ignited fuel. With this class of apparatus it is necessary to have on the grate a thick bed of coal, which involves a great resistance to the travel of the air for combustion. Thus the stokers usually employ forced draught, the air pressure sometimes going to 100 mm. (4 in.) water gauge. To vary the rate of duty of the stoker one regulates the quantity of forced draught air, the speed of the charging ram, and also of the suction draught, when required.

These stokers are widely employed in America, and excellent makes are available. It seems, however, that up to the present not quite so extended a range of fuels can be utilised as is the case for forced draught chain grates. Hitherto, "underfeed" stokers have succeeded in burning 150 to 200 kg. hourly per square metre of grate (say, 30 to 40 lb. per sq. ft.). But the coal should have more than 15 per cent. volatile matter, and less than 25 per cent. ash. The combustion can be regulated so as to have 12 to 15 per cent. CO_2 in the gases, as they leave the boilers. The clinker produced will also have from 10 to 20 per cent. of carbon, just as with chain grates.

Advantages of Underfeed Stokers.

The principal advantages which this type of stoker offers, at least with the improved types are as follows: No ignition arch and no regulation by a gate of the thickness of the fire-bed, which are the weak points of the chain grates. Further, fewer cast-iron parts are subject to the heat of the fire; great flexibility of working due to the fact of the large mass of coal carried in the furnace, either ignited or hot and ready to burn. It is sufficient to increase or to diminish the volume of forced draught air to obtain instantly the variation of duty required.

All banking of the fire is done by introducing fresh coal in sufficient thickness to cover the grate and shutting off forced draught. The stoker is quickly ready for work.

When a stoker on this system is constituted of adjacent units arranged all along the front of the boiler, the dimension of the stoker in width is unlimited, which allows the use of enormous stokers without any great difficulty. This type of stoker is very suitable for present conditions, in either large or small central stations. It will be excellent when a more extended range of fuels can be utilised in it.

Reviews.

Motor and Dynamo Control. By W. S. Ibbetson, B.Sc., A.M.I.E.E. (London: E. & F. N. Spon, Ltd.) Pp. viii.+487. Price 21s. net.

This book is an attempt to combine an explanation of the theoretical principles underlying the design and manufacture of the various types of electrical machinery, with such practical information as is requisite for their efficient control and operation. As a general rule, the task is not an easy one, and rarely is it satisfactorily accomplished.

The author in this case has achieved a fair measure of success, though in the process he has laid himself open to the criticism that his treatment is somewhat superficial; and from the point of view of the student it is, though presumably the book is not intended so much for students as for those who have to supervise the installation and operation of electrical machinery. It is an intensely practical work, and might almost be described as a cross between a text-book and a pocket-book.

It covers a wide field, and describes in pithy paragraphs the main characteristics of the various types of electrical machines, explains the fundamental principles underlying their construction, and compares them from the point of view of operation and reliability.

Like other books by the same author, it commences with the consideration of the electric and magnetic circuits, the production of an E.M.F. in the simple generator, and the salient features of the various types of dynamos. The function which series windings and inter-poles perform in a dynamo is explained, boosters and balancers are described, and diagrams given showing how they are connected. Alternating current generators are next treated, together with rotary convertors, and a chapter is devoted to a consideration of their parallel operation and the various methods of synchronising. The common types of d.c. and a.c. motors are also described and compared, and several typical motor calculations are supplied.

The practical engineer will find a mine of useful information in Chapters 10 and 11, in which the author has tabulated the faults usually found in electrical machinery, together with the best methods of detecting and remedying them. There are also numerous practical hints on the installing of plant. A useful chapter on secondary batteries completes the book.

The author adopts with considerable advantage the method of question and answer, and the latter, though in many cases brief, are very lucid.

It will be seen that, though there is not much which is new in the book, it covers practically every point upon which the ordinary motor and dynamo attendant is likely to require information in connection with the machinery under his control from the time he receives it from the manufacturer. It contains also sufficient practical data to enable the engineer to decide the type of motor, whether d.c. or a.c., which it would be most advisable to install.

In a word the book tells the attendant or engineer-in-charge what to do, how to do it, and the reasons why. It does not simply explain how to cure, but how to prevent trouble, and thus enables him to run his plant more efficiently. It should therefore prove a useful book to those ex-Service students who are taking an intensive course at technical colleges prior to taking positions as sub-station attendants and junior engineers. The diagrams are well printed and on a scale sufficiently large to be quite clear to those whose knowledge of draughtsmanship is limited. A fairly comprehensive index enables the reader easily to put his finger on the information that he requires. We would recommend that in future editions the author should alter the symbols employed in order to bring them into line with the recommendations of the International Electro-Technical Commission. To the practical electrician the kind of symbol used may not matter, but to the student who is familiar with other text-books those employed in the present edition are liable to lead to confusion.

J. W. T.

Correspondence.

THE ELECTROSTATIC WATTMETER AND MEASUREMENT OF LOW-POWER FACTORS.

To the Editor of THE ELECTRICIAN.

Sir,—In a letter published in your columns a short time since I alluded to a zero method of making measurements of this kind described by Mr. Herbert Parry, which I thought a previous suggestion of mine had anticipated.

On looking into the matter further, I find that though both methods were founded on balancing the direction by suitable connection to points on a shunt across the circuit, Mr. Parry's is otherwise quite different and superior to mine, and, as far as I am aware, original, and he is to be congratulated on a very pretty and, I think, useful suggestion.

As very little has appeared in the Press or otherwise on the working of the electrostatic wattmeter for a good many years, perhaps you will give me an opportunity a little later to say something more on the subject generally.—I am, &c.,

London, W., Dec. 27. G. L. Addenbrooke.

THE THERMAL OHM.

To the Editor of THE ELECTRICIAN.

Sir,—In your issue of Sept. 9, 1921, there is an article by Capt. Dunsheath on the Heating of Cables, in which he suggests and recommends using the "thermal ohm" as a new unit of thermal resistance, based on the watt instead of the caloric per second, in calculations concerning electrically produced heat flows. You also refer to it editorially.

The impression one obtains is that the suggestion is thought to be a new one. Permit me to call your attention to the fact that over ten years ago I urged the adoption of exactly this same unit and with that same name, and I can vouch for the fact that it saves much time and effort in calculations when the flow of electric heat is concerned, as it eliminates troublesome conversion factors. In "Metallurgical and Chemical Engineering" (New York), Jan., 1911, Vol. IX., p. 13, and in the "Journal Franklin Inst." (Philadelphia), Dec., 1911, Vol. 172, p. 569, I published articles devoted entirely to this thermal ohm, and giving the conversion factors into other units. In numerous other articles that I published at about that time involving the flow of heat, I used this same unit. The second one of the above was abstracted at some length in your journal, Feb. 23, 1912, p. 786.—I am, &c.,

Philadelphia, Pa., Dec. 15. Carl Hering.

"THE NEGLECT OF FRENCH PRODUCTS."

To the Editor of THE ELECTRICIAN.

Sir,—With further reference to my letter to you, which appeared in the Oct. 14 issue of The Electrician, the result has been quite interesting to me, for I have been favoured with letters from a good many French manufacturers, and in some cases have had a visit from their representative, whom I have been able to help by suggesting names of engineers to call upon and correspond with.

The engineer representing one firm in particular, on a return journey, informed me that he had been extremely well received, and from his conversation I gathered that there is evidently a strong desire to do business with our French friends. Further, I think if French manufacturers were to appoint a resident local representative for this particular district they would get into quicker personal touch with their customers.

I believe some of our own firms do not yet realise the extent of potential engineering business in South Wales, from the very largest structures and machines down to the smallest. Moreover, when a customer or prospective customer has to visit a neighbouring country to inspect works and products, I think he would as soon go to France as any other country. Many of our countrymen visit France for pleasure, and would like to visit it for business, and perhaps by combining the two make both pleasurable.—I am, &c.,

C. T. Allan,

Cardiff, Dec. 30, 1921. Assistant Manager South Wales Electrical Power Distribution Company.

An Electric Gas Lighter.

A short time ago we called attention to a German device for lighting gas from the public electricity supply in a house or building which contained certain elements of danger. Such an apparatus is, however, useful in certain cases, and we are therefore glad to find that an English device has been patented which overcomes the disadvantages to which we called attention. The lighter, which is made by Lord & Shand, Ltd., consists of a specially made condenser, fixed in a convenient handle. One element of the condenser is connected by a single flexible wire through an adaptor or ceiling rose to the supply circuit, and is controlled by an ordinary switch. The other element is connected to a metal brush at the striking end of the lighter. When this latter element is charged it emits a series of sparks which are sufficient to light the gas. There is, it is claimed, no possibility of earthing the supply system by the use of this arrangement, and the energy consumed is, of course, infinitesimal.

The Latest B.T.-H. Showroom.

In our issue of Dec. 9 we gave an illustration of a corner of the new Manchester Showroom of the British Thomson-Houston Company. The accompanying photograph shows the large showroom which the firm have recently opened at 155A, St. Vincent-street, Glasgow.

New B.T.-H. Showroom at Glasgow.

Light and Publicity.

The advertising value of light is wonderfully exemplified by the illuminated hoarding illustrated below. Formerly this hoarding was unlighted at night, and its printed (or lithographed) sapience was only readable during daylight. Realising that the period of display in the winter and autumn was very short, the three advertisers concerned combined and arranged with the British Thomson-Houston Company for an installation of floodlight projectors. The area occupied by the three posters is 55 by 15 ft., and it is lighted by five projectors fixed on a blank wall on the opposite side of the road. The projectors are so disposed and directed that the five separate beams of light cover the area with an intense and uniformly distributed illumination. Type 786 projectors, fitted with powerful mirror reflectors and Mazda gasfilled lamps, and mounted on universal brackets, are employed. This form of mounting allows the projector to be swivelled in any horizontal or vertical direction. These projectors are completely weatherproof, and are intended for use in exposed positions.

Night Illumination by B.T.-H. Floodlight Projectors.

The floodlighting of hoardings must, however, be considered as something more than a means of extending the period of visibility, as it has also the effect of making the advertisement stand out with an individual distinction not otherwise attainable. Floodlighting has been developed in this country by the illuminating engineers of the British Thomson-Houston Company, who have designed a range of projectors for various purposes and conditions. For example, they can be used for the illumination of factory yards, dockyards, goods yards, &c., while for the spectacular lighting of monuments and buildings floodlighting is at once the simplest, the most economical, and the most effective method. Further particulars may be obtained from the B.T.-H. Illuminating Engineers' Dept.

West of Scotland Electricity District.

The Electricity Commissioners have been investigating the position of electricity supply in Scotland, and they have provisionally determined the area of the West of Scotland Electricity District as under :—

The counties of the City of *Glasgow* and of *Renfrew*.

So much of the county of *Ayr* as is included in the Royal burghs of Ayr and Irvine; the burghs of Ardrossan, Darvel, Galston, Kilmarnock, Kilwinning, Largs, Newmilns and Greenholm, Prestwick, Saltcoats, Stewarton and Troon; the parishes of Ardrossan, Ayr, Beith, Coylton, Craigie, Dalry, Dalrymple, Dreghorn, Dundonald, Dunlop, Fenwick, Galston, Irvine, Kilbirnie, Kilmarnock, Kilmaurs, Kilwinning, Largs, Loudoun, Mauchline, Monkton and Prestwick, Ochiltree, Riccarton, Stair, Stevenston, Stewarton, Symington, Tarbolton and W. Kilbride.

So much of the county of *Dumbarton* as is included in the Royal burgh of Dumbarton, the burghs of Clydebank, Kirkintilloch and Milngavie; the parishes of Bonhill, Cardross, Dumbarton, Old Kilpatrick, New Kilpatrick and Kirkintilloch.

So much of the county of *Lanark* as is included in the Royal burghs of Lanark, Renfrew and Rutherglen; the burghs of Airdrie, Coatbridge, Hamilton, and Motherwell and Wishaw; the parishes of Blantyre, Bothwell, Cadder, Cambuslang, Cambusnethan, Carluke, Carmunnock, Dalserf, Dalziel, E. Kilbride, Glasgow, Glasford, Hamilton, Lanark, Old Monkland, New Monkland, Rutherglen, Shotts and Stonehouse; and

So much of the county of *Stirling* as is included in the parishes of Baldernock, Campsie, and Strathblane.

Objections or representations on account of the inclusion in or the exclusion from the district of any area must be made in writing to the Secretary, Electricity Commission, Gwydyr House, Whitehall, S.W. 1, by Dec. 30, 1922. In the opinion of the Commissioners the existing organisation for the supply of electricity in the district should be improved, and a public inquiry will be held into the matter. Schemes for effecting such improvement, including the formation of a Joint Electricity Authority, may be submitted on or before the same date.

Legal Intelligence.

Damages for Tramcar Accident.

In the Second Division of the Court of Session on the 23rd ult. Mr. John Kirk sued the Greenock and Port-Glasgow Tramway Company for damages for personal injuries. The pursuer was an inside passenger on one of the company's tramcars on July 17th last, when the car jumped the points at a loop line, ran across the road and collided with a lamp-post. Pursuer was thrown against the side of the car and sustained a nervous shock.

The company pleaded that pursuer's account of his injuries was exaggerated, and they tendered £50 and expenses.

The jury, however, assessed the damages at £175.

Illegal Electrical Connection.

Messrs. Williams and Williams, casement makers, of Chester, were summoned at Chester Police Court on Friday last by Chester Corporation for illegally taking electric current from the Corporation main. There were also summonses against two members of the firm for an alleged assault on Dec. 2 upon the Corporation Electrical Engineer, Mr. S. E. Britton, while there was a cross summons against Mr. Britton for assault.

The Corporation case was that owing to a change being made in their supply of power it was necessary to cut off their customers temporarily, Messrs. Williams Bros. being among the number. Two of defendants' firm interviewed the Town Clerk on Dec. 2 and appealed for an extra supply of current as a special concession. This was agreed to, but when an official of the Electricity Department visited defendants' works later they found that they had connected up two cables with the Corporation supply mains and the current was not being metered. When Mr. Britton visited the works in order to seal up the illegal supply he was tackled by one of the Williams brothers, who refused to let him leave the works through the gate, and he had to climb a wall in order to get out.

The defence was that only a technical breach of the law had been committed in order to avoid closing their works and throwing about 5 000 men out of work.

A great deal of evidence was given on both sides, but ultimately, for illegally taking the current the firm was fined £5, with 3 guineas costs, and for assaulting the Corporation Electrical Engineer one of the partners was fined 10s., the summons against Mr. Britton being dismissed.

Electricity Supply.

Owing to the failure of the electricity supply on Tuesday at the METROPOLITAN-VICKERS works, Trafford Park, Manchester, the employees enjoyed a half-day's holiday.

SHOREHAM AND DISTRICT ELECTRIC LIGHTING AND POWER COMPANY, LTD., give notice of intention to apply to the Electricity Commissioners for a Special Order to authorise the company to supply electrical energy in Southwick.

The Home Secretary has made an Order authorising the employment of two women of eighteen years of age and over as attendants at the LANGLAND-STREET SUB-STATION OF KILMARNOCK Electricity Department on two day shifts, on condition that neither of them is employed on Shift II. in consecutive weeks.

CHICHESTER Corporation have applied to the Electricity Commissioners for a Special Order to revoke the Chichester Electric Lighting Order, 1898, and the Chichester Electric Lighting (Extension) Order, 1911, to authorise the Chichester Electric Light and Power Company to sell and the Corporation to purchase the undertaking and works of the company, &c.

Following a conference between the Lighting Committees of Montrose and Brechin Councils in regard to the Special Order being promoted by the North of Scotland Electric Light and Power Company, which seeks power to revise charges every three instead of five years, MONTROSE Council, on the recommendation of their Committee, have decided not to join with Brechin in obtaining the opinion of counsel on the matter, as they consider that their interests and those of the consumers are amply safeguarded under the present arrangement.

New Schemes and Mains Extensions.

Sanction is being sought by SHREWSBURY Town Council to a loan of £2 650 for electricity purposes.

MAIDENHEAD Town Council contemplate the purchase of additional generating plant and a new balancer.

HASTINGS Town Council have decided to duplicate the high-pressure cable to St. Leonards at a cost of over £8 000.

WITNEY Urban Council have decided to apply for sanction to borrow £1 000 for the extension of the mains on the Woodstock-road.

Application is to be made to the Electricity Commissioners by HARROGATE Corporation for sanction to borrow £3 250 for electricity works extensions.

PERTH Electricity Department have authorised the borough electrical engineer to invite tenders for a new boiler, required in connection with the extension of the electricity works.

The North Metropolitan Electric Power Supply Company have asked the consent of the CHESHUNT Urban Council to their supplying electricity to the town. A report on the matter is to be prepared by the Council's legal adviser.

WORCESTER City Council have received the sanction of the Electricity Commissioners to the extension of the generating station by the installation of 3 000 kW set, three boilers, and auxiliary plant, and by the construction of the necessary buildings.

DOUGLAS (Isle of Man) Corporation have instructed HANDCOCK & DYKES to proceed with the plans for an electricity supply station for the borough in accordance with the Douglas Corporation Electricity Act, which has just received the Royal assent.

A committee has been formed to canvas BRACKLEY with a view to ascertaining the probable number of consumers of electricity and likely supporters with capital. The proposal is to form a company to carry out a scheme, at a cost of about £5 000.

As a result of complaints regarding the supply of electricity in WOLSTANTON, the engineer has been instructed by the Electricity Committee, Stoke, to submit a report for additional supply, with comparative estimates of the cost of the different methods of supply.

ABERRAYRON Urban Council has decided to make a grant of £100 towards the cost of obtaining a Special Order to enable a company to provide a supply of electricity for the town. The company has undertaken to apply for the order forthwith, and to proceed with the scheme without further delay.

ACCRINGTON Corporation, in accordance with the understanding arrived at with the Electricity Commissioners recently, have decided to proceed with their application for sanction to borrow £100 000 for extensions of plant at the electricity station. The revised figures show a decrease on the original of £30 000.

The scheme of the LYME REGIS Town Council to purchase the local electric light company's undertaking, and to supply electricity in Lyme Regis and Uplyme, narrowly escaped being held up last week. A motion to seal a new contract on modified terms was only carried by the casting vote of the Mayor, Councillor H. Ellis.

The BOSTON Deep Sea Fishing Company have offered to supply the town and district with electricity, and the Council have intimated that they would look favourably upon such a scheme. At present a Provisional Order for supplying the town is held by the National Electric Construction Company, but nothing has been done to comply with its provisions.

TRURO Town Council has broken off negotiations with the Cornwall Electric Power Company for a supply of electricity in bulk, on account of the high price asked, which would, it is contended, make the scheme a burden on the customers or the ratepayers. The Council will now proceed to draw up a scheme based on the original idea of erecting their own generating station at Newham.

Terms have been arranged between the Gas, Electricity, and Housing Committees of GLASGOW Corporation for laying down mains and supplying gas and electricity to the various housing schemes. It is understood that under the agreement the Housing Department will pay £20 000 and the Electricity Department £10 000 towards the cost of laying electric supply mains.

CONNAH'S QUAY Urban Council have decided to oppose the application of Chester for a Special Order under the Electricity Acts to extend the area of supply. They have also decided to prepare a distribution scheme consequent upon the North Wales Electricity Power Company being constituted authorised suppliers, and have agreed to arrange a loan in respect of a distribution network for the district.

Cable extensions at Hillside-avenue, Plymouth, and at Beresford-terrace, Beauchamp-crescent, and Fairfield-avenue Devenport, have been authorised by the PLYMOUTH Electricity and Street Lighting Committee. It has also been decided to apply for sanction to borrow £1 467 for laying new feeder cables from Raglan Barracks to Fore-street, and £3 161 for a new feeder cable from the Newport-street Station to New Passage Hill.

Exeter Town Council have intimated that they are not prepared to extend their area of supply to include CREDITON, but, subject to a satisfactory arrangement as to terms, they would furnish a supply of electricity in bulk at the city boundary at Cowley Bridge. Under the circumstances, Crediton Council consider it would be better to form a company in the town, and the matter has been referred to the General Purposes Committee.

It is stated that NOTTINGHAM Electricity Committee is at last seriously tackling the steadily increasing number of applications for current. Good progress is being made with the laying of the new double electric cable along London-road and Pennyfoot-street, and the work is to be extended along Manvers-street in order to serve the Carlton-road and Sneinton Market areas, from which the demand for installations has been imperative for some time past.

Application is to be made by KEIGHLEY Town Council for sanction to borrow £5 000 for laying the necessary feeder cables and other work for the added area covered by the Keighley Electric Lighting (Extension) Order, 1915. The area comprises the urban districts of Oakworth and Oxenhope, and part of the rural district of Keighley. Application is also to be made to the Unemployment Grants Committee for a grant towards the cost of carrying out the works.

In order to provide for the anticipated demand for electricity for industrial purposes on the south side of the River Aire, LEEDS Electricity Department are laying further mains from the works on the north side of the river. The present mains have been carried under the streets in the centre of the city and over Victoria Bridge, but as an economy the new mains are being laid in a trench below the bed of the river. It is expected that the work will be completed at the end of this month.

AYR County Council have decided to withdraw their objection to the Kilmarnock Electricity Extension Order, 1921, on condition that Kilmarnock Corporation lay mains in the southern portion of the extended area if the County Council call upon them at any time to do so, and there is a reasonable prospective return. The Kilmarnock Corporation have agreed to this proviso on the understanding that should a difference of opinion arise as to a "reasonable prospective return" the question should be referred to the Electricity Commissioners.

BROMLEY Electric Light and Power Company have applied to the Town Council for their assent to change the existing system of electricity supply in the districts of Bromley Common, Bickley and Elmstead from d.c. at 210 and 420 volts to a.c. at 210 V for lighting and 420 for power at a frequency of 50 cycles per second. In order to do this it will be necessary to lay a new 3 300 V cable from the company's works in West Street through the districts mentioned, and to build four small transforming stations at various points. The Council are recommended to consent to the change.

LEYTON Urban Council have this week approved of a scheme for providing additional feeders to meet the increased demands for power in the Lea Bridge-road area, and also for the L.C.C. trams in Leyton. The present scheme has been prepared by Mr C. H. Wordingham and the Council's electrical engineer, Mr. F. H. Lewis, and will, it is estimated, cost about £34 500, including a new sub-station at the junction of Church-road and Waterloo-road, five new feeders, additional switchgear, &c. Walthamstow Council could give a supply in the district under certain conditions, but their terms were too high, and the present scheme represents the most economical method of solving the problem.

Alteration of Charges.

The FLEETWOOD Electricity Committee is now giving a discount of 5 per cent. to electricity consumers, consequent upon the improved position of the electricity undertaking.

CROYDON Council has arranged to supply electricity to works in Morland-road at 2d. per unit for the first 100 000 units a year, and 1½d. above this figure, with a minimum payment of £2 000 a year.

At the coming meeting of WARRINGTON Town Council the Electricity Committee will present a resolution for the withdrawal, as from Dec. 31, of the last three increases in the price of electricity,

amounting in all to 30 per cent. above pre-war prices, for lighting and traction, and 60 per cent. for power.

SALFORD Corporation is reducing the charges for electricity for lighting from 90 per cent. over the pre-war rate to 75 per cent., and from 115 per cent. to 100 per cent. over the pre-war rate for heating and power.

WEST BROMWICH Town Council has decided to lower the charge for electricity for power by 12½ per cent. from the December reading of the meters, and, alternatively, to offer power consumers current at £9 per kW demanded, plus 1d. per unit consumed. The lighting charges remain at 100 per cent. above the pre-war figures.

The following reductions have been made by WHITEHAVEN Town Council in the charge per unit for electricity :—Lighting from 7½d. to 7d.; maximum demand from 3½d. to 3¼d.; heating and cooking from 1⅞d. to 1½d.; power from 3·15d. to 2⅜d.; power (flat rate) from 2·05d. to 1⅞d.; factory power, the addition of 60 per cent. to be reduced to 50 per cent., with a minimum charge of 1¼d.

In order to stimulate the demand for electric heating and cooking, BEDFORD Town Council have reduced the price of electricity from 2d. to 1½d. per unit. For new combined lighting and heating services no charges will be made for laying the service mains provided the consumer agrees to pay in advance a minimum revenue for the first year, calculated at the rate of £5 per kW installed for heating, and that this be not less than 1 kW. A consumer who already takes energy for lighting and requires a heating service will be supplied on similar terms.

Electric Traction.

The relaying of BOURNEMOUTH tramway track along some of the main roads is now completed.

Sanction to borrow £450 000 for track renewals, &c., is to be applied for by BRADFORD Tramways Committee.

ACCRINGTON Tramways Manager has been instructed to report on economies to be effected on the tramway services so as to minimise the present losses.

Coatbridge Town Council have approved the agreement with regard to the purchase by the Corporation of Glasgow of the AIRDRIE AND COATBRIDGE tramway system.

It is announced that some of the outer LONDON TRAMWAY authorities have arranged with the London General Omnibus Company not to reduce fares without conferring with one another on their proposals.

The new luggage bridge at the CARDIFF Great Western Railway Station spans seven lines, and is connected with each platform by electric lifts. The electrical work is under the supervision of Mr. R. T. Smith, the Company's electrical engineer.

Penny fares were revived on all the BRIGHTON tramway routes on Sunday. Slight alterations in distances have been made on several branches, but pratically the system is the same as that abandoned in July last in favour of the 2d. minimum charge.

SALFORD Tramways Committee, being faced with omnibus competition, has issued a strongly-worded resolution of protest, in which it advocates the legal regulation of private passenger-carrying enterprises. The motion has been endorsed by the Borough Council.

The BLACKPOOL Electricity and Tramways Committee has instructed the Borough Electrical Engineer (Mr. C. F. Furness) to invite tenders for four single-deck saloon motor omnibuses in order that they may be ready for the summer season traffic.

The president of the MUNICIPAL TRAMWAYS ASSOCIATION has stated that of 102 undertakings, representing a capital of nearly sixty million pounds, only five succeeded last year in paying their way after meeting the obligation to provide adequately for renewals.

After a long discussion at a special meeting of EDINBURGH Town Council last week it was agreed by 51 votes to 18 that the electrification of the tramway system should be proceeded with, and that the overhead system should be adopted generally. It was decided also, by 41 votes to 26, that the overhead system should be adopted for Princes-street, with span wires.

We understand that the Geddes Economy Committee regard as unnecessary the rule requiring LONDON TRAMCARS to be painted and varnished before the annual renewal of the licence. It is calculated that by reducing the frequency of RENEWAL OF PAINT AND VARNISH, &c., to once in twenty-one months, £35 000 a year would be saved in the cost of labour alone, and a capital sum of £175 000 by a consequent reduction of the number of cars required for the service. Three and a half per cent. more cars would be freed for work.

It is probable that the SCARBOROUGH electric tramway service may not be shut down, as reported in our last issue, for three offers have been made for the purchase of the system. These include one from some London and Yorkshire tramway engineers, which the directors have accepted, subject to the approval of the tramway company shareholders. Mr. H. Seaton will act as managing director of a new company which will run an omnibus service in conjunction with the tramways to every part of the town. Mr. Moinet, the local manager of the tramways, has received instructions to continue running the cars.

In his annual report Mr. C. Furness, the BLACKPOOL TRAMWAYS Manager, states that the year affords evidence that the attempt to avoid any appreciable alteration in fares and stages was a mistaken policy. Last year the reserve balance was practically depleted, the sum available being only £36, and the revenue account will now be called upon to provide expenditure formerly met out of reserve. Increase in capital expenditure would also require further contributions for interest and redemption charges, and the restoration of the finances of the department to their former level would require careful consideration. An abstract of the accounts appeared in our issue of Dec. 2.

The official report of the Ministry of Transport Inspector (Major A. Mount, R.E.) on the BURTON-ON-TRENT TRAMCAR ACCIDENT on Nov. 3 was issued on Saturday. The car was passing from a single to a double line when the leading wheels took the left track and the trailing wheels the right track, the rear of the vehicle swinging round, and the car overturning at right angles to the road. The trailing axle fractured. The car was one of four new ones which had been running less than two years. On three of these cars eight axles had broken, after an average life of only 18 000 miles. Before the war only two axles were broken per annum on twenty cars, and Major Mount is of opinion that the post-war material is not so good. He considers that the driver was going nearer six miles than four per hour at the time, and suggests rigorous compliance with the speed regulations; also that all axles be tested before purchase.

Telegraph and Telephone Notes.

A new telephone exchange was opened at WALLASEY last Saturday to replace with up-to-date apparatus the existing Wallasey Exchange.

The Bridlington correspondent of the "Manchester Guardian" states that the gale over the week-end tore down miles of wires in EAST YORKSHIRE. Overhead telegraph and telephone wires in other parts of the country have also suffered severely.

Permission to erect telephone kiosks in Market-street, Deansgate, and Albert-square has been granted to the Post Office authorities by the MANCHESTER Highways Committee. These will be the first telephones to be set up in the streets of Manchester.

A correspondent of the "Railway Gazette" states that he has recently seen a copy of a letter, dated April 4, 1878, from Mr. W. Langdon, then Telegraph Superintendent of the Midland Railway, to Mr. W. L. Newcombe, the Goods Manager at Derby, intimating that "Should he feel interested in testing its capabilities, he begged to acquaint him that he had now a telephone communication in operation between his (Mr. Langdon's) office and the Stores in Siddals Road." This letter is of interest as it refers to the FIRST TELEPHONE USED ON THE MIDLAND RAILWAY, and one of the first on any railway.

During the current month the following TELEPHONE JUNCTIONS AND TRUNK LINES have been brought into use in SCOTLAND :—A new line between Aberdeen and Dundee, Dundee and Kirriemuir, Dundee and Brechin, Eassie and Forfar, Aberdeen and Ellon, Aberdeen and Inverness, and Brechin and Laurencekirk, and two new lines between Dundee and Arbroath and Aberdeen and Glasgow. In the north, new call offices have recently been established. There has been a considerably increased demand for the extension of the telephone system in Caithness-shire, especially in the Wick and Thurso districts.

Wireless Notes.

The FRENCH UNDER-SECRETARY for Posts, Telegraphs and Telephones announces that he is prepared to receive applications for the installation of the wireless telephone on private premises. Over a distance of thirty miles the cost of a complete station will be about 17 000fr. (approximately £340).

A Central News message from Washington states that the Far East Committee has decided that wireless stations operated by foreign Governments in CHINA shall be left in existence, but be restricted to the use of official messages. All private dispatches will be handled exclusively by the Chinese wireless companies. The Committee decided to call a conference of the world Powers to regulate the wave length to be used at Chinese stations.

In a letter to the "Northern Whig" Mr. W. Guy, of Tyrone, asks what safeguards have been provided in the Irish Peace Treaty for the AMATEUR RADIO-TELEGRAPHIST and the experimenter in WIRELESS TELEGRAPHY AND TELEPHONY. At present, he states, "the freedom of the amateur and the experimenter in this science is so limited in Great Britain as to be the butt and the jest of every other nation. Owing to the P.O. regulations we have very little to our credit in this country in the field of radio science, simply because the experimenter is to a great extent bound down to certain antiquated apparatus with which little can be added to the sum total of radio knowledge."

Obituary.

The death has taken place, in London, at the age of seventy-one years, of COMMANDER FREDERICK JOHN LOBB, R.N. (retired), late Inspector of Imperial Lighthouses in the Bahamas.

The death is announced of Mr. JOHN MILTON, of 7, Frogmoor-street, High Wycombe. Mr. Milton was forty-three years of age, and for over thirteen years was chief assistant engineer to the Wycombe (Borough) Electric Light and Power Company.

We regret to announce the death on Monday, at the age of thirty-eight, of Mr. ERNEST HOLT, manager for the past nine years of the Ashton-under-Lyne Corporation tramways undertaking. Mr. Holt went to Ashton as chief tramways clerk from Halifax in 1905, and he succeeded Mr. Dugdale as manager in 1912. Under his management the borough tramways have been completely reorganised.

Personal and Appointments.

Sir George Perley is retiring from the High Commissionship of Canada.

Mr. W. E. H. Berwick has been appointed Reader in Mathematical Analysis at Leeds University.

Mr. C. C. Paterson has been appointed the Member of Council of the Institution of Electrical Engineers to act as consultative member of the London Students' Committee for the session 1921-22.

The following firms of electrical engineers are among the latest admitted to membership of Glasgow Chamber of Commerce :—Anderson & Munro, Fraser & Borthwick, Haddow & Company, Andrew Hutcheson, Osborne & Hunter, and Underhill & Ritchie.

Mr. W. T. Kerr, electrical engineer to the Hereford Corporation, has sent in his resignation to the City Council. As we stated in our issue of Dec. 16, he is forming a company to acquire the Bleachley Power Station at Chepstow, from which it is proposed to supply power for industrial purposes in the Forest of Dean coalfield.

Mr. Lionel Jenkins, of Bury St. Edmunds, who has been recommended for the appointment of borough engineer and surveyor to the Newport Corporation, carried out the construction of the Middlesex Light Railway and Tramway system, at a cost of nearly £1 000 000. He saw service with the Royal Engineers during the war, and was mentioned in dispatches.

Capt. J. R. Birch, London Electrical Engineers, has been transferred to the general list of the Reserve of Officers of the Territorial Army; Lieut. A. W. Mawby, London Electrical Engineers, has been promoted to major in the Territorial Reserve of Officers; and Lieut. A. C. Stacey, from the same corps, has been transferred to the Territorial Reserve of Officers.

Among the New Year Honours conferred by the King, the following may be of interest to those engaged in the electrical industries :—

Baronet.—Sir Edward Mortimer Mountain (Chairman of Eagle, Star and British Dominions Insurance Company), for public services in connection with schemes for revival of trade, &c.

G.B.E. (*Knight Grand Cross of the Order of the British Empire*).—Prof. Chas. Scott Sherrington, M.A., M.D., F.R.S., D.Sc., President of the Royal Society.

Knights.—Prof. Wm. Abbott Herdman, C.B.E., D.Sc., President of British Association; Albert John Hobson, President of Association of Chambers of Commerce, 1920-21, and Pro-Chancellor of University of Sheffield; Cyril R. S. Kirkpatrick, Chief Engineer to Port of London Authority; Alfred S. Mays-Smith, President of Society of Motor Manufacturers and Traders; Alex. Richardson, M.P., Managing Director of Engineering, Ltd., and Vice-President of the Junior Institution of Engineers.

C.B.—Frank Jas. Brown, C.B.E., Head of Telegraph Branch, G.P.O.

C.I.E.—John Willoughby Meares, Electrical Adviser to the Government of India, and Chief Engineer of the hydro-electric survey.

Business Items, &c.

The Union Cable Company have become members of the Cable Makers' Association.

Stirling Town Council has appointed Henderson Brothers as electricians for the ensuing year.

The title of the Dubilier Condenser Company is now the Dubilier Condenser Company (1921), Ltd.

Mansfield Guardians have appointed the Mansfield Engineering Company electricians for the ensuing six months.

The new telephone number of Measurement, Ltd., 34 and 35, Provost-street, City-road, N. 1, is Clerkenwell 3157.

It is stated that Guest, Keen, & Nettlefolds propose to undertake the electrification of the whole of their Dowlais works and collieries.

The business of J. Owen and Sons, of Blackheath, has been taken over by Mr. T. A. Keating, electrical engineer, of 186, Westcombe-hill, Blackheath.

Baughan & Company, Ltd., electrical engineers, of Reading, who are having their premises rebuilt, are carrying on business temporarily at 175, Friar-street.

The Hoover Electric Suction Sweeper has been greatly reduced in price as from Jan. 2, and it can now be purchased at the same price as many ordinary vacuum cleaners.

The Automatic Telephone Manufacturing Company, manufacturers of "Xcel" electric heating and cooking appliances, announce a 16 per cent. reduction in the prices of these appliances as from the new year.

Moorgate-street and Finsbury-pavement are now officially known as Moorgate, and the numbering of the old Moorgate-street is to be continued to the beginning of Finsbury-place, which marks the City boundary. No. 1, Finsbury-pavement, on the west side, now becomes No. 75, Moorgate; No. 2, Finsbury-pavement, on the east side, No. 66, Moorgate, and so on.

The business of Mr. Justus Eck will, from January 1, be carried on under the title of Justus Eck & S. Brook. Mr. Brook has been Mr. Eck's colleague for many years, and will now become, together with Mr. Eck, proprietor of the new firm. Owing to the increased business the offices have been transferred from Central Hall, Southall, to Palmer Street, Westminster, to which address all correspondence should be sent.

We understand that Ransomes, Sims, & Jefferies, Ltd., of the Orwell Works, Ipswich, have been appointed sole manufacturers and licensees in the United Kingdom, the Colonies and Dependencies, South America, Dutch Indies and China, for the Patent Kestner Water-Tube Boiler. This boiler has had a great success in France, where it is manufactured by Schneider & Cie., of Le Creusot, and is in use at many of the large municipal power stations.

It is announced in the "London Gazette" that the following firms hold Royal Warrants of Appointment :—*To the King.*—Burt, Escaré & Denelle, electrical fittings, &c.; Edison, Swan Electric Company, electric lamps; Hart Accumulator Company, accumulators; A. P. Lundberg & Sons, electrical accessories; Perry & Company, electric light fittings; C. A. Vandervell & Company, manufacturers of electrical equipment for motor-cars. *To the Queen.*—Tredegars, Ltd., specialists in decorations and lighting. *To Queen Alexandra.*—Edison, Swan Electric Company, electric lamps and fittings; India Rubber, Gutta Percha & Telegraph Works Company, manufacturers of electric cables and wires, &c.

Educational.

As usual, young and old alike have crowded to the Christmas juvenile lectures at the Royal Institution. Prof. J. A. Fleming has chosen for his subject "Electric Waves and Wireless Telephony," and the fifth lecture of the series will be held to-morrow (Saturday) at 3 p.m.

Bristol University, known as the University of the West, is making an appeal for funds, the idea being to raise within five years the sum of one million pounds. The University is still without any endowment for many of the Chairs it maintains, including the chair of electrical engineering, and these are absorbing revenue from general sources which is urgently needed for other purposes.

The closing of the winter term of Finsbury Technical College was marked by an interesting cinema lecture, given on Dec. 9, before the staff and students of the engineering faculty. The chair was taken by Mr. J. K. Catterson-Smith, chief electrical lecturer. The film and projector were loaned by the British Thomson-Houston Company, and showed the manufacture at Rugby of a B.T.H. Curtis turbo-alternator, illustrating step by step the various processes in the manufacture of both turbine and alternator, until the complete turbo-alternator was seen under working conditions. The film included scenes in the manufacture of a 40 000 h.p. turbo-alternator, the largest power unit yet constructed in Great Britain. At the close of the lecture the chairman, on behalf of those present, thanked Mr. B. E. Williams, third year electrical student, as the originator in the college of cinema lectures, for his painstaking efforts in bringing about what had been a most instructive and interesting afternoon.

Institution Notes.

The next Annual Dinner of the Institution of Electrical Engineers will be held on Tuesday, Feb. 21, at the Hotel Cecil.

Arrangements are being made for a Summer Meeting of the Institution of Electrical Engineers to be held at Glasgow and the Western Highlands in May or June next. The programme will be similar to the one arranged for the meeting which was to have been held in 1921.

The Electrical Engineers' Ball, 1922, will be held this season at the Hotel Cecil on Friday, Feb. 10. Tickets may be obtained from the joint secretaries, Messrs. A. M. Sillar and W. S. Lonsdale, at 104, Victoria-street, Westminster, S.W. 1; or from any member of the committee on personal introduction.

Finsbury Technical College Old Students' Association are holding a smoking concert at the Engineers' Club, Coventry-street, W., on Friday, Jan. 27. The chair will be taken by the president, Mr. W. G. Head, at 8 p.m. (Tickets 2s. 6d. each.) An informal dinner at 7 p.m. has been arranged. Tickets must be applied for seven days beforehand. (Dinner 5s. 6d., payable at the club.)

The Committee of the Scottish Centre of the Institution of Electrical Engineers has decided to resume the annual dinner, which has not been held since 1913. The dinner will take place on Tuesday, February 28, at the Grosvenor Restaurant, Gordon Street, Glasgow. Tickets 17s. 6d. each—exclusive of wines—can be obtained from the Convener of the Entertainments' Committee, Mr. W. L. Winning, 166, St. Vincent Street, Glasgow, or from the Hon. Secretary, Mr. J. Taylor, 153, West George Street, Glasgow.

There will be a general meeting of members of the Golf Circle of the Engineers' Club on Wednesday, Jan. 18, at 6.30 p.m., in the Kelvin Room, followed by a dinner in the Stephenson Room at 7.45 p.m. It is hoped to have six regular meetings from March to October, leaving out July and August, and suitable courses are being arranged. The Waldie Cup and the Club Challenge Cup will be played for in medal and bogey rounds respectively at these meetings. Other prizes are being arranged for, and full information will be given at the meeting on Jan. 18.

In future the Council of the Institution of Electrical Engineers will award each year a maximum of six students' premiums of £10 for papers read before the Institution, provided they are of sufficient merit. The papers will be divided into the following

six classes :—(1) Design and manufacture of electrical plant; (2) generation and distribution of electric power; (3) utilisation of electric power (traction, power and lighting, and electro-chemical); (4) telegraphy and telephony; (5) wireless; (6) unclassified. In the event of a premium not being awarded in any section, two premiums may be given in another section.

The undermentioned have been appointed presidents and recorders (to whom all communications should be sent) of the following sections of the BRITISH ASSOCIATION for the meeting to be held at Hull on Sept. 6-13 next, under the presidency of Prof. C. S. Sherrington :—SECTION A (*Mathematics and Physics*) : President, Prof. G. H. Hardy; Recorder, Prof. A. O. Rankine, Imperial College of Science and Technology, S.W. 7. SECTION B (*Chemistry*) : President, Principal J. C. Irvine; Recorder, Prof. C. H. Desch, University of Sheffield. SECTION G (*Engineering*) : President, Prof. T. Hudson Beare; Recorder, Prof. G. W. O. Howe, Elmswood, Malden, Surrey. SECTION L (*Education*) : President, Sir Richard Gregory; Recorder, Mr. D. Berridge, 1, College Grounds, Malvern.

Imperial Notes.

WINDSOR (Queensland) Council has decided to apply for an Order-in-Council for electricity supply in the town.

BLACKHALL (Queensland) Council has been granted a loan of £1 600 by the Government for the completion of the Council's electric supply works.

The erection of the transmission line, 52 miles in length, from the Great Lake to the Northern end of TASMANIA has been commenced.

NARRANDERA (N.S.W.) Council is acquiring the electrical generating plant of Messrs. Wise Brothers. The plant is to be used to provide electric power for water pumping.

The distribution system in connection with the supply of electricity in LITHGOW (N.S.W.) from the works of the Hoskins Iron & Steel Company is now being carried out by Messrs. Ramsay, Sharp, & Company.

LISMORE (N.S.W.) Council has adopted a scheme by Mr. J. E. Donoghue for establishing a municipal electricity undertaking at an estimated expenditure of £32 153. The plant will include two 150 kW steam-driven alternators.

The Hobart correspondent of the "Industrial Australian" states that the Marine Board have been asked to lease a site near the Ocean Pier, HOBART, for the ELECTROLYTIC MANUFACTURE OF PIGMENTS. It is stated that 500 H.P. of electrical energy will be used in the process.

A WIRELESS TELEPHONY SERVICE BETWEEN TASMANIA AND VICTORIA is contemplated. A temporary station is being erected at Launceston, and will be equipped with American apparatus. Mr. G. Apperley and Mr. W. H. Conray are superintending the experiments.

Mr. C. B. Davies, who has been engaged to report on the desirability of transmitting electricity to ZEEHAN (Tasmania) from the Lake Margaret station of the Mount Lyell Company, has expressed the opinion that a large demand can be anticipated and that the line could be constructed within nine months.

After long discussion of the subject and many negotiations, WOLLONGONG (N.S.W.) has at last secured its supply of electricity from the Public Works Department's power house at Port Kembla. The supply was inaugurated early in November. The installation of the distribution system was carried out by Ramsay, Sharp & Co., of Sydney, the contract price being £12 000.

According to a Reuter's message from JOHANNESBURG, the Chamber of Mines has notified the South African Industrial Federation of the termination of certain wage agreements, and their intention to withdraw from the *status quo* in connection with the differentiation in the employment of white and coloured labour. The electrical power companies have declined to enter into further conference with the federation, or to discuss the increased minimum rates of pay recently demanded by the trade unions.

The New South Wales Government proposes the following terms in connection with the raising of a district loan to enable the NYMBOIDA HYDRO-ELECTRIC SCHEME to be carried : Currency, 10 years; interest not exceeding 5½ per cent.; deposit, 25 per cent.; balance payable in three quarterly instalments; bonds not to be negotiated during the currency of the loan. A special prospectus will not be necessary, as in October last a prospectus was issued calling for subscriptions for a loan of £3 000 000 for hydro-electric and other public works.

The annual report of the TASMANIAN STATE HYDRO-ELECTRIC DEPARTMENT shows the capital expenditure to date to be £2 055 043. Compared with 1918, the units generated increased from 16 500 000 to 38 486 000, and those sold from 14 256 000 to 32 593 000; the total connexions numbered 14 705, against 9 205. During the year the consumers connected increased by 29 per cent., units sold by 26 per cent., working costs by 25 per cent., and revenue by 26 per cent. Taking the department as a whole, it has been able to balance its accounts after providing for all interest charges, working and management expenses, and also providing £10 610 for the depreciation account (1½ per cent. on capital investment), which is regarded as ample in present circumstances. It is estimated, the "Times Trade Supplement" states, that the Great Lake scheme, which will increase the power to 58 000 h.p., can be completed by the middle of 1 922 for an additional £800 000.

Foreign Notes.

Increased tramway and omnibus fares are to come into operation in PARIS on the 22nd inst.

Improved lighting for PARIS streets is provided for in the Municipal Budget of Paris for 1922.

The MANILA RAILROAD COMPANY contemplates the utilisation of the water power of the Agno River in Central Luzon for generating electric current for traction. It is estimated that from 12 000 to 15 000 h.p. is available.

Official telegraphic communications, which were broken off when the revolution broke out, have been opened again between SOVIET RUSSIA and SWEDEN, without any restrictions whatsoever, and at a lower rate than before the war.

Last week's "Manchester Guardian Commercial" contains an article on RUSSIAN RECONSTRUCTION by Herr Felix Deutsch, managing director of the Allgemeine Elektricitats Gesellschaft Berlin, who recently propounded a scheme for Anglo-German co-operation in the re-habilitation of Russian trade.

An Exchange Telegraph message from BERLIN states that the Siemens-Schuckert Werke, which is part of the Stinnes electro-mining trust, has concluded an agreement with a Chinese concern for the erection of works at Shanghai and for the formation of a new company which will push the sale in China of goods produced by the Stinnes companies.

The SOUTH SWEDISH ELECTRIC POWER COMPANY has negotiated a 12 000 000 kronor 6 per cent. bond loan, with five Swedish banks, at an issue price of 100·5 per cent. The loan is repayable between 1926 and 1945, and the bonds are in denominations of 10 000, 5 000, and 1 000 kronor. The company has a share capital of 10 592 400 kronor, reserve fund of 2 468 000 kronor, and a redemption fund of 1 198 000 kronor. The last three dividends have been 8, 10, and 8 per cent respectively.

The formation of a big HYDRO-ELECTRIC GROUP in the neighbourhood of St. Etienne and Grenoble is being considered by the French Ministry of Public Works. According to present proposals the firms concerned will be the Cie. Electrique de la Loire et du Centre, the Cie. Hydro-electrique de l'Auvergne, Soc. des Forces Motrices de la Loire, Aciéries et Forges de Firminy, the Union Electrique, and the Soc. des Forces Motrices de la Truyère. The chief need for such a combination is the difficulty experienced by individual members in dry years owing to irregularity of supply. To guard against this eventuality there will be four main transmission lines passing respectively through St. Etienne, Roanne, and Commentry : St. Chély d'Apscher, Firminy, and St. Etienne; Grenoble, St. Chamond, and St. Etienne; Roanne and Villefranche-s.-Saône.

As a result of the abolition of Government subsidies in AUSTRIA the price of goods and various services has risen considerably. There has been an increase in electricity charges, in railway and tramway fares, and in postal and telegraph rates. As already announced, a scheme is being launched to develop the country's water power. This provides for the combined working of all the valuable water powers in Styria and of the steam-driven plants near the Crown coal pits. The total concessions will provide 450 000 H.P. The financing of the scheme has been undertaken by a syndicate of the large Vienna banks and the credit institutions of Styria. The Government have received offers from the Vickers and Armstrong companies for the purchase of the great Woellersdorf arsenal, which would be converted into works for the manufacture of locomotives for the Balkans.

The freight locomotives recently shipped by the Westinghouse Electric and Manufacturing Company to the PAULISTA RAILWAYS OF BRAZIL are now in service between Jundiahy and Louveira. These are claimed to be the first electric locomotives to be used in Brazil. The new locomotives, the "Railway Gazette" states, haul trains of from 43 to 45 units over grades as steep as 1·5 per cent. The so-called "unit car" is of 10 tons gross weight, and the term refers to the old wooden car of thirty years ago. Modern cars are said to be two, three, or four units, according to their size and load. Thus a train of 45 units represents 450 tons weight, and is approximately 675 ft. in length. Under former steam operation such trains could not be carried over a 1·5 per cent. grade at a speed greater than 15 km. per hour. The Westinghouse locomotives negotiate such grades at 45 km. per hour, which means tripling the capacity of the track and greatly increasing the speed of handling freight.

The project for linking the RHINE WITH THE DANUBE is now taking definite shape, according to a Berlin correspondent of the "Times Trade Supplement." The preparatory organisation is almost complete, and a joint stock company is to be floated to carry out the work. The scheme adopted involves the construction of a waterway from Aschaffenburg-on-the-Main, *via* Bamberg, Nuremberg, and Regensburg, to Passau, the improvement of the Upper Danube between Kelheim and Ulm, construction of junction canals for navigation to Munich and Augsburg, and the development of hydro-electric power on a large scale. Forty hydro-electric power stations are to be installed along the new waterway with an estimated capacity of 400 000 H.P. It is hoped to complete the entire scheme within twenty years. The construction company will be known as the Rhein-Main-Donau A.G., and will have a total

capital of 900 000 000 marks (nominally £45 000 000). As soon as sections of the waterway are available for navigation they will become State property, but the company will retain the power stations for 100 years, after which they will be taken over by the Government.

A message from Rome, dated Dec. 29, states that the continuous drought is causing an "electric famine," which will probably render the winter one of the most disastrous in the history of ITALY. Already reservoirs which supply electric power for the industries of Lombardy, Piedmont, and Liguria are reduced 50 per cent. The Mont Cenis reservoir, it is stated, will be dry in twenty days. This will cause the stoppage of supplies to nearly all the factories in Turin. Factories have reduced working hours to thirty-two a week. Tramway services have been cut down, and steam has replaced electricity on many lines. At the Fiat works this temporary difficulty has been met by the installation of 25-35 H.P. agricultural tractors for driving machinery. More than 150 of these tractors are being used, the power developed by them totalling more than 5 000. The use of agricultural tractors for driving machinery is not new, but this appears to be the first time they have been employed on such an extensive scale. No special installation is necessary for the use of tractors. Belt connection is made from the tractor driving pulley to the overhead shafting for a group of machine tools, or, if necessary, direct to the machine tool, and the change speed mechanism of the tractor is made use of if necessary. In order to avoid the repetition of a temporary shortage of the hydro-electric supply, extensive work is being carried out in the Italian Alps to form artificial reserves of water which can be brought into use on such occasions as this.

Latin-American Engineering Progress in 1921.

While several IMPORTANT ENGINEERING CONTRACTS were arranged during 1921 in Latin America, little new construction was actually commenced; railway building fell off owing to the high cost of labour and disputes; modified wages, however, were agreed upon and many labour difficulties arranged during the last months of the year, leaving a clearer field for 1922.

Electric Railway Progress.

The Buenos Aires Great Southern Railway completed the line from Stroeder to Patagones; progress was made with the electrification of the Buenos Aires Western Moreno branch; an important contract valued at £1 500 000 (7 000 000 dollars) was placed for the Santiago-Valparaiso State line. In Brazil preliminary work proceeded in connection with the Central Railway electrification. Small branch constructions were carried out in Bolivia, Colombia, Mexico, Honduras, and El Salvador.

A small amount of railway construction took place in Cuba, together with the erection of two or three additional sugar factories electrically equipped. Port and harbour works, additional railway mileage, and an electrically equipped sugar factory (the largest of its kind) were carried out in the Central American States.

Brazil.

A concession for the development of the waterfalls on the Preto River, State of Rio de Janeiro, Brazil, and the waterfalls of the Ayruocha River, State of Minas Geraes, was granted to a company organised for the purpose.

An electro-metallurgical company was authorised to construct a steel mill with electric furnaces, exemption from export duties on machinery, motors, furnaces and equipment for the project being granted for thirty years. The Brazil Electro-Metallurgical Company was formed, with a capital of 6 000 contos of reis, to install two electric furnaces at Ribeirao Preto with a daily output capacity of 60 tons of structural iron.

An official investigation of the waterfalls of Brazil showed that they can produce electric energy of over thirty million H.P.

Argentina.

A commencement was made upon the erection of the first Argentine power fibre-plant at a cost of 5 000 000 dollars (moneda nacional)

Chile.

A contract was entered into for the erection at Valparaiso of an iodizing copper plant by the Compania Yoduradora de Cobre, capitalised at £200 000 sterling. A British-Chilean Syndicate, capitalised at £12 000 000, was formed to carry through important engineering contracts. Important irrigation schemes are to be carried out.

Colombia.

An iron bridge was erected at La América section of the Medellin (Antioquia) tramway.

A proposal for the irrigation of 40 000 hectares of land in the Plains of Tolima was adopted by the Ministry of Agriculture and Commerce.

Mexico.

Large irrigation schemes were also authorised in this State. Authority was given for the construction of a pipe line and oil refinery at a point near Rio Tuxpan, with powers to lay branch pipelines, water and gas-lines, telegraph and telephone lines, and electric light and power cables, and to build a refinery near Mexico City.

Reuter's Trade Service Special.

Activities in China.

The following electrical activities in CHINA are reported from official sources :—

Specifications for power-house machinery, rails, rolling stock, and workshop equipment for the Peking Electric Tramway Company are now in preparation.

The China Electric Company propose to build the Harbin Electric Railway, and a contract has been signed with an American engineering company.

Preparations are in progress for the establishment of a company to undertake the construction of tramways in Hankow.

Petitions have been addressed to the Ministry of Agriculture and Commerce by a Tsinan merchant for the construction of tramways in the city. The Ministry has dispatched representatives to make investigations before official approval is granted.

The authorities of the Peking-Suiyuan Railway are drawing up plans for the installation of electric brakes along the entire line.

The Yau Hua Electric Company at Hsu Shih-kwan, Soochow, started business on Oct. 1. The company has just ordered a larger plant from a Shanghai firm to be installed in Hsu Shih-kwan.

The Kwang Hwa Electrical Light Company, established at Laohokow (Hupeh) with a capital of $70 000, has been registered at the Ministry of Agriculture and Commerce.

The Ministries of Interior, Agriculture and Commerce, and Communications have approved of an electric company at Peitaiho.

The Lee Hua Electric Light Company in Tsing Kiang-pu, Kiangsu, is to be opened almost immediately. 2 000 lamps have been installed.

Li Chia-ju and others have organised the Hanyang Electric Company and requested the Ministry of Agriculture and Commerce and the Ministry of Communications for registration.

South African Contracts.

The "Financial News" reports that German goods are coming into the SOUTH AFRICAN market in increasing quantities, and recently German firms or agencies secured some important contracts for electrical and hydraulic plant from the Rand Water Board. The National Trading Company (on behalf of the Mannesmann Tube Company, of Dusseldorf) obtained a contract for 229 300 ft. of steel pipes at £276 223. Stewarts & Lloyd (S.A.) Ltd., submitted the lowest tender for steel pipes of British manufacture at £392 476. An order for electric pumping plant and an overhead crane was given to Mr. C. Kleudgen for plant made in Germany, the amount being £7 828. The next tender (for Swiss pumps and English electrical plant) was £9 307; but the lowest tender for all British plant was £9 853, or £2 025 more than the German price. The pumps are being made by Amag-Hilpert of Nürnberg, and the electric motors by the Siemens Schuckert Company, and the crane by the Findeiden firm of Chemnitz. In respect of the pumps, the chief engineer found that the firm had fully grasped the Board's requirements. Regarding the electrical plant, the engineer reported that the offer was a complete one in every way. "The electric motors were larger and heavier, the insulation of the windings was of a better quality, and the temperature rise at full load less than that put forward by any British manufacturer." Moreover, the whole of the Board's general conditions and specification, including penalties, terms of payment, &c., and the whole of the prices were firm, and not subject to any variation in exchange, freightage, &c.

Exceptions taken to the Board's Conditions.

Hubert Davies & Company tendered for Swiss pumps and English electric motors, but certain exceptions were taken to the Board's conditions, while Messrs. Webber & Gillham, who sent the lowest all-British tender, stated that they were not prepared to accept the following :—(1) Guarantee the insulation resistance, (2) full penalties for low efficiency, (3) to test plant at their works under load, (4) responsibilities for mistakes under a certain clause of the conditions, (5) penalty for late delivery, (6) Board's engineer as sole arbitrator, and (7) Board's terms of payment, and (8) they also required some modification of the tests to be applied to the plant after erection. According to the Board's engineer, the alterations to the general conditions and specification were of such magnitude that it made it impossible for the Board to consider the tender.

Other tenders accepted by the Board are as follow :—Blane & Company, for a Paterson rapid gravity filter plant, £15 458; Webber & Gillham, two turbo-centrifugal pumps having a normal capacity of 5·5 million gallons per day against a head of 570 ft. (£19 652); and two Allen steam turbines and Metropolitan-Vickers electrical generators (£16 971).

Customs and Tariff Alterations.

According to the latest amendments to the AUSTRALIAN CUSTOMS TARIFF, the British Preferential Tariff on electrical machines and appliances, including electric heating and cooking appliances; electric fittings, consisting wholly or partly of metal, viz., switches, fuses, and lightning arresters, n.e.i.; regulating, starting and controlling apparatus for all electrical purposes, including distributing boards and switchboards, n.e.i.: dynamo electric machines; static transformers and induction coils for all purposes, unless otherwise expressly provided, electric fans, is to be 27½ per cent. *ad val.* The intermediate tariff on these articles is 35 per cent. and the general tariff 40 per cent.

Miscellaneous.

The address of the TRADE FACILITIES ACT Advisory Committee is now 17, Throgmorton-avenue, E.C. 2.

As from Dec. 30 the rate of interest to be allowed on sums deposited with the Inland Revenue Commissioners for the purpose of satisfying any EXCESS PROFITS DUTY will be 3 per cent per annum.

Electrical plant valued at several thousands of pounds was destroyed by a FIRE which broke out last week in an armature workshop at PORTSMOUTH DOCKYARD. The cause of the fire is unknown.

NEW COMPANIES REGISTERED IN SCOTLAND in 1921 numbered 424, with a total capital of £7 020 801. Seven were gas and electricity companies with a combined nominal capital of £75 000, against four in the previous year with a total capital of £25 000.

In the course of a visit of inspection to the Underground Railways last week, the members of the JAPANESE delegation of business men were taken to the Lots-road, Chelsea, power house, which has a capacity of 78 000 kW.

We are asked by Mr. C. P. Kininmonth to state that the coal-handling plant of the City of London Electric Lighting Company, described in last week's issue of THE ELECTRICIAN, was made by HENRY SIMON, LTD., MANCHESTER.

The first five COMMERCIAL RESEARCH FELLOWSHIPS instituted by the executive council of the British Empire Exhibition for competition among the Chambers of Commerce in the United Kingdom have been awarded to the Chambers of Commerce of London, Glasgow, Norwich, Warrington, and Oldham.

The December number of "THE BOMBSHELL," the house organ of Thos. Firth & Sons, contains, among other interesting articles, a short history of the firm since its establishment in 1850. The pamphlet, which consists of forty-two pages, is well illustrated, and makes good reading for outsiders as well as for the firm's employees.

With the January issue the "Journal of Industrial Welfare" has changed its name to "Industrial Welfare." The number contains many interesting articles, including one on "Industry Humanised," by Mr. Arthur Henderson, M.P., and another by Mr. Albert Barratt, chairman of Barratt & Co., on "Making Co-Partnership a Success."

Hughes and Young, Patent Agents, London, state that the number of APPLICATIONS FOR PATENTS FILED DURING 1921 will show a slight decrease compared with the 1920 figures. The number will exceed 35 000 against 37 000 last year. The principal inventions for which patents have been obtained are electrical appliances. These also head the list in numbers.

The late Sir CHARLES DOUGLAS FOX, J.P., civil, mechanical, and electrical engineer, one of the joint engineers of the Mersey Tunnel, the Liverpool Overhead Railway, the Metropolitan Division of the Great Central Railway, the Great Northern and City Railway, and the Hampstead Tube, has left estate valued at £45 766 (net personalty £44 988).

The B.T.-H. AMATEUR OPERATIC AND DRAMATIC SOCIETY (amateur theatrical section of the B.T.-H. Recreation Club) recently produced at Rugby Hippodrome, by kind permission of Mr. Rupert D'Oyly Carte, "The Yeoman of the Guard." This is the eighth play the society have produced, six of which have been by Gilbert and Sullivan. The play ran for a week, and was very successful.

Mr. C. F. MUSGRAVE, secretary of the London Chamber of Commerce, advocates the appointment of COMMERCIAL EXPERTS to the staffs of British Embassies and legations to act in liaison with the Consulates; and urges that the Consuls should be empowered to engage the services of qualified commercial experts in preparing reports and making inquiries on trade matters outside judicial or routine work.

The Industrial League and Council has issued a syllabus of LECTURES AND DISCUSSIONS ON INDUSTRIAL SUBJECTS to be held every Wednesday evening at 7.30 p.m. at Caxton Hall, Westminster, S.W. 1, from Jan. 4 to March 29. Admission is free to all meetings, and no tickets are necessary. The League will be pleased to supply further particulars on application to the General Secretary, Grosvenor-mansions, 82, Victoria-street, S.W. 1.

The newly formed TRANSPORT AND GENERAL WORKERS' UNION began operations in large offices at Central-buildings, Westminster, on Tuesday. Fourteen unions concerned with road and water transport are represented, and two others are balloting on the question of joining. The total membership is about 420 000. The president is Mr. Harry Gosling, and the general secretary and chief adviser of the whole scheme is Mr. Ernest Bevin.

A recent publication of the Bureau of Standards, Washington, contains a brief description of the occurrence, collection and preparation of CRUDE RUBBERS, of the manufacture of a number of rubber goods, such as tyres, inner tubes, hose, sundries, and moulded goods. The Bureau's methods of physical and chemical testing are described in detail. This publication is now ready for distribution, and anyone interested may obtain a copy by addressing a request to the Bureau until the free stock is exhausted.

At the fifth SMALL-POWER ENGINEERING AND SCIENTIFIC EXHIBITION, to be held at the Horticultural Hall, Westminster, early this month, besides the exhibits of the makers of models and scientific machinery and appliances, there will be shown the handiwork of amateur engineers and inventors, entered for the championship cup for the best exhibit in the show. These include three electric motor launches, the work of a Thames policeman.

The action of the MANCHESTER Corporation in REDUCING the WAGES of the maintenance workers of the Tramways and Gas Departments by 2d. an hour in the case of the skilled men, and 1½d. an hour in the case of the semi-skilled and the unskilled, has been endorsed by the Industrial Court, to which the matter was submitted for arbitration. The Corporation also reduced at the same time the wages of the maintenance workers of the Electricity Department by these amounts, but this department has an Industrial Council of its own, to which the dispute so far as it affects the electricity men has been referred.

At the Guildhall, recently, Ald. Sir T. Vansittart Bowater fined Frederick Alex. Oppenheim, assistant manager of the Trade and Finance Syndicate, for unlawfully GIVING A BRIBE OF £3 to Harold W. Camp, an officer of the London Telephone Service. It was stated that in consequence of complaints about the firm not getting calls from Switzerland, Mr. Camp went to the offices of the syndicate, where he explained that all calls were taken in rotation, and it was impossible for any preference to be shown. As he was leaving, Mr. Oppenheim remarked, "See that we get our Swiss calls through the same as other people," and put in his hand an envelope containing three £1 notes.

In addition to the reduction in rates announced in our issue of Dec. 23, the ENGLISH AND WELSH RAILWAY COMPANIES have decided to revert to the free periods allowed in pre-war days for the loading and unloading of wagons, and the use of sheets used in the conveyance of merchandise other than coal, coke, and patent fuel. The effect of this concession, which will operate as a temporary measure for twelve months as from Jan. 1, is that traders will save charges for demurrage to the extent of one million days per annum. The question will be reviewed at the end of 1922. The companies also announce a reduction in the charges for shipping coal and coke at the North-East and Humber ports. South Wales ports have already introduced lower charges.

The charge of "profiteering" is one that is easily launched, and in many cases no evidence is given in support of it. However, the following letter in the "Daily Mail" of Friday—assuming the facts are as stated—gives a clear case of "profiteering": "Sir,—We tendered to a firm in Manchester for 20 000 electrical fittings and offered them a keen price. As a trial order we undertook to make 5 000 of these articles. When the work was partly done the question arose as to our taking an order for the balance of the 20 000, but we declined as the price was too fine. Our customers then informed us that they could not possibly pay more, but later when our representative called at their retail shop he was asked 3s. 6d. each for the articles for which we were charging 3s. per dozen. This is 1 300 per cent. profit. Do not you agree that the sooner the law is amended to stamp out this sort of thing the better it will be for all concerned? We think that this will prove to your readers that it is not the manufacturer but the retailer who is profiteering.—NORTHUMBRIAN."

Hydro-Electric Power in Argentina.

The scheme for the utilisation of the great FALLS of IGUAZU, on the borders of Argentina and Brazil, is not progressing very rapidly, and efforts are being made to interest American financiers in the subject, though it is probable that the work will eventually be carried out either by the Waterworks Department of the Argentine Government or by a Joint Commission of the Argentine and Brazilian Governments. About twelve months ago a committee of engineers reported that there were no insuperable engineering difficulties to be overcome, and that during ten months of the year 125 000 kW, allowing for transmission losses, could be delivered in Buenos Aires. For that purpose twelve Francis turbines, of 23 000 H.P. each, would be required, two being held in reserve, while the power could be increased by the construction of dams, which need not necessarily interfere with the scenic beauties of the falls. During two months of the year, however, the power delivered at Buenos Aires would be only 76 250 kW. The question of distributing power along the route to Buenos Aires and also of constructing a branch transmission line to Rosario de Santo Fé, is regarded as of minor importance, since 80 per cent. of the power would be absorbed by Buenos Aires. The plans provide for the development of 150 000 H.P., to be increased lated to 300 000 H.P. Four transmission lines would be built, and to guard against interruption of the supply each would be of sufficient capacity to carry all the power needed. It is estimated that between six to eight millions sterling would represent the cost of the scheme, the actual work requiring perhaps two and a half years. Auxiliary power could be obtained from the Uruguay River and 30 000 H.P. could be generated by a hydro-electric plant at Salto Grande. Before the commercial practicability of the scheme can be settled, a careful examination of the question of labour is necessary. The temperature at the falls is about 45°C., which not only prevents European or American labour from being employed, but also favours the rapid propagation of disease. There are also transport and other difficulties to be surmounted.

Tenders Invited and Accepted.

UNITED KINGDOM.

Maldens and Coombe Urban Council. Jan. 10.—Two 10 b.h.p. horizontal electric motors, starting gear, &c., and electric lighting in the subsidiary pumping station at Blake's-lane; one 2½-ton electric lorry with tipping body; and mercury vapour rectifier outfit. Particulars from the Engineer and Surveyor, Municipal Offices, New Malden.

Dublin Electricity Committee. Jan. 11.—30 h.p. three-phase motor. Particulars and forms of tender from the City Electrical Engineer, Fleet-street, Dublin.

London County Council. Jan. 12.—Electric passenger lift, to lift a load of 11½ cwt., at Geoffrey House, Tabard Estate, Bermondsey, S.E. 1. Specification from the Chief Engineer, Gloucester House (Room 91), 19, Charing Cross-road, W.C. 2.

Peterborough Corporation. Jan. 12.—One 3 000 kW turbo-alternator, with condensing plant, two 750 kW rotary converters, two 100 kW motor converters, e.h.t. and l.t. switchgear; steam, water and drain pipes, &c. Specifications from the City Electrical Engineer.

Leeds Electricity Department. Jan. 12.—Single-phase wattmeters, minimum number required 2 000. Particulars from Mr. C. Nelson Hefford, Manager, Electricity Department, 1, Whitehall-road, Leeds.

East Ham Corporation. Jan. 12:—Extension No. 4. Sec. A: 1 500 kW rotary or motor converter, for converting 3-phase 50 period 6 600 V to d.c. 480-500 V; Extension No. 4 S. Sec. A: e.h.t. and l.t. switchgear and connections. Particulars from Mr. W. C. Ullmann, Nelson-street, East Ham, E.

Edinburgh Corporation. Jan. 19.—Electric lighting installation in Public Washhouse, Causewayside, Edinburgh. Specification, &c., from the City Electrical Engineer, Dewar-place, Edinburgh.

Worthing Corporation. Jan. 23.—One Diesel engine and c.c. dynamo; and vulcanised bitumen-sheathed paper-insulated concentric and triple concentric cable. Specifications, &c., from the Borough Electrical Engineer.

Metropolitan-Vickers Electrical Company, Cardiff.—Wiring for the electric lighting and heating of their new premises in Custom House-street.

AUSTRALIA.

City Electric Light Company, Ltd., Brisbane.—Feb. 10, 1922.—*Supply and delivery of six miles of three-core 0·15 by 0·15 paper insulated cable, suitable for 5 500 V, with a non-earthed system. Tenders, accompanied by a preliminary deposit of £100, to the Engineer and Manager, Boundary-street, Brisbane.

Australian Commonwealth Government, Feb. 15:—30 tons approximate Wheatstone tape paper white (Schedule 544). Particulars from the Supply Officer, Australia House, Strand, London, W.C. 2.

Victorian Government Railways.—Feb. 15.—*Supply and delivery of: (1) Fifty track relays, four front and two back contacts, fifty track relays, eight front and two back contacts, fifty line relays, six front and two back contacts (Contract No. 34 739); (2) 100 three-position line relays (Contract No. 34 740); (3) 100 electric signal mechanisms (Contract No. 34 738); (4) electro-mechanical interlocking apparatus (Contract No. 34 822); (5) fifty miles insulated copper wire (Contract No. 34 823). Local representation is essential.

New South Wales Government Railways and Tramways Department (Electrical Engineer's Branch).—Feb. 22, 1922.—*Supply, delivery, erection and maintenance of one 5 000 kW 50 cycle turbo-alternator with condenser and accessories, at Zarra-street power house, Newcastle. (Contract No. 556.) Tenders, on proper forms and accompanied by a preliminary cash deposit, to the Secretary for Railways, Phillip-street, Sydney, N.S.W. Local representation is essential.

Municipal Council of Sydney (Electricity Department). April 24.—*Supply, delivery, and erection of two 2 000 kW rotary converters; one 10 000 to 12 000 kW turbo-alternator.

NEW ZEALAND.

Post and Telegraph Department. Jan. 17.—*25 000 dry cells for telephone work.

Borough Council of Palmerston North. Original closing date Sept. 24. Extended date not yet decided.—*Service meters: (a) Single-phase, 230 V, 400 5 A, 150 10 A, 50 15 A; three-phase, balanced load, 400 V, 100 10 A, 30 25 A, 15 50 A, 10 75 A, 5 100 A. (b) 19 50 kVA single-phase transformers, with oil, complete; 1 complete winding h. and l. tension, for one l g; spare parts and accessories.

Lyttelton, Public Works Tenders Board of New Zealand. Jan. 31.—*Two complete sets of 3 phase automatic oil circuit breakers suitable for 6 600 V, 1 200 A capacity, four sets of disconnecting switches for isolating the oil switches, and one 6 600 V air break lever operated switch for main transformer switches at Lake Coleridge power house. Tenders to the Secretary, Public Works Tenders Board, Government Buildings, Wellington.

Public Works Department, Wellington. Feb. 28.—*Supply and delivery, ex ship's slings Lyttelton, of a bank of three 11 000 V reactances, complete, for the Lake Coleridge electric power scheme.

Public Works Tenders Board, Waikato Power Scheme. March 6.—*(Section 45) two 2 500 kWa alternators, three-phase, 50 cycle, 5 000 V, at 166⅔rds rev. per min., with a power factor of ·8. Excitation at 220 V. (Section 46) two 3 100 h.p. water turbines of the double-runner Francis type to operate the generators mentioned in Section 45. (Section 47) two exciter sets, each consisting of one 200 kW d.c. generator, and one 350 h.p. asynchronous motor, together with a Tirrill regulator. The generator shall have an output of 220 V, with a full-load current of 7 000 A. The motor shall be of 350 h.p., with a power supply of 400 V, three-phase, 60 cycle. The synchronous speed of the sets shall be 750. (Section 48) four Stoney sluice gates for the pits, appertaining to the turbines mentioned in Section 46. Tenders to the Secretary, Public Works Tenders Board, Government Buildings, Wellington.

Auckland Harbour Board. April 25.—Four double-barrel electric winches for the Central Wharf, Auckland. Specifications from W. & A. McArthur, 18-19, Silk-street, Cripplegate, London, E.C. 2.

SOUTH AFRICA.

Municipal Electricity Supply Undertaking of the City of Port Elizabeth. Jan. 31.—Supply of electrical plant.

Public Works Department of the Union of South Africa. Feb. 1.—Conduit and conduit fittings. Particulars from the Electrical Engineer, Public Works Department, Pretoria.

SOUTH AMERICA.

Chilean State Railways, Feb. 4, 1922*:—1 electric compressor; 1 air storage drum and 1 continuous current electric motor (70 h.p.); 1 300 electric filament lamps for locomotives; 38 wall telephones.

Argentine Ministry of Public Works. Feb. 21, 1922.—*Nine electric motors, 36 tip waggons, 1 centrifugal pump with electric motor. Specification expected at the Department of Overseas Trade by Dec. 28.

BULGARIA.

Bulgarian Direction of Posts, Telegraphs and Telephones. Jan. 10, 1922.—Supply of sixty 50-line and fifteen 100-line telephone exchanges. Particulars and drawings may be obtained from the Bulgarian Legation, 3, Queensberry-place, S.W. 7.

Bulgarian Department of Posts, Telegraphs and Telephones. Jan. 25.—*100 000 porcelain insulators.

Bulgarian Department of Posts, Telegraphs, and Telephones. January 30.—*Supply of the following parts for telephone exchanges: 2 200 subscribers' line indicators, 600 indicators (end of conversion), 2 500 jacks, 1 500 plugs, 2 000 connecting pieces, 20 000 switchboard connecting pieces.

Bulgarian Department of Posts, Telegraphs and Telephones. Feb. 8. *Supply of the following telegraphic accessories:—Twenty terminal boxes for 40-pair cable, 1 000 combined lightning arresters and 1 A fuses, 500 combined lightning arresters in fuses (different type), 300 transformers, 700 condensers (2 micro-farad), twenty junction-boxes with protective devices for 40-pair cable.

Bulgarian Department of Posts, Telegraphs, and Telephones. February 20.—*2 000 telephone instruments for table use, with local battery and magneto. Also for spare parts for these instruments.

Bedford Town Council has accepted the tender of C. & A. Parsons & Company for a 1 500 kW turbo-alternator, with circulating pumps, &c., at £17 976.

Cannock Urban Council have accepted the following tenders for the supply of cables, switchboards, and transformers: British Insulated and Helsby Cables, Ltd., £5 899; Ferranti, Ltd., £4 084 10s.; British Electric Transformer Co., £3 954 10s.; and Reyrolle and Co., £973 10s.

Bermondsey (London) Council have accepted the tender of Ferranti, Ltd., for d.c. meters at the following prices.— 24 2½ A, £3 10s. each; 12 10 A, £4 15s. each; 12 20 A, £5 12s. 9d. each; two 5 A two-rate, £7 13s. each; two 10 A two-rate, £8 5s. 6d. each; two 20 A two-rate, £8 15s. each.

Eastbourne Corporation recently received the following tenders for a 2 500 kW single-phase turbo-alternator with condensing plant:—W. H. Allen, Sons & Company, £19 598 (*accepted*); Escher, Wyss & Company, £20 417; Ateliers de Construction Oerlikon, £21 333; British Thomson-Houston Company, £23 753; Frazer & Chalmers' Engineering Works, £23 839; Belliss & Morcom, £23 893; Brush Electrical English Company, £23 965 (for 2 000 kW set); English Electric Company, £23 990; Richardsons, Westgarth & Company, £24 091; J. Howden & Company, £24 317; Metropolitan-Vickers Electrical Company, £24 470; and C. A. Parsons & Company, £25 540.

The following tenders were received for the condensing plant only:—Mirrlees, Watson & Company, £5 703; Cole, Marchant & Morley & Company, £5 815; Hick, Hargreaves & Company, £5 834; Richardsons, Westgarth & Company, £6 379; Worthington, Simpson, £6 623; and G. & J. Weir, £7 567.

For a water-tube boiler, with mechanical stoker, economiser, coal bunkers, chimney, induced-draught fan, and engine and pipework, the following submitted tenders—Stirling Boiler Company, £16 765 (*accepted*); British Niclausse Boiler Company, £17 000; Spearing Boiler Company, £17 746; John Thompson Watertube Boilers, £17 910; Babcock & Wilcox, £18 124; and Clarke, Chapman & Company, £20 542.

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* *Particulars from the Department of Overseas Trade.*

Companies' Meetings, Reports, &c.

The net profits of DURELCO, LTD., for the year ended Sept. 30 amounted to £10 191.

The BELL TELEPHONE COMPANY OF CANADA has declared a dividend of 2 per cent. on the capital stock.

The directors of EDGAR ALLEN & COMPANY announce an interim dividend at the rate of 6d. per share, tax free, for the half year ended Sept. 30.

At an extraordinary meeting of shareholders of CLAUD HAMILTON, held in Glasgow last week, special resolutions relating to increase of capital, &c., were confirmed.

The SHANGHAI ELECTRIC CONSTRUCTION COMPANY announce a second interim dividend at the rate of 6 per cent. actual (12s. per share), less tax, in respect of the year 1921.

The directors of RUSTON & HORNSBY, LTD., are unable to authorise the payment of the half-yearly dividend on the 5 per cent. and 6 per cent. cumulative preference shares, due on Jan. 1.

The STOCK EXCHANGE Committee have granted official quotations to 507 897 £1 fully paid ordinary and 530 067 £1 fully paid 7 per cent. cumulative preference shares of Tube Investments, Ltd., and £130 000 5½ per cent. redeemable debenture stock of the Yorkshire Electric Power Company.

The report of the CANADIAN WESTERN NATURAL GAS, LIGHT, HEAT & POWER COMPANY for the year ended Sept. 30, with which is incorporated the accounts of the Calgary Gas Company, shows a net loss of $213 512. The net loss in the previous year amounted to $101 607. The balance sheet now shows a total debit balance to profit and loss of $60 650.

The profit of ISLE OF THANET ELECTRIC TRAMWAYS AND LIGHTING COMPANY for the year ended Sept. 30, 1921, was £31 448, and the total receipts amount to £105 628. Allocations to the various reserve funds total £16 078; written off cost of motor vehicles, £864. The half-year's dividend, due in July, 1908, was paid on the preference shares, leaving to be carried forward £3 972, against £4 284 brought in.

The report of the SOCIÉTÉ INDUSTRIELLE DU RADIUM for the year ending June 30 states that the shareholders' response to the issue of £25 000 10 per cent. cumulative participating preference shares was much too small to justify going to allotment, and the directors are therefore obtaining requisite funds from a syndicate which is being formed for the purpose of developing the mine, installing additional plant and treating the ore. The mine was once more unwatered a few weeks ago, and is being worked with satisfactory results. The accounts show a loss of £201, making debit balance £14 834.

Presiding at the annual meeting of the LOW TEMPERATURE CARBONISATION COMPANY, in London, last week, Sir Hy. Goold-Adams said that a large quantity of coal had been carbonised. All this smokeless coal had been sold. No fewer than 30 000 gallons of oil had also been dealt with. Negotiations with a view of fixing up contracts were now being carried on with colliery firms here and abroad. With a plant of twenty retorts they had proved that it was possible to put up a low carbonisation plant that would pay. They also considered they had successfully solved the problem of by-products. The result of the experiment at Barnsley was absolute and conclusive.

In moving the adoption of the report and accounts at the annual meeting of the SOUTH AFRICAN CARBIDE AND BY-PRODUCTS COMPANY, held in London last week, the chairman said that the power station and the carbide factory were now practically completed, and that it was anticipated that production would commence next month. Owing to increases in cost of materials and labour, the cost of the works had proved greater than anticipated, and it had become necessary to raise additional capital for working expenses; for this purpose it was proposed to make an issue of £75 000 8 per cent. debenture stock, of which the directors and their friends were prepared, if necessary, to take up approximately £55 000. With the object of maintaining efficient control of affairs in South Africa, a local board of management had been appointed, consisting of Prof. Lawn, Mr. Hallett and Mr. D. D. Drury.

The accounts of S. SMITH & SONS (MOTOR ACCESSORIES) for the year ended July, 1921, show, after writing off £28 572 for depreciation on plant and machinery, &c., writing down stock-in-trade to market prices, and providing for income tax and adjustment in connection with excess profits duty, a loss of £295 437. From this has to be deducted £91 452 brought in, leaving a deficit of £203 985 to be carried forward. At the annual meeting on Tuesday Mr. W. H. Swift, who presided in the absence, through illness, of Mr. Samuel Smith, stated that at the late Olympia Show out of 227 British cars fitted with speedometers 115 were of Smith's make, while their nearest competitor fitted 53. With motor watches, 148 British cars were fitted, 99 being Smith's and the nearest competitor 39. At the Motor Cycle Show at Olympia "M-L" magnetos were fitted to 53 motor-cycles, against the nearest competitor's 31.

Presiding at the annual meeting of ALLDAYS & ONIONS, LTD., held in Birmingham last week, Mr H. Marks said that for the year ended July 31 there was a loss of £108 303. This was largely accounted for by the writing down of the vast stock owing to the fall in the price of materials. He thought the property and plant of the company, if realised, would sell at materially more than what appeared in the balance-sheet. There was nothing organically wrong with the business—it had a thoroughly sound constitution. One thing that had hampered resumption of full-blast activity had been the Government sales of material. There was every reason to expect the overseas trade would be resumed when the money market became more stabilised. Given something approaching normal conditions, or even a continuance of the present ones, with no violent upheaval in the labour world, they could look forward with confidence to the business resuming its place as a steady dividend-paying concern. At an extraordinary meeting that followed a resolution was passed authorising the alteration in the articles of association so as to extend the borrowing capacity of the company.

In the course of his speech at the annual meeting of the NORTHERN NIGERIA (BANCHI) TIN MINES last week, Mr. G. Temple Harris, chairman of the company, said that it was in cheap power that the future of their property lay. Electricity generated by water was the cheapest form of power, and he understood that several other Nigerian mining companies were paying attention to the same point. Their company were now shut down so far as the hydro-electric scheme was concerned, pending being able to obtain the necessary additional capital, but the plant and work so far done was fully protected, and should suffer no harm. They had just applied for State assistance from the £25 000 000 voted by Parliament to assist trade and unemployment. After providing for depreciation, interest, &c., the accounts for the last year show a loss of £18 221. Mr. Mackness, head of the hydro-electric department of Vickers, Ltd., has been elected a director.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, 116-118, Chancery-lane, London, W.C. 2.

CONVEYOR AND ELEVATOR COMPANY, LTD. (178 621), Croft Street, Accrington, Lancaster. Registered Dec. 23, 1921. Conveyor and elevator manufacturers and erectors. Nominal capital, £15 000 in 15 000 ordinary shares of £1 each. Directors: J. J. Stevenson and Margaret Stevenson. Qualification of directors, £100.

JESSHOPE, LTD. (178 565), Dale Street, Burslem, Stoke-on-Trent. Registered Dec. 21, 1921. Mechanical, electrical, and general engineers. Nominal capital, £2 000 in 2 000 shares of £1 each. Directors: S. Malkin, J. R. Malkin, L. G. Stevenson, and A. P. Jesshope. Qualification of directors, fifty shares.

NATILITE (SOUTH AMERICA), LTD. (178 571), Lennox House, Norfolk Street, Strand, W.C. Registered Dec. 21, 1921. To carry on the business of making, using, exercising, and vending the motor spirit for internal combustion engines and for power, heat, and light, known as Natilite or Natalite. Nominal capital, £30 000 in 28 000 ordinary shares of £1 each and 40 000 founders' shares of 1s. each. Directors: Sir W. Alexander, A. E. Leonard, and Sir T. D. Nicol. Qualification of directors, £500. Remuneration of directors, £500.

J. RUSSELL & CO., LTD. (178 637), 5, Credon Road, Plaistow, E. Registered Dec. 23, 1921. General engineers and pump makers. Nominal capital, £1 000 in 1 000 shares of £1 each. Directors: J Russell and J. Walford. Qualification of directors, £50C.

A. SMETHURST & SONS, LTD. (178 542), 16, Bernard Street, Southampton. Registered Dec. 21, 1921. Electrical engineers. Nominal capital, £6 000 in 6 000 shares of £1 each. Directors: A. A. Smethurst and Mrs. Beatrice Smethurst. Qualification of directors, fifty shares. Remuneration of directors, A. A. Smethurst, £500 per annum.

VARDAS ET CIE, LTD. (178 648), Finsbury Pavement House, Finsbury Pavement, E.C. Registered Dec. 23, 1921. Electrical, mechanical, and sanitary engineers. Nominal capital, £1 000 in 1 000 shares of £1 each. Directors: J. E. Bembaron, R. W. Sellers, G. O. Nevile, A. V. Vardas. Qualification of directors, one share.

Forty Years Ago.

(THE ELECTRICIAN, JAN. 7, 1882.)

THE AMOY CABLE REPAIRED.—The Eastern Telegraph Company (Limited) notifies the repair of the Amoy-Shanghai cable, thus restoring telegraphic communication with China and Japan.

THE BERLIN ELECTRIC RAILWAY.—It is said that Messrs. Siemens are carrying out experiments at Berlin to ascertain the effect of winter weather, snowstorms, frost, &c., on the conducting wires, &c., of their electric railway.

ROYAL INSTITUTION.—The following Papers have been settled for reading before Easter next, viz.:—Jan. 20, "On Comets," by W. Huggins, F.R.S.; March 10, "Electric Lighting by Incandescence," by J. W. Swan; March 24, "Electric Railways," by Professor W. E. Ayrton, F.R.S.

ELECTRIC LIGHT FOR THE SUEZ CANAL.—There is a fair prospect of the Suez Canal being lighted by electricity, so that ships may pass through it at night, instead of coming to an anchor, as at present. Major Strutt, managing director of the Eastern Electric Light Company, is in Egypt, arranging with M. Lemasson, the engineer-in-chief of the Canal Company, for the lighting of parts of the canal by the Brush system, so that dredging operations may be carried on at night, instead of in the day time. There is some prospect also of the lighting of the Suez Dock by electricity for the Peninsular and Oriental Company.—*Homeward Mail.*

Catalogues, Price Lists, &c.

Higgs Bros. have sent us their monthly magazine containing their stock list of a.c. and d.c. motors and dynamos.

The "Sunic" deep therapy apparatus is the subject of Bulletin 41S., published by Watson & Sons (Electro-Medical), Ltd.

A pamphlet illustrating the Hotpoint electric grills, toasters, and hollow-ware appliances has just been issued by the Hotpoint Electric Appliance Company.

Particulars and prices of the new C.A.V. Motor-cycle Dynamo Lighting Sets are contained in an illustrated folder ("H") just issued by C. A. Vandervell & Company.

Metropolitan-Vickers Electrical Company have issued a pamphlet of Cosmos nursery rhymes, and in connection with the same they have arranged a colouring competition for children between the ages of five and twelve, and are offering a number of attractive prizes.

Medway's Safety Lift Company have issued a new illustrated pamphlet in connection with their "Britain's Best" electric lifts, which include invalid lifts, passenger lifts, motor-car lifts, goods lifts, restaurant lifts, &c. The firm have a specially trained staff of engineers exclusively engaged in inspection, maintenance, and repairs of the lifts.

Tramways Supplies Ltd., of Leeds and London, are circulating a pamphlet (o. 102/1) which gives particulars of their h.t. and l.t. oil switches. These are suitable for voltages up to 3 000 V, and for capacities up to 300 A; they can be supplied in non-automatic and automatic patterns, d.p. or t.p., and they comply fully with Home Office requirements.

No. 3 of the series of Transformer Abstracts has been issued by Johnson & Phillips, Ltd. This describes and illustrates seven out of the eight tests carried out by the firm on their power transformers before delivery to customers. As there are several alternative methods of carrying out the eighth test—heat runs—this will form the subject of a separate memorandum.

Reavell & Company have sent us a copy of their Pamphlet No. 101 illustrating and describing their turbo compressors and exhausters. The great advantage of these machines over others of this type is the improved design of the diffuser blades fixed in the stator, which have a large bearing on the high efficiency obtained, and successfully solves the problem of overload on the prime mover, should there be such a tendency at any time.

A well got up pamphlet has been issued by Nalder Bros. & Thomson, Ltd., illustrating their N.C.S. "Ideal" instruments for use in connection with the generation and distribution of electricity. These include the "ideal" moving iron ammeters, three-phase voltmeters, power factor meters, rotary synchronisers, leakage indicators for alternating current, relays, insulation testing sets, &c. The firm's complete illustrated catalogue, giving prices and other information, will be sent on application.

The Societe Industrielle d'Electricite (France), manufacturers of patent safety cartridge fuses, have recently opened a British, Irish and Colonial Department at 23, Queen Anne's-gate, Westminster, London, S.W. The safety fuse system manufactured by them is called "Eternos," and while it differs somewhat from what in England is known as the "Z" system, and on the Continent as the "Diazed" system, it is interchangeable with these systems, and can, therefore, be used for all existing installations of these systems without any alteration of the fuse bases. In addition to the "Eternos" system, the firm manufacture other safety cartridge fuses which are interchangeable with all Continental and American systems, such as the "A.E.G." and "American Edison Screw."

Calendars, Diaries, &c.

The Saxonia Electrical Wire Company have issued a calendar for 1922 consisting of twelve monthly sheet mounted on a stout card.

A very useful calendar has been sent us by Francis Polden & Company, consisting of twelve monthly sheets mounted on a stout card. Each sheet contains the calendar for the entire year, with the particular month running printed in large black letters with a small adjustable red frame to indicate the date required.

Books Received.

"The Swedish Year Book, 1921." (London: Williams & Norgate.) Pp. 170. 7s. 6d. net.

"Electrical Engineers' Diary and Year Book, 1922." (London: S. Davis & Company.) Pp. 534. 10s. 6d. net.

"The Practical Electrician's Pocket Book and Diary, 1922." (London: S. Rentell and Co.) Pp. lxxx. + 558. 3s. net.

"The Fundamental Basis of Dynamo Electric Machine Design." By Tatsuo Tanaka. (Tokyo: Maruzen Co., Ltd.) Pp. 140.

"Universal Exchange and Interest Tables." By A. J. Lawson, M.Inst.C.E. (London: Thomas Skinner and Co). Pp. 242. 15s. net.

"La Propagation des Ondes Electromagnetiques à la Surface de la Terre." By L. Bouthillon. (Paris: Librarie Delagrave.) Pp xv+340.

Arrangements for the Week.

FRIDAY, Jan. 6th.

Institution of Mechanical Engineers.

6 p.m. At Storey's Gate, London, S.W. Joint meeting with the Society of Chemical Industry. Paper on "The Co-operation of the Engineer and Chemist in the Control of Plants and Processes," by Mr. G. M. Gill.

Royal Institution.

At Albemarle-street, London, W. Christmas Lectures on "Electric Waves and Wireless Telephony," by Prof. J. A. Fleming, F.R.S.

SATURDAY, Jan. 7th.

3 p.m. Lecture V., "Electric Waves."

TUESDAY, Jan. 10th.

3 p.m. Lecture VI., "Wireless Telephony."

MONDAY, Jan. 9th,

Institution of Electrical Engineers. Informal Meeting.

7 p.m. At Savoy-place, Victoria Embankment, London, W.C. Discussion on "Co-operative Advertising in Relation to the Electrical Industry." To be opened by Mr. J. W. Beauchamp.

Institution of Electrical Engineers.
(North-Eastern Centre.)

7.15 p.m. At Armstrong College, Newcastle-on-Tyne. Paper on "Induction Type Synchronous Motors," by Mr. L. H. A. Carr.

Institution of Electrical Engineers.
Dundee Sub-Centre.

7.30 p.m. At University College, Dundee. Paper on "Electrical Distribution," by Mr. Charles Lamb.

TUESDAY, Jan. 10th.

National Association of Supervising Electricians.

6.45 p.m. At St. Bride's Institute, Bride-lane, Ludgate Circus, London, E.C. Lecture on "A Talk Round the Thermionic Valve," by Major T. Vincent Smith.

Institution of Electrical Engineers.
North-Western Centre.

7 p.m. At the Engineers' Club, Manchester. Paper on "Telephone Line Work in U.S.A.," by Mr. E. S. Byng.

Institution of Electrical Engineers.
Scottish Centre.

7 p.m. At the North British Station Hotel, Edinburgh. Paper on "Induction Type Synchronous Motors," by Mr. L. H. A. Carr.

Röntgen Society.

8.15 p.m. At the Institution of Electrical Engineers, Savoy-place, London, W.C. Paper on "The Structure and Dimensions of Molecules," by Prof. A. O. Rankine, O.B.E.

WEDNESDAY, Jan. 11th.

Institution of Civil Engineers.
(Students' Meeting.)

6 p.m. At Great George-street, London, S.W. Lecture on "The Economic Aspects of Various Methods of Power Transmission," by Mr. E. W. Monkhouse.

Industrial League and Council.

7.30 p.m. At Caxton Hall, London, S.W. Lecture on "A Fair Day's Work for a Fair Day's Pay," by Mr. R. Stelling.

Liverpool Engineering Society.

8 p.m. At the Royal Institution, Colquitt-street, Liverpool. Paper on "Wireless Telegraphy in the Mercantile Marine." by Capt. J. A. Slee, C.B.E.

THURSDAY, Jan. 12th.

Institution of Electrical Engineers. Extra Meeting.

6 p.m. At Savoy-place, London, W.C. Cinematograph films on "Investigations and Tests on High-tension Switchgear," by Mr. P. Torchio, with explanatory notes by Dr. C. C. Garrard; "Telephone Inventors of To-day," "The Audion," and "Electricity in the Home," by Mr. F. Gill.

Optical Society.

7.30 p.m. At the Imperial College of Science, South Kensington, London, S.W. Papers on "The Manufacture of Optical Glass," by Dr. C. J. Peddle, M.B.E.; "The Barr and Stroud 100-ft. Self-contained Base Rangefinder," by Dr. J. W. French; and "The Optical Three Apertures Problem," by Mr. T. Smith.

Institution of Mechanical Engineers.
Midland Branch.

7.30 p.m. At the University, Edmund-street, Birmingham. Paper on "Dr. Leonard Hill's Katathermometer," by Mr. H. C. Young.

FRIDAY, Jan. 13th.

Institution of Electrical Engineers.
Scottish Centre. (Students' Section.)

7.30 p.m. At the Royal Technical College, Glasgow. Paper on "The Protection of Alternating Current Circuits." by Mr. E. T. Pounds.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Partnership Dissolved.

HONE, Henry Percy Greenwood, and DAYIAN, Paul, electrical contractors, 46, Malden-road, New Malden, Surrey, under the style of Greenwood Hone & Company, by mutual consent as from Dec. 25, 1921. Debts received and paid by P. Dayian.

Bankruptcy Information.

DEPLEDGE, Robert Adrian, Scunthorpe, Lincolnshire, electrical engineer. Receiving order, Dec. 30. Debtor's petition.

LANGSFORD, Edwin Growdon, Burnley, electrician. Receiving order, Dec. 30. Debtor's petition.

Companies Winding-up Voluntarily.

PLANET ELECTRIC COMPANY, LTD. Meeting of creditors at the offices of Dollman & Pritchard, 52, Tavistock-square, London, W.C. 1, on Jan. 9, 1922, at 12 o'clock noon.

TAMPICO ELECTRIC LIGHT, POWER & TRACTION, LTD. (in voluntary liquidation). Meeting of creditors at liquidator's office, Jan. 17, 3 p.m. Particulars of claims by Feb. 7, to the liquidator, J. S. Evernden, 47, Parliament-street, Westminster.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

ARMATURE REPAIRING & SUPPLY COMPANY, LTD., Pipe House Wharf, Swansea, electrical engineers. £17 4s. 10d. Oct. 28.

BATE, Mr. D. C., 16, John Dalton-street, Manchester, electrical manufacturer. £25 13s. Oct. 27.

BOLLEY & LEESON, 28, Bond-street, Hinckley, electrical engineers. £66 11s. 4d. Nov. 2.

EVANS, Mr., Salubrious-passage, Swansea, electrical engineer. £15 8s. 2d. Oct. 31.

KNIGHT, Wilfred, Sen., 6, Oak-end, Waye, Gerrards Cross, electrical engineer. £22 3s. Oct. 11.

SOUTHERN COUNTIES PLATING COMPANY, LTD., 164A, Friar-street, Reading, electro platers. £17 19s. 5d. Oct. 26.

STRONG, Henry, 157, Chester-road, Hulme, Manchester, electrical engineer. £10 0s. 6d. Nov. 1.

WALTON, Mr. C. W., 33, Keelings-road, Dudley Port, electrician. £14 1s. 7d. Nov. 2.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

COATBRIDGE & AIRDRIE ELECTRIC SUPPLY COMPANY, LTD. Registered Dec. 20, further charge (supplemental to mortgate dated March 31, 1904, securing £5 500, additional), to County of London Electric Supply Company, Ltd., Moorgate-court, E.C.; general charge, and Coatbridge and Airdrie undertakings, and benefit of certain agreements, contracts, &c. *£179 812 8s. 11d. March 17, 1921.

JESMOND ELECTRICAL & GENERAL ENGINEERING COMPANY LTD. Registered Dec. 16. £300 debentures, to J. Sharp, 29, Armstrong-avenue, Heaton; general charge.

TARANTO TRAMWAYS & ELECTRIC SUPPLY COMPANY, LTD., London, E.C. Registered Dec. 21. £20 000 charge, to Commercial Bank of Scotland, Ltd.; charged on certain concession and rights granted by Municipality of Taranto (Italy), also general charge. *£72 000. Dec. 31, 1920.

Satisfactions.

DAWLISH ELECTRIC LIGHT & POWER COMPANY, LTD. Satisfaction registered Dec. 22, £300, part of amount registered Oct. 4, 1920.

ENGLISH ELECTRIC COMPANY, LTD., London, W.C. Satisfaction registered Dec. 23, £30 100, part of amount registered Oct. 3, 1919.

Deed of Arrangement.

HARRIS, Sydney Henry, trading as the MANCHESTER MAGNETO REPAIRING COMPANY, 191, Chapel-street, Salford, and 7, Brideoak-street, Cheetham Hill, Manchester, electrical engineer. Trustee, J. F. Warburton, 28, Queen-street, Manchester, accountant. Filed Dec. 24. Liabilities unsecured, £522; assets, less secured claims, £210.

PRIVATE MEETING.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

WILLIAMS & BEVAN, electrical and general engineers, Aberdare. Creditors were called together recently, when a statement of affairs was presented, which disclosed liabilities of £1 753, all due to the trade. The assets, consisting of stock £300, and book debts £316, were estimated to realise £616, a deficiency of £1 137. It was stated that the debtors commenced trading some two to three years ago, after leaving the army. The bank allowed an overdraft to the extent of £700, which had now been reduced to £312, and was secured. The present position was attributed to want of capital, competition, and taking contracts at too low a price. The creditors decided that the estate should be dealt with under a deed of assignment with Mr. S. E. Clutterbuck, of Messrs. Clarke, Dovey, & Co., accountants, Cardiff, as trustee. The principal creditors are: English Electrical Company, London, £331; General Electric Company, Ltd., Cardiff, £110; Simpson & Baker, Bristol, £147; Siemens Bros., Ltd., Woolwich, £112; McWhirter & Sons, Ltd., Cardiff, £65; St. Helens Cable & Rubber Company, Ltd., Warrington, £47; British Thomson-Houston Company, Ltd., Cardiff, £54; Engineering Equipments Company, Ltd., Swansea, £22; Chloride Electric Storage Company, Ltd., Manchester, £21; India Rubber & Tile Works Company, Ltd., London, £28.

Benn Brothers' Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"The Cabinet Maker": "Rococo Ornament," "The Fitted Washstand," and "Retail Advertising: Christmas Gift Announcements Reviewed."

"The Chemical Age": "Leaders of Chemical Industry: (1) Sir William Alexander"; "The Structure of the Atom," by Dr. Stephen Miall, and "The Nitrate Situation."

"Farm and Home": "Milk Hygiene," by Alex. Levie, F.R.C.V.S.; "Producing Baby Beef," by Prof. James Long, and "Milk Analyses—Extraordinary Variations."

"The Fruit Grower": "Industrial Uses of the Potato," by H. V. Taylor, B.Sc., Deputy Controller of Horticulture: "Control of Red Spider," by Theodore Parker, M.A.E.B., and "Fruit Prices in 1921."

"Gardening Illustrated": "December Chrysanthemums." "Plants of Shakespeare," and "The Week's Work."

"The Hardware Trade Journal": "The Operation of Grinding Machines," "Advertising and Selling," and "British Trade Methods in the Argentine."

Prices of Metals, Chemicals, &c.

TUESDAY, JAN. 3.

		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£68 15 0	10s.	—
Electro Wirebars ..	,,	£75 0 0	—	10s.
H.C. wire, basis	per lb.	0s. 11½d.	—	$\frac{1}{16}$d.
Sheet	,,	0s. 10½d.	—	
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze wire, basis.....	,,	1s. 3¼d.	—	$\frac{1}{16}$d.
Brass 60/40—				
Rod, basis	,,	0s. 7¾d.	—	—
Sheet, basis.....	,,	0s. 10¾d.	—	—
Wire, basis	,,	0s. 11¼d.	—	—
Pig Iron—				
Cleveland Warrants	per ton	£5 5 0	—	—
Galvanised steel wire, basis 8 SWG	,,	£22 0 0	—	—
Lead Pig—				
English	,,	£26 0 0	—	10s.
Foreign or Colonial ..	,,	£24 7 6	—	12s 6d.
Tin—				
Ingot	,,	£170 15 0	—	10s.
Wire, basis	per lb.	2s. 3¼d.	—	¼d.
Aluminium Ingot		£120 0 0	—	—

Salammoniac.—Per cwt. 65s.-60s.
Sulphur (Flowers).—Ton £12 10s.
,, (Roll-Brimstone).—Per ton £12 10s.
Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.
Copper Sulphate.—Per ton £28 10s.
Boric Acid (Crystals) —Per ton £65.
Sodium Bichromate.—Per lb. 6d.
Sodium Chlorate.—Per lb. 3½d.
Rubber.—Para fine, 1s. 1¾d.; plantation 1st latex, 11¾d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

Patent Record.

APPLICATIONS FOR PATENTS

August 29, 1921.

22 825 Halden. Electric photographic printing or copying machines.
22 838 Moxham. Switch.
22 857 Allan. Wireless telegraph and telephone apparatus.
22 858 Automatic Telephone Mfg. Co. Telephone systems. (15/3/21, U.S.)
22 860 Sykes. Electro-magnetic apparatus for recording sound.
22 861 Harris, Horton, Preston & Hodgson. Direction-finding apparatus for wireless telegraphy.
22 870 Pride. Electric light fittings with bowl shades or reflectors.
22 875 Igranic Electric Co. (Cutler-Hammer Mfg. Co.). Electric motor control.
22 893 Wilson. Wireless telegraph apparatus.
22 897 American Radio & Research Corporation. Electrical apparatus. (30/8/20, U.S.)
22 906 Nishimoto. Incandescent lamp.

August 30, 1921

22 930 Cooper. Alternating current dynamo.
22 964 Robertson. Combination electric radiator and hot-water circulator.
22 990 Metropolitan-Vickers Electrical Co. & Field. Devices for balancing currents in parallel connected conductors for heavy alternating currents.
22 999 Pullin, Goolden & Greatbatch. Rectifiers for high potential alternating currents.
23 001 Koolhaas. Electric maximum automatic cut-out. (30/8/20, Holland.)
23 004 Westinghouse Brake & Saxby Signal Co. & Peter. Alternating current track signalling.
23 013 Scott-Taggart. Signalling systems.
23 018 Brougham (Walker Accessories Co.). Commutators for ignition apparatus.
23 020 G. E. Co. & Eden. Holders for electron discharge devices, &c.
23 021 B. T.-H. Co. (G. E. Co.). Electric motor starters.
23 034 & 23 040 Wacker. Circuit closers for electrically operated alarms.
23 044 Levi & Rottenburg. Electric lamps.

August 31, 1921.

23 066 Ashton. Accumulator battery.
23 075 Moyle. Electrical bonding junction boxes for metallic sheathed wires, &c.
23 080 Ely. Well-globe fittings for electric lamps.
23 091 Fairweather (Diehl Mfg. Co.). Motor-driven sewing machines.
23 103 Becherraz. Electric light switches.
23 138 Gordon. Electric motor, &c., controllers.
23 144 B. T.-H. Co. (G. E. Co.). Current limiting devices.
23 149 A. C. Cutting & Welding Co., Smout & Flood. Electrodes for welding, &c.
23 154 Akt. Ges. Brown, Boveri et Cie. Rapid energising of magnets. (9/9/20, Switzerland.)
23 157 Allmänna Telefonaktiebolaget L. M. Ericsson. Control clocks for trunk line switchboards. (20/5/21, Sweden.)
23 168 Corrico & Hughes. Method of mending resistance elements. (11/9/20, U.S.)

September 1, 1921

23 223 Armstrong. Galvanic batteries.
23 229 Thompson. Electric wire union.
23 232 Juchli. Production of insulating material. (1/9/20, Switzerland.)
23 234 Westinghouse Air Brake Co. Automatic electric couplings. (1/6/21, U.S.)
23 241 Fuller's United Electric Works & Beswick. Storage battery electrodes.
23 246 Metropolitan-Vickers Electrical Co. Liquid rheostats. (18/10/20, U.S.)
23 253 Automatic Telephone Mfg. Co. Telephone systems.
23 261 B. T.-H. Co. Electron discharge amplifiers. (29/10/13, U.S.)
23 264 Albrecht. Electrically-heated soldering iron. (10/5/21, Switzerland.)
23 281 Palmer. Accumulator battery.
23 285 Eckersley, Round & McLellan. Aerials for wireless signalling.
23 434 Exley. Electric batteries or accumulators.

September 2, 1921.

23 291 Sayer. Electric traction.
23 302 Griffiths. Incandescent lamp holders.
23 314 Fairweather (Diehl Mfg. Co.). Electric motor.
23 317 Fairweather (Singer Mfg. Co.). Electrically controlled sewing machine.
23 318 Fairweather (Singer Mfg. Co.). Lighting attachment for sewing machine.
23 319 Fairweather (Singer Mfg Co.). Electrically lighted sewing machine.
23 320 Fairweather (Singer Mfg. Co.). Electric sewing machine.
23 321 Fairweather (Singer Mfg. Co.). Electrical connectors and terminal blocks.
23 340 Callender's Cable & Construction Co. Clips for testing purposes.
23 349 Boudou. Electric apparatus for waving hair. (26/3/20, France.)
23 376 B. T.-H. Co. (G. E. Co.). Electric discharge devices.
23 377 Frith. Means for rectifying l.t. alternating currents.
23 379 Higgs. Starters for squirrel cage motors.
23 404 Paddon. Electrically operated brakes for self-propelled vehicles.
23 419 Graham. Telephone systems.
23 434 Handasyde. Accumulators.
23 437 Ges. für Drahtlose Telegraphie. High frequency telegraphy and telephony. (29/9/20, Germany.)

September 3, 1921.

23 451 Bratt. Electrically heated utensils.
23 452 Proprietary Smallwares, Ltd. Insulating block for lamp holders.
23 453 Proprietary Smallwares, Ltd. & Goldsmith. Electric lamp holders.
23 469 Thompson (Splitdorf Electrical Co.). Combined connection and terminal block.
23 476 Wilson. Testing points for use in electrical work.
23 501 Dufaux. Permanent magnets. (7/9/20, Switzerland.)
23 518 Kirk & Milliken. Terminal blocks for electric conductors.
23 523 Pritchett. Switch.
23 535 Reynolds. Composition for screening X rays and for electrical insulating.

September 5, 1921.

23 537 Bentley-Humphries. Cycle electric lighting sets
23 539 Baker. Commutators or distributors for ignition systems.
23 579 Radio Communication Co. & Scott-Taggart. Signalling systems.
23 594 Ford. Miners' electric safety lamps.
23 604 Metropolitan-Vickers Electrical Co. & Fletcher. Armatures of d.c. machines.
23 610 & 23 617 Vickers, Ltd., Astington & Flann. Frictional driving gear for electric machines in railway vehicles.
23 612 B. T.-H. Co. (G. E. Co.). Switches.
23 633 Every. Electric switches for railways, &c.
23 639 Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Production of ammonia from nitrogen and hydrogen. (7/9/20, Norway.)
23 640 Suter. Electric heating apparatus for waving hair.

September 6, 1921.

23 648 Besford. Dimming devices for electric lighting on vehicles, &c.
23 668 Polson. Fittings for electric conduits, &c.
23 676 Electro Dynamic Construction Co. & Pensabine. Electric machines
23 686 Pemberey. Commutators.
23 710 Metropolitan-Vickers Electrical Co. & Orange. Electric radiators, &c.
23 725 Haddan (Meier). Galvanic cells and batteries.
23 730 B. T.-H. Co. & Given. Motor control.
23 731 B. T.-H. Co. (G. E. Co.). Flexible conductor connectors.
23 760 Rivers-Moore. Automatic selectors, &c., for wireless systems.

September 7, 1921.

23 782 Thompson (Nelson Tuner Co.). Timing switches or commutating devices.
23 790 Crowther, Grenfell, -Erskine-Murray, Robinson & Gill. Directional wireless systems
23 791 Whitehead. Accumulators.
23 796 Automatic Telephone Mfg. Co., Smith & Jordan. Telephone instruments.
23 836 Houston, Sleeman & Schmidt. Magneto ignition for engines (7/9/20, Australia.)
23 861 Palmer. Telephone junction or terminal boxes, &c.
23 869 Barcn (Oldendorff). Automatic switching arrangements.
23 872 Watson & Sons (Electric Medical), G. E. Co., Gough & Gossling. Circuits and electro-medical apparatus for transforming and utilising electric currents.
23 891 Taylor. Arrangement of cables and transformers in h.t. transmission lines.
23 895 Taylor. Electrical transmission systems.

September 8, 1921.

23 898 Glover & Unwin. Electrical automatic clock.
23 912 Silcock. Electric rotary contact maker
23 938 Denny. Electric irons.
23 952 Metropolitan-Vickers Electrical Co. & Ross. Protective devices for transformers.
23 954 Vickers, Ltd. & Etchells. Electro-magnetic regulating devices for electric machines.
23 962 Akt. Ges. Brown, Boveri et Cie. Damping out third harmonics in 3-phase transformers. (15/9/20, Switzerland.)
23 971 B. T.-H. Co. (G. E. Co.). Tensioning devices.
23 972 B. T.-H. Co. (G. E. Co.). Furnaces.
23 974 Signal Ges. Acoustic apparatus for telephone communication. (27/9/20, Germany.)
23 980 Runbaken & Torrance. Testing devices for electric ignition systems.
23 982 Zagury (Buscha Ges.). Operating from h.t. d.c. mains apparatus operated by l.t. current.

September 9, 1921.

23 996 Tucker. Fuse-boards.
24 026 Western Electric Co. Vacuum tubes.
24 035 White. Mounting and driving magneto-electric machines.
24 045 G. E. Co. & Bartlett. Circuits for electric heating.
24 057 B. T.-H. Co. (G. E. Co.). Electric arc devices.
24 062 Kindliman & Co. Portable electric heating apparatus. (13/12/20, Switzerland.)
24 063 Dalsgaard-Anderson. Electric bicycle bell.
24 064 Schweizerische Magneta A.G. Electric clock and signal installation. (11/9/20. Switzerland.)
24 071 Schott & Gen. Electrode for electricity meters in which gases are electrolytically dissolved and eliminated. (17/9/20, Germany.)

September 10, 1921.

24 076 Ellis. Trolly heads for tramcars, &c.
24 094 Morgan. Bulb and battery tester.
24 098 Hippisley & Milham. Incandescent lamp holder.
24 099 Hippisley & Milham. Shade retainer for electric lamp holders.
24 136 Midgley. Switches or switch boards for controlling electric circuits.
24 140 Woods. Electric motors.
24 143 Peirce. Enclosed cartridge fuses.
24 146 Hepworth. Electric generators for road vehicles.

September 12, 1921.

24 179 Western Electric Co. Electro-magnetic step-by-step mechanism.
24 180 Radio Communication Co. & Scott-Taggart. Signalling systems.
24 194 Rosenkrantz. Electric water heaters.
24 202 Paul. Circuit breakers. (10/9/20, Germany.)
24 206 Metropolitan-Vickers Electrical Co. Clamps for trolly conductors. (29/10/20, U.S.)
24 207 B. T.-H. Co. (G. E. Co.). Photo-electric devices.
24 227 Watson & Sons (Electric Medical) & Phillips. Electrical indicator.
24 240 Hancock. Electric furnaces.
24 241 Warburton. Mining type switchgear
24 250 Porscke. Depolarizers for galvanic elements.
24 251 Porscke. Electrolytes for galvanic elements.
24 266 Smith. Electrical or mechanical hand or chain control.

September 13, 1921.

24 285 Western Electric Co. Telephone exchange systems.
24 303 Lyon. Adaptors or wall plugs for electrical connections.
23 331 Ellison. Unidirection electric generator set.
24 332 Metropolitan-Vickers Electrical Co., Brooks & Hall. Electric traction systems.
24 333 Metropolitan-Vickers Electrical Co. & Cameron. Sealing electrical conductors in glass, &c
24 340 Haddan (Automatic Temperature Control Co.). Electrically operated vale regulators.
24 345 Whittaker-Swinton. Control apparatus for wireless waves.
24 349 Johnston & Schwuchow. Electrical etching machines.
24 352 Marks (Siemens-Schuckertwerke). Electric lifting gear.
24 356 Bignamy. Electric circuit controlling devices.

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CONTENTS.

Notes of the Week.

A.C. Commutator Motors.

In these troublous days the work, and therefore the outlook, of the electrical engineer is so likely to become obscured by a mass of detail, that he is in danger of losing sight of those fundamental problems whose solution is essential to real progress. For that reason alone the Institution of Electrical Engineers is to be congratulated on arranging for a lecture on "Single and Three-Phase Alternating Current Commutator Motors with Series and Shunt Characteristics," and Dr. Stanley Parker Smith is to be felicitated on the way in which he marshalled and delivered his arguments. The fact that there is nothing new about these motors, that they were indeed invented, among others, by Mr. Alexander Siemens, Mr. Llewylyn Atkinson, and Prof. Ernest Wilson as long ago as the 'eighties and 'nineties, is an added reason for such an exploration as was conducted last week into the work of these pioneers, to discover whether some of their results, long forgotten because too often before their time, could not usefully be adapted to present-day conditions. Only within the past few weeks we have noted in our own columns two examples of such "re-discovery." This sort of thing is not only waste of the "re-discoverer's" time, but leads to conflicting claims to priority which are always unfortunate, and sometimes acrimonious.

A Necessary Clarification of Ideas.

There is no doubt from the course both of the lecture and the subsequent discussion that the development of alternating current supply, both for power and traction, has made the use of alternating current motors a necessity. A re-statement of the properties of these machines, and a candid discussion of their drawbacks (which they certainly received from Dr. Smith) is therefore advisable for the clarification of our ideas. Though at first sight it seems that we have in these motors all the disadvantages of both the d.c. and the induction motor, with a few peculiar ones thrown in, it has been demonstrated that nevertheless they are quite a commercial proposition. As Mr. Creedy showed (and no one is better able to demonstrate the facts than he) there is little to choose between alternating and direct current commutator motors on the scores of efficiency and price, while on the scores of weight and size the former has the advantage. It is to be hoped this lecture will be the forerunner of others, as well delivered, on equally interesting subjects.

Standardisation à la Mode.

In the course of the discussion at the Institution of Electrical Engineers on Dr. Stanley Parker Smith's lecture, Sir Philip Dawson let the cat out of the bag. He had only, he said, signed the report of the Railway Electrification Advisory Committee because it left a loophole for any railway company which did not wish to use the "standard" 1 500 V direct current system to apply to the Minister of Transport for permission to employ something else. From the very nature of things such standardisation as was recommended by the committee could only hope to be illusory, and we have always suspected that this standard system was no standard at all. Now our suspicions are confirmed. At the same time we are relieved to learn that even in official circles the door has not been shut to the admission of any system which future experience shows to be the best for particular conditions. As has often been pointed out, there is at the locomotive stage little to choose between the various systems available, while as regards the reduction in the number of sub-stations and the direct employment of high voltages the single-phase system has distinct advantages. As Sir Philip Dawson remarked, he and his system had been severely criticised for many years. Is the tide turning?

The Locomotive Drive Question.

An important question for designers is raised in Sir Vincent Raven's recent Paper before the North-East Coast Institution of Engineers and Shipbuilders. As in the case of the Paper which he read before the Engineering

Conference last summer, Sir Vincent was content to state the pros and cons of the various methods available, and to leave it at that. But it is interesting to note that on the new North-Eastern passenger locomotive the power is transmitted to the road wheels through a quill and gearing in accordance with British standard practice. On the other hand, as Dr. Stanley Parker Smith recently showed the connecting rod design is favoured in Switzerland, probably owing to the employment of the single-phase system, in which the use of larger motors than can be accommodated between the wheels is necessary. This, like many other similar matters, is a question to which, we feel, the answer must depend on the conditions present in each particular case. Are we, in fact, sure that British standard practice is the best, or are its presumed efficiency and simplicity illusory? This is a type of query, of which there are many connected with electric traction, which should receive full discussion in technical circles. In the meantime more polemical matters can well be relegated to the background.

The Present Financial Obstacle.

So great and obvious are the improvements which would follow the electrification of many sections of railway in this country that the only obstacle which prevents their conversion is finance. It is now well known that the electrification of suburban lines is justified by the increased revenue obtained. Unfortunately, though everything points to a similar result following the electrification of a steep gradient line over which heavy trains have to be hauled, there are no actual British figures that show that this would be the case, though American statistics are definite enough in this respect. It is perhaps only natural, then, that railway directorates should show a little hesitancy in these uncertain times to spend large sums of money without being assured that they will obtain satisfactory results. This, however, is but a passing phase. Conditions during 1922 will, we hope, lead to an extension of enterprise of this character. It is well that electrical engineers and manufacturers should be prepared for it.

The Physical Society Exhibition.

The annual exhibition of scientific apparatus jointly organised by the Physical Society of London and the Optical Society was held at the Imperial College of Science, South Kensington, on Wednesday and Thursday in last week. The account of the various exhibits, which we begin on another page of this issue, while it shows the influence of the war on the scope and design and manufacture of scientific instruments, also indicates that satisfactory progress is being made in the paths of peace. The organisers are to be congratulated on the collection of equipment they were able to bring together, and still more on the interest they were able to excite in the minds of those who cater for the public through the columns of the daily Press. Nearly all the London dailies had a shorter or longer account of the exhibition, and though these ranged from grave to gay, and from the inane to the dull, they were at least an indication of the growing realisation in the great world of the influence that scientific endeavour has on human existence. This in itself is a step forward. But much more remains to be done. We therefore hope that now a breach has been made in the wall, the attack will be quickly followed up.

The Marconi Marine Alarm.

As is well known, recent legislation has imposed upon shipowners the necessity of either providing an alarm which can be operated wirelessly by a second ship, in distress or desiring communication for other reasons, or of having an operator constantly in attendance to pick up such emergency messages. Except on the largest ships, the latter solution is obviously economically impossible, and much time has been spent, notably by the Marconi Company, in devising an arrangement which shall be efficient from both the wireless and seafaring point of view. On another page of this issue we describe the emergency alarm which was shown by the Marconi Company at the Physical Society Exhibition.

Details of the Alarm.

This alarm consists of an ingenious combination of the four electrode valve with electrical relay and clockwork time devices of the kind familiar in ordinary telegraphy to produce an apparatus which, if demonstrations are any guide, is amply capable of performing the duties imposed upon it. The problem to be solved, at first sight, seems to present no difficulties. But an alarm, to be an alarm, must only operate on certain definite occasions, and, in the case of a wireless alarm, must, therefore, be impervious to the effect of atmospherics and to a variety of other messages and signals of different wave lengths and strengths. It is these desiderata that introduce all the complications, and the Marconi Company are to be congratulated on the enterprise with which they have tackled, and the ingenuity with which they have overcome, the various problems involved.

An Error in Organisation.

In carrying out the electrification of British railways, work which we hope will soon be begun and continued at an accelerated pace, it is axiomatic that the railway companies should follow the advice of men closely acquainted with electrical progress and properly equipped with the necessary technical knowledge. The best way of doing this is to appoint a qualified electrical engineer directly responsible to the directorate, with the general manager as the only connecting link, and to give weight to his opinions at least equal to that which would be accorded to those of, say, the chief goods manager. For a railway is a complicated organisation whose affairs are not conducted in an atmosphere entirely free from jealousy and controversy, especially when matters affecting several departments come up for review.

A Retrograde Step.

We are therefore sorry to see that this essential has been forgotten in the reorganisation of the London and North-Western and Lancashire and Yorkshire Railway, which took place at the beginning of the year. Col. F. A. Cortez Leigh, lately chief electrical engineer of the former company, is now placed under Mr. Geo. Hughes, who combines the posts of chief mechanical and electrical engineer of the two systems. Col. Leigh also becomes a junior to Col. O'Brien, who has for some years been Mr. Hughes's electrical assistant on the Lancashire and Yorkshire Railway. Placing the personal aspect entirely on one side, we feel it is the greatest mistake to combine the mechanical and electrical departments under one head, and even greater to place an expert electrical engineer in a position where his talents cannot fail to lack their full utilisation. The result will be extremely harmful to a progressive department, and still more so to the railway companies concerned.

Amalgamation of Electricity Undertakings.

The announcement that the Liverpool Corporation have acquired the Electricity Supply undertakings of the Bootle

Corporation and the Liverpool District Lighting Company is an interesting item of news, and is a clear indication of the present trend of things in the supply branch of the electrical industry. Amalgamation and co-operation are found to be as advantageous in electricity supply as in other business undertakings, and, consequently, it is not surprising that the larger municipal and company undertakers are acquiring their smaller neighbours and extending their powers of supply into the rural areas. No doubt this will lead to economy in administration, and it will also assist the movement for reorganisation initiated by the Electricity Commissioners.

Electrical Details of the Areas.

The step taken by Liverpool should aid the negotiations for the creation of a Joint Electricity Authority for the West Lancashire and Mersey District, and, provided the Commissioners give their sanction to the purchase, arrangements can be made at once for unifying the supply in the whole of the Corporation's new area. This will not be a difficult matter, for supply is given in both Liverpool and Bootle on the d.c. three-wire system at 230 and 460 V, and a.c. at 230 and 400 V, while in the Liverpool District the supply is d.c. 220 and 440 V. At Liverpool energy is generated on the three-phase system at 6 600 V, 50 periods, and at Bootle the generation voltage is 3 300 V, three-phase, 50 periods; but at the Liverpool District Lighting Company's station there is only direct current plant.

Terms of Purchase.

Few details of the terms of purchase have been published, but as these have been approved by the Liverpool and Bootle Corporations by large majorities, there is likely to be little opposition to the scheme. As consideration for the transfer of the Bootle undertaking, the Corporation of Liverpool will pay in perpetuity an annuity of £7 500, and for the Liverpool District Company the annuity will be £4 000; but in the latter case the annuity can be commuted by paying £60 000 in cash, or by the issue of mortgages producing £3 600 a year. As the paid-up capital of the company is £60 000, and as a dividend of 5 per cent. was paid in 1919, it will be seen that the Corporation have acquired a progressive undertaking for a very reasonable figure.

Finance and Education.

The proceedings at recent meetings of those associations that have been established in the interests of the scholastic profession have been overshadowed by the Geddes report (as yet unpublished) hovering menacingly in the background. Taught by long experience, educationalists know only too well that the economy axe will fall first and with the sharpest strokes on their activities, and much objection and even panic are naturally the result. We feel, however, that much of the criticism of the new economic policy of the Government is being conducted from the wrong standpoint. No one (not even the politician when he thinks about it) wants to limit the scope or usefulness of education, but everyone, at least in his or her taxpaying capacity, wants to limit its cost. Such limitation need not necessarily reduce either its efficiency or its scope, for the expensive thing is not always the best.

No Reduction in Teachers' Salaries or Grants.

It is, moreover, common knowledge, especially among teachers, that far the greater proportion of the money spent on education finds its way into the pockets of the bureaucracy. It is that expenditure which should be cut down, and teachers would do well to assist in the operation. On the other hand, it is in the highest degree unwise that any reduction should be made in teachers' salaries. These are even now too low for efficiency. They should rather be raised sufficiently high to attract the best men and women into the profession, and the remainder should be ruthlessly weeded out. This is especially necessary in technical education, where, if real improvement is to be obtained, the emoluments of those engaged in this important work must equal those obtainable in commercial life. We see no reason why a better education cannot be obtained at a less cost than at present, and teachers, whether individually or through their associations, are working against their best interests in taking up any other standpoint. A memorandum to the Prime Minister from the Universities of Birmingham, Durham, Leeds, Liverpool, Manchester and Sheffield—a memorandum which is concurred in by the Vice-Chancellors of the Universities of Oxford, Cambridge, London, Bristol, Glasgow, Aberdeen, and Wales—urges the dangers of any reduction in the grants made by the Government to the Universities and University Colleges of Great Britain, and shows in no uncertain way that, to obtain efficient instruction, adequate financial support is necessary. We hope the Government will ponder well the arguments put forward.

French Products and British Engineers.

In a letter which we published in our Correspondence columns some weeks ago, Mr. C. T. Allan pleaded for the greater recognition of French products by British users, not to the exclusion of our own goods, but, rather, in preference to the output of other foreign countries. We are glad to learn that Mr. Allan's appeal has not been unsuccessful. French manufacturers are anxious to do business with English engineers, and the anxiety is reciprocated. It is a state of mind that is worth exploiting. The fine characteristics of our French neighbours in warfare were sufficiently well demonstrated during the years when their armies fought side by side by ours. But it is not sufficiently well recognised that those same characteristics are equally present among French engineers and commercial men; that, however, is the truth of the matter, and it is a point which in these days of national reconstruction should be used to mutual advantage.

Compensation for Loss of Employment.

It was early realised that the reorganisation of the electricity supply industry might mean loss of employment or reduction of status to certain individuals. For this reason Section 16 of the Electricity (Supply) Act provides that compensation may be given to those affected, and electricity supply engineers will therefore be interested in the decision which has just been come to by the Arbitrator in the Morley case—the first of its kind. At Morley the generating station was recently shut down, and a bulk supply taken from Leeds. Mr. J. E. Ellis, the chief engineer, and his assistant, Mr. J. Crisp, therefore claimed compensation for loss of status, and Mr. Ellis also claimed for the loss of fees for premium pupils. The Arbitrator, Sir Wm. Mackenzie, K.C., rejected the status claims, but allowed Mr. Ellis £140 compensation for the loss of pupils. The decision, which apparently was based on the fact that both claimants continued in the Corporation service at the salaries they were receiving when the generating station was shut down, does not err on the side of liberality. As the amount of the award is in the dis-

cretion of the Arbitrator, we suggest that an independent engineer would make a better arbitrator in such cases than a lawyer.

Electrical Engineers and the Election.

While electrical engineers are not primarily concerned with politics, a decision on the date at which we are to be troubled with a General Election will nevertheless be awaited with interest by our readers. At its best such an event does no good to trade, and at the present time matters are complicated by the difficulty of deciding how most efficiently by means of the vote to make the requirements of the electrical industry known to those who govern us. There is, however, one paramount interest which overrides every other—the reduction of taxation. So much is this recognised, that economy will certainly be a plank in every election platform. But the business men will take at its true value this sudden change of heart, and not overlook the fact that politicians have a way of trimming their sails to the wind when an election is imminent. Incidentally, the necessity for economy will conveniently be forgotten as soon as the ballot-boxes close. Electrical engineers would, therefore, do well to go warily and to select from the candidates before them the one who, irrespective of political complexion, can be most trusted to take the greatest interest in this serious matter. Past words and personal predilections are in these circumstances not a bad guide, and in any case it is the duty of every electrical engineer to impress on every candidate over whom he exercises any influence the terrible seriousness of failure to bring the national budget within a figure that the taxpayer can afford.

Radio Telegraphy and Telephony in 1921.

In contradistinction to other fields of electrical progress, 1921 was a very active year in wireless telegraphy and telephony, but the activity has chiefly taken the form of commercial progress. It was, like 1920, a year of consolidation. Full use, even now, has not been made of the great developments of the war period, but radio engineers have begun to select from amongst the hundreds of alternative arrangements those which may be applied most successfully to meet practical requirements. Few new inventions brightened the year. For some reasons, there is something to be thankful for in this; wireless designers are only just catching up with the technical progress that has been made during the last few years.

Wireless Societies.

The Wireless Section of the Institution of Electrical Engineers continued to be very successful, and the Papers read during the session were of a type which appeals to those actually engaged in wireless work. There has, ever since the section was formed, been a tendency to terminate the discussion hurriedly. Possibly this speaks well for the success of the meeting, but if a short discussion is imperative, it would appear that some means of lessening the abruptness of the adjournment might be devised without making the last few speakers feel they are unnecessarily prolonging the proceedings.

Amateur wireless societies have increased greatly in number, and there are now about eighty in existence, most of them being affiliated to the Wireless Society of London. Very interesting tests have recently been carried out, during which signals have been received in this country from American 1 kW valve sets.

Patent Litigation.

The past year saw a recommencement of patent litigation in connection with wireless telegraphy. The matters under dispute were of interest, but, with one exception, of only secondary importance. The air will, no doubt, be very much clearer when these cases are decided. Perhaps, for this reason, the litigation will have its beneficial effects. In the meanwhile, the various actions emphasise the great importance of patent work, which, though usually unproductive in itself, has a vital connection with a company's prosperity when competition is keen and litigation constantly in the air.

We cannot help feeling that much patent litigation could be saved if there were a more general dissemination of technical knowledge.

Patents and Monopolies.

The importance of patents has probably had a greater effect on wireless progress, not only in this country, but throughout the world, than on any other industry. For very many years the early basic patents enabled a monopoly to be maintained. No doubt the advantages resulting from such a monopoly were the just reward for much research and expenditure. Nevertheless, monopolies tend to stifle progress, and this has tended to some extent to be the case in this country. Within the last few years the basic wireless patents have expired, and the immediate result of the inevitable competition has been a general improvement of wireless apparatus and communications. The reaction has found expression in no half-hearted manner, and it is due not a little to the lapsing of important patents that the field of wireless in this country has been thrown open to competition to the benefit not only of shipowners, contractors and wireless engineers, but of the art of wireless itself.

The Need of Greater Publicity.

If more information were circulated throughout the world, there would be far fewer valid patents. Many a patent in this country would operate against an inventor from another country, where he may have used his invention for years, simply because he did not publish his results.

During the past year there have been a very large number of patents published in this country. Most of them have been from foreign countries, and date as far back as 1913. Some of them are very interesting, and corroborate our views that remarkably few basic inventions in connection with three-electrode valves have originated in this country. The early work of Langmuir and his colleagues is unfolded, and there is no doubt that the great bulk of the credit for early work in connection with valves must go to America. The reason for this is probably that from the very nature of the commercial position of wireless here before the war, there were very few investigators. The advent of these various patents, dating from early periods, will fortunately not affect most manufacturers in this country, as the patents are only granted on condition that they will not operate against those who were cognisant of the inventions during the war. It is to be regretted that very many of the 1921 patents were for mere details, or clearly obvious arrangements. Such patents hinder rather than assist progress, and are probably filed either to intimidate others, or to prevent intimidation.

New Inventions.

There were few inventions of importance published during the last year. One which has aroused considerable interest is the so-called "Negration," which, as its name implies, is a negative resistance valve. We understand that this valve, used as a continuous wave generator, has found a wide commercial application, particularly on board vessels of the mercantile marine. More recently, much has been heard of magnetic control thermionic valves for producing oscillations, although it is too early to say if they will find a practical application.

The Admiralty carried out a great deal of very valuable work in connection with high-powered valve transmitters. They successfully used multi-phase currents for supplying the anodes of transmitting valves without the use of rectifying valves. The installation at Horsea was very successful. It seems likely that the experience gained at that station will lead to a very much wider use of high-powered valve sets.

Automatic Call Devices.

The need for automatic call devices, particularly for S.O.S. calls, was greatly felt, but no national or international regulations have yet been put into force. It is undoubtedly necessary that smaller ships, which cannot afford to carry more than one operator, should be in possession of an automatic apparatus which will give an alarm on receipt of an S.O.S. signal. The Radio Communication Company have put on the market an apparatus which will respond to a ship's call letters or the letters S.O.S. The Marconi Company have more recently devised a very effective call device which responds to a series of dashes; this apparatus was shown at the Physical Society's exhibition last week, and is described in this issue of The Electrician.

Imperial Chain Communications.

The first station of the Imperial Wireless Chain, namely, Leafield, was opened towards the end of last year. The station is fitted with Elwell arcs, and is to work with a similar station near Cairo. The construction of these stations is in the hands of the British Post Office. Full details have been given in The Electrician.

There seems some little doubt as to the future of the chain of wireless stations, as some of the Dominions are in favour of direct communication with England, instead of through a number of relay stations. Australia, fortunately, is in favour of direct communication. The Marconi Company have offered to subscribe £500,000 towards a £1,000,000 company to be formed in partnership with the Commonwealth Government for erecting and maintaining a high-powered station in Australia; the Radio Communication Company have offered to undertake the erection of a station on an ordinary contracting basis. Whichever scheme is adopted, it seems likely that direct communication with Australia will soon be an accomplished fact. Even at present, the signals from the stations at Leafield and Carnarvon can be received for limited periods in Australia.

High-Power Valves.

In connection with the Imperial Chain, it will be remembered that the Technical Committee recommended the use of high-powered valve installations. A considerable amount of very valuable work has been carried out in the past year by the British Admiralty, working in conjunction with the Mullard Radio Valve Company. Much progress has been made in the construction of silica valves, which have now been made in 10 kW sizes. The result of this work will undoubtedly be seen in the forthcoming year. We may expect to see a large number of land stations operating on valves of large power.

Direction Finding.

During the past year there were few published developments in connection with direction finding. The British Post Office is becoming interested, and it is likely that in the near future coast stations will be fitted with D.F. gear. Slow progress was made in the mercantile marine, but it is likely that when general business prospects are brighter there will be many more ships fitted than at present. The Robinson direction-finder system proved as successful on board ship as for the navigation of aircraft.

Land Stations.

Turning to the consideration of land stations, the most important development was undoubtedly the opening of the Long Island station, near New York, which is equipped with Alexanderson alternators. This station will be a central station, having a number of radial antennæ and several alternators which may be connected in parallel. When complete, it will be the most powerful in the world. At present only a portion of the station is complete and working, but communication with Europe is already proceeding satisfactorily.

The Marconi stations at Clifden and Carnarvon are both fitted with valve sets which have given very good results. In connection with high-powered installations, this company has carried out some remarkably good work in connection with "earth screens," which is the name they give to what most people have called "balanced capacity" earths. Although the idea of these "earths" is old, yet we cannot help but admire the work of those who have shown us the great advantages which attend the use of these earth connections in modern high-powered installations.

Turning to the smaller-powered stations, it seems likely that some of the apparatus of the British coast stations will be replaced by modern and up-to-date sets. The Marconi transmitter at North Foreland (probably the hardest-worked coast station in the world) has already been replaced by one of the Radio Communication Company's standard sets.

Radio Telephony.

Wireless telephony made, in some quarters, great strides, but very little was heard of any general progress. Although there is always a strong appeal to the imagination of the public, wireless telephones will probably find few applications in this country, apart from aircraft. Communication with foreign countries may, however, soon become an accomplished fact, and some kind of a service has already been tried between London and Holland. Experiments in using wireless telephony in conjunction with ordinary land lines have given good results, and by using two different wave-lengths speech has been carried on as effectively as if the ordinary land line system were in use.

Possible Future Developments.

As regards future developments, the problem of atmospheric elimination has not yet been solved, or, at any rate, there has been no publication of any results, except, of course, the perennial announcements of transcendental developments in connection with wireless research. Whatever has been achieved, there are no signs yet of the very high powers still used in longe-range communication being materially cut down. We are hoping that this—the greatest modern problem in wireless communication—will be solved in the very near future.

Electric Winding Engines and Mine Hoists.*

Some Notes on Double Helical Gearing.

By H. H. BROUGHTON.

The author has collected a series of notes on the strength of helical gearing, as well as particulars of a number of individual gears, with the idea of providing the user of such gears with data by which he can check the designs of the gearing manufacturers. In the second part of the article published below the properties of typical gears are described and compared.

(*Concluded from page 7.*)

Typical Gears.

For a considerable time the author has been collecting data on large gears with the object of being able quickly to prepare rough estimates and to check the gears called for in various specifications. Although the actual design of the gears is best left to the gear specialist it is, nevertheless, highly desirable that the user should be in a position to compare proposed gears with those which are known to have given satisfaction on similar duty.

In Tables II. and III. are set out technical data of a number of helical gears that have been used during recent years for winders and haulages. The gears given in Table II. are of Citroen make, and those in Table III. are of the Power Plant Company's make.

To facilitate transport, and to admit of easy erection, large wheels are often made in two or more pieces. A typical split wheel is illustrated in Fig. 3, and attention is directed to the method of registering the two halves by means of tool-steel ferrules, located as shown, at opposite ends of a diameter.

Inertia.

For a helical or herring-bone gear of given dimensions the moment of inertia of the teeth may be figured as 40 per cent. of a hollow cylinder of the limiting dimensions, and the rim (exclusive of teeth) may be figured as a hollow cylinder. Adding 25 per cent. to the sum of these two moments of inertia will make the necessary allowance for the hub and arms of the wheel.

If the weight and pitch diameter only are given, the moment of inertia may be considered to be the moment of inertia due to 60 per cent. of the total weight concentrated at the pitch circle.

Example.—It is required to determine the approximate value of the equivalent moment of inertia (reduced to the wheel shaft†) of the pair of wheels given under Ref. No. 6 in Table III.

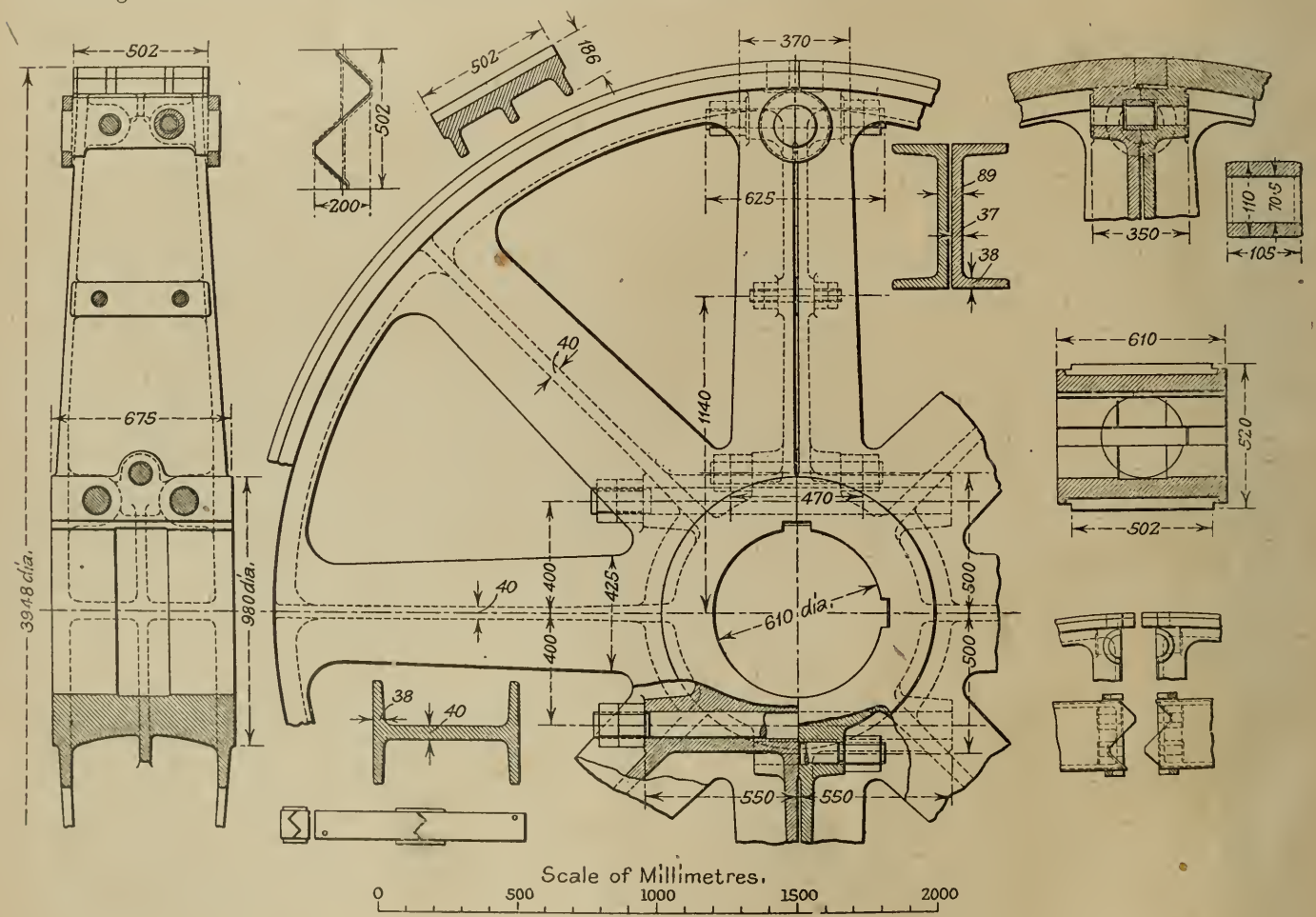


Fig. 3.—Typical Split Double-Helical Wheel.

The constants are:

Diameter of wheel	$= 131 \div 12 = 10{\cdot}92$ ft.
Weight of wheel	$= 8{\cdot}85 \times 2\,240 = 19\,000$ lb.
Diameter of pinion	$= 22 \div 12 = 1{\cdot}83$ ft.
Weight of pinion	$= 0{\cdot}65 \times 2\,240 = 1\,460$ lb.
Gear ratio	$= 6$ to 1

The moment of inertia of the wheel about its own axis is:

$$I_\omega = 0{\cdot}60 \times 19\,900 \times \left(\frac{10{\cdot}92}{2}\right)^2 \div 32{\cdot}2$$
$$= 11\,000$$

As the pinion is a solid forging having a pitch diameter of 1·83 ft., it follows that the radius of gyration will be

† In winders calculations it is usual to "reduce" inertia moments, &c., to drum shaft.

Table II.—*Particulars of "Citroen" Gears.*

Ref. No.	Horse Power. Max. a	Horse Power. Normal. b	Ratio. a/b	Speeds. r.p.m. Pinion. c	Speeds. r.p.m. Wheel	Gear Ratio.	Pitch-line Speed. m. per min.	H.P. per rev. b/c	Wheel. Diam. mm.	Wheel. No. of Teeth.	Wheel. Circular Pitch. mm.	Wheel. Width. mm.	Wheel. Bore. mm.	Wheel. Width of Boss. mm.	Wheel. Material.	Wheel. Weight tons.	Wheel. Keyways. No.	Wheel. Keyways. Size. mm.	Pinion. Diam. mm.	Pinion. No. of Teeth.	Pinion. Bore. mm.	Pinion. Width of Boss. mm.	Pinion. Material.	Pinion. Weight tons.	Pinion. Keyways. No.	Pinion. Keyways. Size. mm.	Put into Service.
1	1 000	—	—	150	32·2	4·67	405	(6·66)	4 014·8	177	71·2	374·64	355·6	570	C.S.	9·60	2	82·5 × 27·2	861·9	38	215·9	374·6	C.S.	1·00	1	53·9 × 16·7	1912
2	1 430	—	—	230	42·2	5·46	388	(6·23)	2 940·7	120	76·9	381	469·9	550	C.S.	5·93	1	114·3 × 36·5	539·1	22	228·6	381	C.S.	0·54	1	53·9 × 19	1913
3	—	465	—	98	20·7	4·73	182	4·75	2 795	142	61·7	304·8	304·8	457·2	C.S.	3·44	2	76 × 25·4	590·7	30	203·2	304·8	F.S.	0·57	2	50·5 × 23·8	1911
4	1 000	640	1·56	248	41·3	6·00	383	2·58	2 964	156	59·6	340	290	380	C.S.	3·32	—	—	494	26	185	380	F.S.	0·46	—	—	1912
5	—	550	—	300	60	5·00	472	1·83	2 500	140	56	270	385	500	C.S.	3·48	—	—	500	28	186	270	F.S.	0·38	1	60 × 12	1910
6	1 400	600	2·33	360	78·2	4·61	673	1·67	2 744·2	152	56·6	330·2	355·6	430	C.S.	3·68	2	87 × 25·8	595·8	33	203·2	330·2	F.S.	0·45	2	50 × 15·8	1912
7	1 025	410	2 50	290	83	3·50	383	1·42	1 471·8	84	55	295·3	177·8	350	C.S.	1·46	1	47·6 × 21	420·5	24	152·4	295·3	F.S.	0·28	1	41·3 × 17·9	1912
8	—	310	—	229	22·4	10·25	216	1·36	3 068·6	164	58·7	292·1	304·8	450	C.S.	4·10	2	79·3 × 25	299·4	16	165·1	292·1	F.S.	0·11	2	44·4 × 14	1913
9	—	300	—	224	32	7·00	187	1·34	1 866·9	105	55·75	355·6	266·7	430	C.S.	2·21	1	66·6 × 25	266·7	15	152·4	355·6	F.S.	0·10	1	38·1 × 12·4	1912
10	400	250	1·60	205	17·1	12·00	165	1·22	3 072	192	50·2	400	350	480	C.S.	5·02	2	100 × 30	256	16	Solid with shaft.		F.S.	0·34	—	—	1912
11	—	465	—	500	97·8	5·11	540	0·93	1 762·9	143	38·7	254	203·2	304·8	C.S.	0·96	2	50·5 × 23·8	345·2	28	139·7	254	F.S.	0·15	2	38 × 12·7	1911
12	650	260	2·50	290	56·7	5·12	362	0·90	2 040	128	50	219	203·2	244·5	C.S.	1·63	1	54 × 19	398·4	25	127	219	F.S.	0·20	1	35 × 15	1912
13	—	250	—	285	37·2	7·67	236	0·88	2 019·4	92	68·8	304·8	228·6	406·4	C.S.	1·25	2	54 × 23	263·4	12	133·4	392	F.S.	0·12	1	29 × 17	1912
14	600	—	—	375	69·8	5·37	413	(1·60)	1 884	118	50	228·6	279·4	370	C.S.	1·78	1	70 × 31	351·3	22	152·4	420	C.S.	0·22	2	38 × 20·1	1912
15	—	300	—	353	70·6	5·00	365	0·85	1 651	100	51·8	165·1	203·2	231	C.S.	0·72	1	54 × 19	330·2	20	133·4	165·1	F.S.	0·10	1	35 × 19·7	—
16	800	390	2·05	490	64·2	7·65	508	0·80	2 520	168	47	300	320	400	C.S.	3·00	—	—	330	22	Solid with shaft.		F.S.	0·53	—	—	—
17	800	390	2·05	490	54·4	9·00	508	0·80	2 970	198	47	300	320	400	C.S.	3·70	—	—	330	22	Solid with shaft.		F.S.	0·50	—	—	—
18	700	390	1·80	490	70	7·00	554	0·80	2 520	168	47	300	320	400	C.S.	3·00	—	—	360	24	Solid with shaft.		F.S.	0·57	—	—	—
19	—	250	—	350	66·7	5·26	375	0·72	1 792	126	44·7	184·2	203·2	260	C.S.	0·84	1	54 × 19	341·4	24	127	184·2	F.S.	0·11	1	35 × 13	1913
20	350	250	1·40	360	36	10·00	288	0·69	2 550	170	47·1	250	220	350	C.S.	2·04	—	—	255	17	Solid with shaft.		F.S.	0·25	—	—	1912
21	500	335	1·45	485	52·3	9·30	414	0·69	2 528	158	50·2	192	210	280	C.S.	1·76	2	50 × 16	272	17	140	240	F.S.	0·75	1	40 × 12	1912
22	300	200	1·50	315	71·2	4·50	417	0·64	1 871	184	31·9	240	180	314	C.S.	1·00	1	51 × 15	416·9	41	135	268	F.S.	0·35	1	22 × 11	1912
23	200	150	1·33	240	24	10·00	194	0·63	2 582	120	67·5	320	225	460	C.I.	3·32	—	—	258·2	12	Solid with shaft.		F.S.	0·24	—	—	1912
24	150	68	2·21	120	27·1	4·43	186	0·57	2 196	168	40·8	161·9	228·6	260	C.S.	0·98	1	60 × 21	496·7	38	152·4	161·9	F.S.	0·25	1	41 × 15	1913
25	—	80	—	160	40	4·00	121	0·50	965·2	64	47·3	181	152·4	197	C.S.	0·35	1	41 × 15	241·3	16	114·3	181	F.S.	—	1	32 × 11	1914
26	300	—	—	360	40	9·00	344	(0·83)	2 743	162	53·1	206·4	228·6	350	C.S.	1·99	4	51 × 22	304·8	18	127	206	F.S.	0·10	1	32 × 11	1913
27	450	192	2·35	425	35·4	12·00	302	0·45	2 717	168	50·7	196·8	292·1	305	C.S.	1·92	2	73 × 21	226·4	14	127	197	F.S.	0·41	1	35 × 12	1912
28	—	200	—	500	83·3	6·00	396	0·40	1 524	126	37·9	165·1	203·2	250	C.S.	0·65	2	44 × 17	254·0	21	127	165	F.S.	0·05	2	25 × 11	1912
29	115	110	1·32	300	20·3	14·87	182	0·37	2 856	208	43·1	174·6	254	310	C.S.	1·80	1	67 × 24	192·2	14	Solid with shaft.		F.S.	0·54	—	—	1913
30	205	165	1·24	620	77·5	8·00	390	0·27	1 600	80	62·8	240	150	300	C.I.	1·08	1	42 × 15	200	10	Solid with shaft.		F.S.	0·13	—	—	1912
31	272	110	2·47	425	46	9·24	329	0·26	2 280	120	59·6	270	225	360	C.I.	2·11	2	50 × 23	247	13	Solid with shaft.		F.S.	0·20	—	—	1912
32	160	140	1·14	580	103·7	5·62	356	0·24	1 095	73	47·1	185	170	240	C.I.	0·46	1	42 × 14	195	13	100	200	F.S.	0·03	1	33 × 11	1912
33	260	156	1·67	690	112	6·16	517	0·23	1 462	86	53·3	205	170	250	C.I.	0·67	2	40 × 19	238	14	120	205	F.S.	0·06	1	36 × 12	1912
34	180	90	2·00	560	80	7·00	303	0·16	1 208	84	45·2	160	165	220	C.S.	0·40	2	42 × 11	172·5	12	Solid with shaft.		F.S.	—	—	—	1912
35	180	100	1·80	650	57·1	11·38	426	0·15	2 375	125	59·6	250	210	300	C.I.	1 74	2	48 × 23	209	11	Solid with shaft.		F.S.	0·13	—	—	1912
36	123	110	1·12	730	93·6	7·80	367	0·15	1 248	78	50·2	200	135	240	C.I.	—	1	40 × 11	160	10	Solid with shaft.		F.S.	—	—	—	1912
37	140	—		580	104	5·62	358	(0·24)	1 095	73	47·1	185	170	240	C.I.	0·47	1	28 × 14	195	13	100	200	C.I.	0·32	1	33 × 11	1909
38	235	110	2·14	730	140	5·23	530	0·15	1 205	73	51·75	200	160	280	C.I.	0·57	2	38 × 18	231	14	110	200	F.S.	0·02	1	33 × 11	1912
39	100	50	2·00	360	24	15·00	140	0·14	1 857	180	32·4	146	191	178	C.S.	0·61	1	14 × 5	123·8	12	Solid with shaft.		F.S.	0·04	—	—	1912
40	—	80	—	720	160	4·50	495	0·11	987·1	81	38·2	191	114	216	C.I.	0·36	1	32 × 11	219·4	18	88·9	191	F.S.	0·04	1	25 × 10	1914
41	120	100	1·20	960	143·5	6·71	328	0·10	728·5	47	48·7	220	110	220	C.I.	0·38	—	—	108·5	7	Solid with shaft.		F.S.	0·15	—	—	1911
42	150	68	2·21	720	120	6·00	460	0·09	1 219	84	45·6	216	152	280	C.I.	0·61	1	41 × 15	203·2	14	101·6	216	F.S.	0·04	1	29 × 10	1913
43	75	50	1·50	582	98·6	5·92	241	0·09	780	65	37·7	145	130	180	C.I.	0·18	1	36 × 12	132	11	60	145	F.S.	0·01	1	18 × 4	1918
44	—	40	—	960	109	8·80	301	0·04	880	88	31·4	120	85	150	C.I.	0·16	—	—	100	10	Solid with shaft.		F.S.	0·03	—	—	1912
45	42	—	—	720	72	10·00	260	(0·06)	1 150	100	36·1	145	100	160	C.I.	0·29	—	—	115	10	Solid with shaft.		F.S.	0·04	—	—	1912
46	36	25	1·41	1 440	192	7·50	487	0·02	810	90	28·2	110	75	110	C.I.	0·12	1	25 × 9	108	12	52	110	F.S.		1	14 × 4	1913
47	—	4	—	950	126	7·56	230	0·001	581	83	22	85	55	95	C.I.	0·05	—	—	77	11	30	77	F.S.	—	—	—	1913

Table III.—*Particulars of Double Helical Gears for Winders and Haulages.*

Ref. No.	Horse Power. Max. *a*	Horse Power. Normal. *b*	Ratio *a* ÷ *b*	Speeds, r.p.m. Pinion. *c*	Speeds, r.p.m. Wheel	Gear ratio.	Pitch-line speed. ft. per min.	H.P. per F.W. *b* ÷ *c*	Wheel. Diam. in.	Wheel. No. of teeth.	Wheel. Diam. Pitch No.	Wheel. Width. in.	Wheel. Bore. in.	Wheel. Width of boss. in.	Wheel. Material.	Wheel. Weight. Tons.	Wheel. Keyways. No.	Wheel. Keyways. Size. in.	Pinion. Diam. in.	Pinion. No. of teeth.	Pinion. Bore. in.	Pinion. Width of boss, in.	Pinion. Material.	Pinion. Weight Tons.	Pinion. Keyways. No.	Pinion. Keyways. Size. in.	Put into service.
1	1 600	1 100	1·45	366	34·5	10·6	1 140	3·01	135 3/8	169	1 1/4	23	14	32	C.S.	12·55	2	2 3/4 × 7/8	12 1/2	16	Solid with shaft		F.S.	1·10	—	—	1919
2	650	550	1·18	225	37·2	6·1	940	2·45	96 3/4	121	1 1/4	17	12	12	C.S.	5·55	1	3 3/4 × 1 5/16	16	20	9	17	N.S.	0·30	1	2 1/2 × 1/2	1913
3	625	500	1·25	250	37·1	9·2	956	2·00	135 1/2	203	1 1/2	16	13	16	C.S.	7·50	2	3 × 1	14 5/8	22	7	16	F.S.	0·28	2	1 3/4 × 3/8	1913
4	525	450	1·17	240	38·9	6·2	1 210	1·88	119 1/16	179	1 1/2	15	14	21	C.S.	6·80	1	3 1/4 × 1	19 1/4	29	7	15	F.S.	0·48	1	1 3/4 × 3/8	1912
5	625	500	1·25	290	27·9	10·4	820	1·72	110 5/16	166	1 1/2	18	11 1/4	22	C.S.	6·05	2	2 1/2 × 7/8	10 3/4	16	Solid with shaft.	18	F.S.	0·44	—	—	1917
6	950	600	1·58	360	60·5	6·0	2 070	1·67	131	131	1	18	12	24	C.S.	8·85	2	3 1/2 × 1	22	22	10 3/4	18	F.S.	0·65	2	2 3/4 × 3/8	1913
7	670	575	1·16	360	63·2	5·7	1 630	1·60	98 3/32	148	1 1/2	15	14	15	C.S.	3·95	2	3 1/4 × 1	17 1/8	26	8	15	F.S.	0·41	1	2 1/4 × 1/2	1909
8	375	310	1·21	195	16·9	11·6	586	1·59	130 7/16	196	1 1/2	17	14	21	C.S.	7·95	2	3 1/2 × 1 1/4	11 3/8	17	Solid with shaft.		F.S.	0·50	—	—	1913
9	700	600	1·16	400	13·7	10·2	1 200	1·50	115 3/8	173	1 1/2	15	12	15	C.S.	5·00	1	3 1/4 × 1 1/8	11 1/8	17	6 1/2	15	F.S.	0·18	1	1 3/4 × 3/8	1913
10	370	312	1·12	255	26·9	9·5	870	1·45	124	217	1 3/4	15	14	20	C.S.	5·25	1	3 1/2 × 1 1/8	13 7/8	23	7	15	F.S.	0·19	1	2 × 3/4	1916
11	245	200	1·23	140	20·0	7·0	600	1·43	116	203	1 3/4	12	12	18	C.S.	4·35	1	3 1/4 × 1 1/4	16 7/8	29	7 1/2	12	F.S.	0·26	1	2 1/4 × 3/4	1913
12	215	180	1·20	136	22·5	6·1	452	1·32	76 1/2	115	1 1/2	16	9	16	C.S.	3·10	1	2 1/4 × 5/8	12 5/8	19	6 1/2	16	F.S.	0·21	1	1 5/8 × 3/8	1911
13	575	450	1·28	390	50·7	7·7	1 300	1·15	97 1/32	146	1 1/2	14 1/2	11 1/2	16	C.S.	3·50	2	2 1/4 × 3/4	13 3/8	19	6	14 1/2	F.S.	0·18	1	1 1/2 × 3/8	1919
14	725	440	1·65	380	69·8	5·5	1 310	1·16	72 23/32	109	1 1/2	13 1/2	11	16	C.S.	2·65	1	2 1/4 × 1/2	13 3/8	20	6	24	C.S.	0·31	2	1 1/2 × 3/8	1914
15	650	540	1·20	495	70·4	7·0	1 900	1·09	103 1/16	155	1 1/2	15	9 7/8	15	C.S.	4·40	1	2 1/4 × 1	14 3/8	22	6	15	F.S.	0·26	2	1 1/2 × 3/8	1913
16	675	500	1·35	485	63·8	7·6	1 780	1·03	106 3/32	160	1 1/2	12 1/2	13 1/2	—	C.S.	3·80	2	1 3/4 × 3/4	14	21	7	12 1/2	F.S.	0·18	2	1 1/2 × 3/8	1913
17	350	300	1·17	385	43·8	8·8	1 460	0·78	127 1/32	255	2	10 3/32	11 7/8	Ring	C.S.	1·80	—	Ring	14 1/4	29	5 1/2	10 1/2	F.S.	0·20	1	1 3/4 × 5/8	1913
18	400	150	2·67	233	30·3	7·7	1 000	0·64	127 3/32	223	1 3/4	12 3/32	9	14 1/2	C.S.	4·95	1	2 3/8 × 7/8	16 7/8	29	4 1/2	12 1/2	F.S.	0·30	1	1 1/2 × 1/2	1911
19	300	250	1·20	460	30·2	15·2	920	0·54	141 1/2	229	2	12 3/32	10	14	C.S.	3·50	1	2 1/4 × 1 3/8	7 3/4	15	Solid with shaft.		F.S.	0·15	—	—	1915
20	215	180	1·20	385	72·0	5·4	1 710	0·47	91	182	2	9 1/2	7 1/2	9 1/2	C.S.	2·70	1	2 × 3/8	17	34	5	9 1/2	F.S.	0·25	1	1 3/8 × 7/16	1912

approximately 0·66 ft., and the inertia about the axis of the pinion will therefore be :

$$I_p = 1\,460 \times 0{\cdot}66^2 \div 32{\cdot}2$$
$$= 19{\cdot}8.$$

Since the gear ratio is 6 to 1, the *equivalent inertia* about the axis of the wheel will be :

$$I = 19{\cdot}8 \times 6^2 = 710.$$

Hence, the total equivalent inertia

$$I_e = 11\,000 + 710 = 11\,710.$$

Comparison of Gears for a Given Duty.

It may be thought that for a pair of wheels transmitting a given amount of power at a definite speed the tooth pitch and width would be more or less standardised ; in other words, that the weights of gears by different makers would be approximately equal.

That such is not the case is evident from an inspection of Table IV., in which are set out the principal particulars of a pair of wheels for which four specialist firms were asked to quote. The enquiry called for 6·89 to 1 gears capable of transmitting a maximum load of 1 780 H.P., the motor rating being 1 150 H.P. at 365 revs. per min. ; and makers were asked to state the pitch and width of gears covered by their quotation. It will be noted that as one extreme we have a tooth of relatively coarse pitch (3 in.), and narrow in width (12¼ in.), and as the other extreme, a tooth of relatively fine pitch (1·57 in.), and 25 in. in width. Other things being equal, the load which can be carried by a tooth is proportional to the product of pitch and width. Thus, in the case of the wheel first mentioned, Firm A, the product is 36·75 ; and in the wheel put forward by Firm B the product is 67·5, or 84 per cent. higher than A.

In addition to the effect of the formula to which the teeth are designed, the product of pitch and width varies directly as the factor of safety. It may be of interest to mention that it was the practice of Firm A till quite recently to allow a factor of safety of 10 on *peak loads*. In the case under notice this corresponds to a factor of safety of 15·5 on the rated H.P. of the motor. It should be remembered that such high factors are necessary for securing durability, and not for securing strength or safety. In other words, the factor is a *factor of durability* as distinct from safety. By adopting improved methods of manufacture and by careful selection of pinion material, a factor of safety of 5 or 6 reckoned on peak loads may be regarded as sufficient to ensure satisfactory service.

Table IV.—*Comparison of Gears by Different Makers for a Given Duty.**

Rating : 1 150/1 780 H.P. ; Speeds, 365 and 53 r.p.m. ; Gear ratio, 6·89 : 1.

	Maker. A	B	C	D
Teeth in wheel	124	172	206	248
Teeth in pinion	18	25	30	36
Pitch, *P* in	3	No. 1¼ (2¼)	2	No. 2 (1·57)
Width of face, *W* in.	12¼	27	24	25
Diameter of wheel, in.	118·8	137·6	131·2	124
Diameter of pinion, in.	17·2	20	19·1	18
Peripheral speed, *S* ft. per min.	1 650	1 910	1 820	1 720
Velocity coefficient, *v*.	0·0055	0·0052	0·0053	0·0054
Material of wheel	Cast steel	Cast steel	Cast steel	Cast steel
Material of pinion	Special hard steel	High carbon stl.	Cast steel	High carbon stl.
Tooth-shape coef *a*. Wheel	1·17	1·20	1·20	1·20
Tooth-shape coef *a*. Pinion	0·86	0·97	1·01	1·04
Shaft centres, in.	68	78·8	75·1	71
Actual gear ratio	6·89	6·88	6·87	6·89
Type				
Ratio *W* ÷ *P*	4·1	10·8	12·0	16·0
Product *P* × *W*	36·75	67·5	48·0	39·25
Cost of gears	£1 183	£1 915	£2 875	£1 300
Cost of sheet-steel gear case	£200	£175	£700	—
Packing for shipment	Included	5 per cent. extra	Included	—
Approximate weight of wheel	4·75 tons	—	—	—

* The figures given in this table are taken from estimates obtained in March, 1920.

Equally interesting are the costs. These cover the supply of unmounted wheel and pinion. One of the gears is of French manufacture and the remainder are of British make.

Specifications.

One of the best specifications for heavy gears of which the author has knowledge is that recommended by a committee of the American Electric Railway Engineering Association. The specification is as follows :

Wheels.—Castings to be of open-hearth steel or other approved process. They must be free from shrinkage cracks and spongy portions. The design of wheel must be such as to minimise shrinkage stresses. The unfinished surfaces must be reasonably smooth and free from sand and scale. The finished surface of the teeth and the finished rim below the teeth should be reasonably free from sand holes or blow holes, and must not fall below specifications as given below. No tooth or finished surface between teeth should have sand holes or blow holes which will reduce the strength of the tooth more than 10 per cent. on motors of 100 H.P. or under, or more than 7½ per cent. for motors of 100 H.P. or over. When sand holes are detected in a tooth, a chisel with $\frac{3}{16}$-in. cutting edge should be used to determine the depth and extent, as frequently a hole which appears on the surface to be very small will be found to contain a great deal of sand. In case of blow holes the chisel should be used to open them up if possible, and then a small piece of flexible wire inserted to find the extent of the cavity to which they lead. If this cavity enlarges under a tooth or between teeth in such a manner as to affect the strength of the tooth to the extent mentioned above, the gear will be rejected. The other portions of the wheel must not contain gas, shrinkage or sand holes to affect the strength of these portions more than 10 per cent. It is the practice of some manufacturers of gears to fill gas or shrinkage holes with a mixture or compound which greatly resembles the metal itself.* This does not add to the strength of the tooth or wheel, and prevents the above inspection being made. The committee, therefore, recommend that any wheels so treated be rejected . . . The thickness of the teeth, compared one with another, must not vary more than 0·01 in. and thickness at correct pitch line must not exceed the correct thickness and must not be below the correct thickness by more than 0·010 in. . . . All gears should be stamped with the name of the manufacturer and date of manufacture in a place not subject to wear and where the same can be seen without removal of the gear.† The steel must not contain more than 0·06 per cent. of sulphur or of phosphorus, and must have the following physical properties : Tensile or ultimate strength not less than 60 000 lb. per sq. in. ; elastic limit or yield point not less than 27 000 lb. per sq. in. ; elongation in 2 in. not less than 15 per cent. ; reduction of area not less than 20 per cent.

Pinions.—Finished surface of teeth must be absolutely free from flaws of any kind. The thickness of teeth, compared one with another, must not vary more than 0·010 in., and thickness at correct pitch line must not exceed the correct thickness and must not run below correct thickness by more than 0·010 in. . . . The name of the manufacturer and date of manufacture should be stamped on the pinion in a place not subject to wear.† . . . Their physical characteristics should be as follows : Tensile strength, 110 000 lb. per sq. in. (minimum) ; elastic limit, 70 000 lb. per sq. in. (minimum) ; elongation in 2 in., 15 per cent. ; reduction of area, 20 per cent.

* No blow-holes or cracks should be filled up by electric welding before the castings have been inspected, and then only with the entire approval of the inspector.

† The correct pitch circles should be clearly marked on each side of the gear faces.

Notes on the Duplex Balancing of Long Submarine Cables.

By E. S. HEURTLEY.

The duplex balancing of long submarine cables has been made more difficult in recent years by the introduction of "magnifiers." These, in raising the speed constants from a maximum of 600 up to 1000 and over, have, in effect, necessitated the employment of a receiving instrument of much greater sensibility than has hitherto been used. This sensibility has reached such a point at the present time

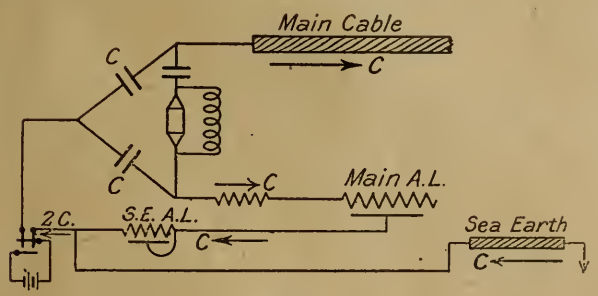


Fig. 1.

that difficulty occurs with the stability of the balance, and, even allowing for the marked improvement in this respect due to the introduction of non-temperature co-efficient artificial lines, yet the number of times that the balance needs adjustment in the twenty-four hours frequently places a limit on the degree of amplification which can be beneficially employed.

The modern practice in the case of cables of high KR is to employ a sea earth of considerable length, say ten nautical miles, in order to overcome disturbances. The earth conductor is usually twinned up with the main cable conductor, the two being covered with the protecting sheathing.

Connections for Use of Sea Earth.

The question arises as to the best method of employing this sea earth in the duplex balance, and, in considering this matter, the following points must be borne in mind :—

1. Freedom of the receiving instrument from extraneous disturbances.
2. Stability of balance.
3. Interference of the circuit on other circuits in the vicinity.

Normal Method.

The normal method of connecting up a duplex cable working "double block" is shown in Fig. 1, the arrows denoting the relative direction of the currents in the various circuits. The following points should be noted :—

1. The currents in the cable and in the sea earth are in opposite directions.
2. The earth acts as a return path for the current in the cable, and consequently any change in the resistance of the sea earth has the same effect on the balance as a similar change of resistance at the beginning of the cable.
3. The battery earth lead being part of the balanced circuit, it is absolutely essential that the sending battery and all apparatus should be maintained in a permanent state of insulation.
4. The currents in the cable and in the sea earth leads being equal in intensity and opposite in direction, the cable is neutral in its effect on other circuits in the vicinity for the distance covered by the sea earth

Alternative Method.

Fig. 2 shows an alternative method of utilising the sea earth. In this arrangement the sea earth is connected direct to the earth plate of the artificial line, and a local earth is used on the sending apparatus. This system is by no means

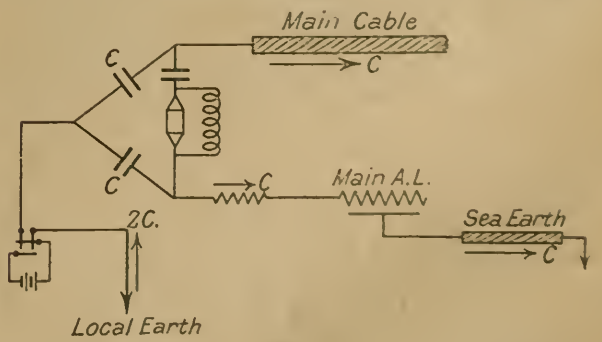


Fig. 2.

novel, having been used for a considerable period for various reasons by certain telegraph companies.

Its particular merits are not, perhaps, clearly understood, and it may be useful to mention the following points in regard

to this method of connection as compared with that depicted in Fig. 1 :—

1. The currents in the cable and in the sea earth are in the same direction.

2. The sea earth acts as a direct lead for the earth plate of the artificial line, and all the current which enters into the artificial line passes through the sea earth. Consequently, any change in the resistance of the latter affects the balance in an opposite sense to a similar change of resistance at the beginning of the cable.

3. The battery earth lead not being in a balanced circuit, good insulation of the battery and sending circuit is not important, and its variation has no effect on the steadiness of the balance.

4. When balance is obtained, and assuming equal R/S values for cable and artificial line, the currents in the cable and sea earth are equal in intensity, but, being in the same direction in both cores, the circuit

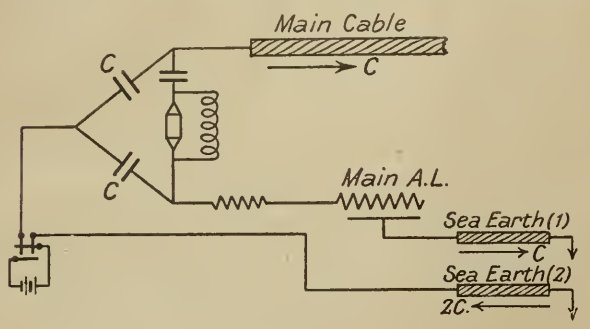


Fig. 3.

is not neutral in its effect on other circuits, and the disturbing effect *due to induction* is double that given by a single cable using a local earth.

5. Any variations in E.M.F. in the local earth enter the apex of the bridge in the same way as the current from the sending battery, and if balance is maintained it has no effect on the receiving instrument at the near station.

In the above points, paragraphs 2 and 3 outline very valuable assets in the maintenance of a stable balance on a long submarine cable.

Merits of Alternative Method.

Referring to paragraph 2, we have here an automatic compensation in the balance for changes of resistance due to temperature changes in the first part of the cable covered by the sea earth. For any change of resistance in the cable due to this cause means a similar change in the earth lead (assuming the cores to be of the same dimensions). Paragraph 3 secures that the state of the insulation of the part of the circuit which is undoubtedly the most difficult to maintain in good order (viz. :—the sending battery and apparatus)

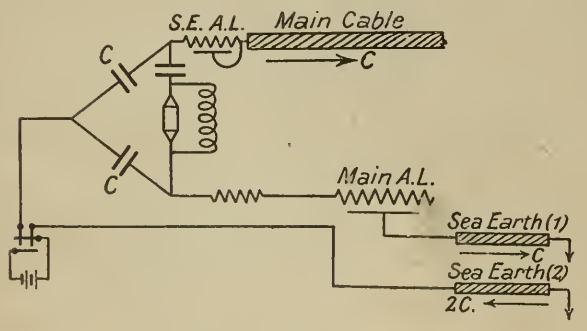


Fig. 4.

is immaterial to the maintenance of the duplex balance. Paragraph 4 is the only serious disadvantage to the use of this system as compared with that outlined in Fig. 1, and whether or not it makes the system impracticable depends on the proximity of other circuits and the sensitiveness of the receiving instruments used on them. In many cases it has been found to be of no practical importance, but where cables run in close proximity to each other for long distances, especially in underground connections, there is a probability that induction troubles would be serious.

With regard to a method of overcoming this difficulty, the best plan would undoubtedly be to earth the battery on a second earth return, which need not necessarily run the whole distance covered by the sea earth, but simply through the locality where induction troubles are likely to be met. The current in this lead will be the sum of the currents in the cable and the artificial line, and, if the capacity per nautical mile is the same as that of the other leads, the inductive effect on outside circuits should be completely neutralised. Fig. 3 shows these connections. It is interesting to note that this second sea earth being in the battery circuit, neither its resistance nor its insulation has any effect on the duplex balance, and the benefits outlined in reference to Fig. 2 are maintained without the inherent disadvantage of that system.

Compensation Arrangements.

An interesting point arises as to how the resistance and capacity of the artificial line sea earth can be compensated for in the case of systems outlined in Figs. 2 and 3; for the sea earth being in series between the earth plate of the artificial line and earth, the sea earth artificial line shown in Fig. 1 should theoretically be placed between the sheathing of the cable and the earth, which is obviously impossible.

So long, however, as the same current passes through this sea earth artificial line as passes through the cable, and so long as this artificial line is located in series with the cable and on the cable side of the receiving apparatus, its effective impedance on the outgoing current and, therefore, its effect on the balance will be the same, whether it is placed before the cable or between the earth plate of the cable and actual earth. In this way a practical means of compensating for the sea earth in the duplex balance is obtained, the artificial line for the sea earth being placed immediately before the cable as shown in Fig. 4. The writer has no hesitation in expressing the opinion that this form of duplex connections, where long sea earths are involved, will give the most stable balance, and he recommends that where cables are laid in a congested area tricore shore ends should be used, two cores being utilised for earths as explained above, and the third core for the main cable.

Leakage in Cross Circuit.

An adjustment which has been found useful in connection with balances such as these referred to and may be mentioned here, is to reduce artificially the insulation on the cable side by a high resistance, say, in the neighbourhood of 100 000 O, connected from the head of the cable to earth, which is balanced by an adjustable leak from the beginning of the artificial line. Not only has this been found a useful adjustment, but, in addition, it artificially lowers the insulation of the cross circuit, and, in this way, makes the balance less susceptible to variations due to leakage in the cross circuit.

Proposed Duty on Lighting Glassware.

Sir W. Ashley's Committee is inquiring into the application for the imposition of a tariff on imported German and Bohemian glass under Part II. of the Safeguarding of Industries Act. The application is opposed by the Glassware Section of the London Chamber of Commerce, for whom Sir A. Colefax, K.C. (and Capt. Ernest Evans, M.P.) urged that a great deal of the evidence asking for the duty was irrelevant under Part II. The object of the Act was not to stop imports from one country in order to promote them from another. Primarily the object was to help British industry, and they were not to consider helping a new manufactory to get on to its feet. The evidence clearly showed that there was no established manufactory in this country of some of the articles about which evidence had been given. He submitted that there was no importation of electric bulbs from Germany, and in regard to domestic glass, the bulk of it came from Belgium, to which country the Act did not apply.

Mr. C. G. Brooks said that the large firms in Bohemia gave quotations in English sterling. If a duty was imposed, unless the British manufacturer changed his methods he would not be able to compete successfully with Continental manufacturers.

Mr. Fernand R. Lang (proprietor of Messrs. Jules Lang & Son) thought the exchange did not affect the situation to any appreciable degree. The German exchange had collapsed, but it had not made any difference to them. His firm started making scientific glass and trained many disabled soldiers and some local labour, but they steadily lost money. He attributed that simply to the fact that the Germans were better equipped for making that kind of glass; and even if his firm got adequate protection it would take years to train their people, without reckoning the loss in the meantime.

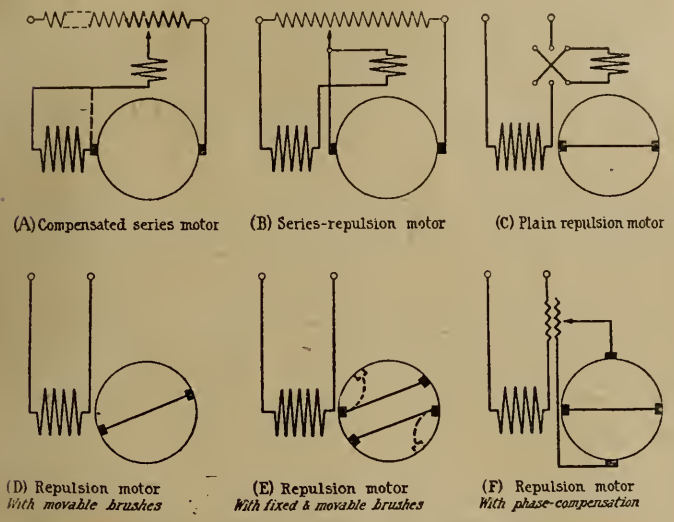
On Tuesday Mr. B. L. Cohen, Mr. J. Collyer and Mr. P. C. Gunningham also gave evidence against the duty.

"Single- and Three-Phase Alternating-Current Commutator Motors with Series and Shunt Characteristics."*

By STANLEY PARKER SMITH, D.Sc.

In this lecture Dr. Smith deals succinctly with the electrical and mechanical characteristics of single-phase and three-phase series and shunt alternating current commutator motors. These machines, though interesting theoretically, possess certain grave practical difficulties from both the designer's and manufacturer's point of view. Though, therefore, they were invented some years ago, their commercial development has been slow, until recent demands for alternating-current motors have lead to their possibilities being further considered. The lecture was, therefore, a timely contribution to our knowledge of this subject, and should form a firm stepping stone to further progress.

Owing to the rapid growth of alternating-current networks, there is an increasing demand for suitable a.c. motors possessing high power factor, large starting torque, and economical speed regulation. From the manufacturer's and designer's point of view these machines are most unpopular; but, from the inventor's and scholar's point of view, they are probably the most interesting of all.



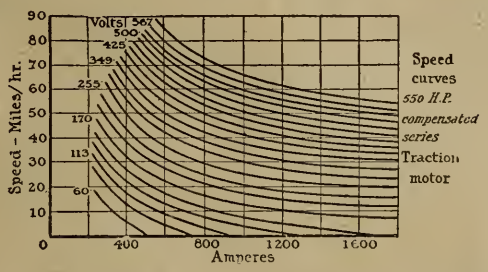


FIG. 1.—SINGLE-PHASE MOTORS WITH SERIES CHARACTERISTICS.

It is desirable to speak about these machines, because, though a good deal was published about them so long ago, it had almost been forgotten. The need for these machines is becoming urgent on account of the growing demand for a.c. motors.

Non-Commutator Types.

Non-commutator types of a.c. motors include the synchronous motor and the induction motor.

In the synchronous motor, powerful starting torque is obtained by winding the rotor as an induction motor, or, with the salient-pole construction, by arranging the damping winding so that the cross-flux at starting becomes approximately equal to the main flux. Power factor can be varied by adjustment of exciting current; d.c. supply is thus necessary, and speed control is impracticable. This type is seldom used on single-phase supply.

In the induction motor the above requirements are not feasible with single-phase induction motors, but polyphase induction motors can be made to satisfy demands. Power-factor rectification is possible by means of a phase-advancer of either the revolving or vibratory type. A commutator is essential.

A large starting torque demands high power factor during starting, but the power taken from the mains is proportional to the torque, and not to the output. Economical speed variation of a single machine entails a change in the number of poles, is achieved by regrouping the coils or phases, or by varying the phase angle (as in Creedy's method), or by cascade devices (as in Hunt's and Creedy's methods). The addition of a second, or cascade, motor introduces further possibilities.

By these means, multi-speed motors can be made to give 2, 3, 4, 5 or 6 constant speeds (shunt characteristics); but in some cases at the expense of high power factor and large starting torque. Further, gradual or continuous economical speed variation is impracticable.

Commutator Motors.

Since phenomena in the conductors are always reproduced at the commutator brushes (independent of sense or speed of rotation) it is possible to connect field and armature windings in series or parallel, although inductive effects may entail modifications with a.c. In principle, the commutator motor is well adapted for economical speed control and large starting torque. In many cases phase-advancement can also be obtained.

Considering, for simplicity, the d.c. motor, the speed is proportional to $\frac{\text{supply voltage} - \text{pressure-drop}}{\text{flux}}$, and the torque depends on the product of the armature current and flux.

Speed regulation by series resistance is uneconomical, but the speed can be controlled by varying either voltage or field.

With a single machine, voltage control is impracticable with direct current, but, with alternating current, a variable-ratio transformer or other device can be used.

With field control (the only economical method for a single d.c. motor), the torque varies inversely as the speed, assuming constant armature current; hence the output remains constant over the whole speed-range, and a variable speed d.c. motor must be

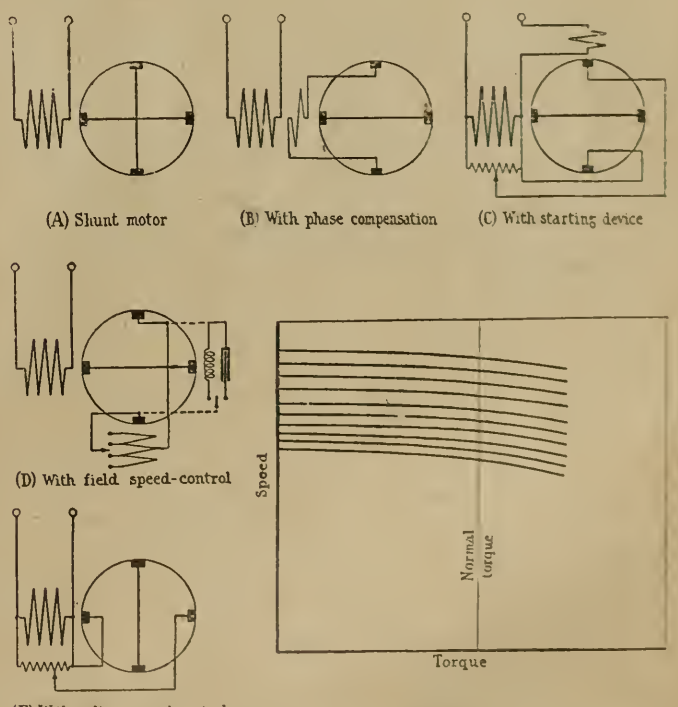


FIG. 2.—SINGLE-PHASE SHUNT MOTORS.

designed for full output at lowest speed; at all higher speeds the material cannot be efficiently utilised.

With voltage control (possible with a.c. motors), both field and armature current can be kept constant over the whole speed-range. A constant torque is maintained, and the output is proportional to the speed, enabling the material to be fully utilised over the whole

*Abstract of a lecture delivered before the Institution of Electrical Engineers.

working range and corresponding more closely to the load characteristics of usual drives.

Alternating-Current Commutator Motors.

The a.c. commutator motors in practice unite most of the drawbacks of both d.c. motors and induction motors. And short circuiting by the brushes of the transformer E.M.F. induced in the coils predominantly affects the design. Therefore the "air-gap" must be

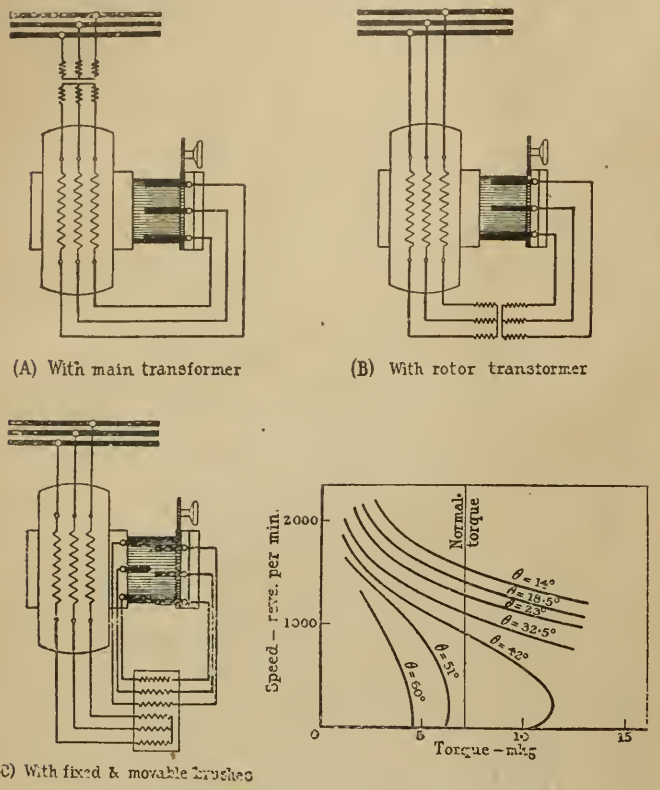


Fig. 3.—Three-Phase Series Commutator Motors.

short, the armature reaction compensated, and a low commutator voltage used—sometimes at the cost of a transformer.

Figs. 1 to 5 illustrate types of motors of practical importance. The first mention of the fact that the laminated series motor could work with a.c. current, appears to have been made by Alexander Siemens in 1884, in a discussion at a meeting of the Society of Telegraph Engineers; the polyphase commutator motor was patented by Ernest Wilson in 1888 (E. P. 18 525). About the same time Wightman in America discovered rotor excitation. In 1898, Ll. B. Atkinson showed how the single-phase commutator motor could be made to yield a shunt characteristic. The invention of the induction motor by Ferraris and by Tesla, in 1885-86, and its rapid development, indicate the inherent difficulties of a.c. commutator motors.

Single-Phase Commutator Motors.

Single-phase motors with series characteristics are illustrated in Fig. 1. The more rapid development of these types is attributable to their relative simplicity, and the incentive afforded by the prospects of railway electrification.

The compensated series motor has ousted all other types as a single-phase traction motor. For this work the transformer E.M.F. in the short-circuited coil is usually neutralized by a rotational E.M.F. induced by the flux produced by an interpole winding shunted by a resistance and excited by the main current. This gives the motor a very wide speed-range. The speed is controlled from rest by means of a variable-ratio transformer. High power factor is obtained by designing the motor with a weak field and a strong armature magneto-motive force, by working well above a synchronous speed, and by reducing inductive effects. On Continental single-phase railways, inductive effects are reduced by adopting a frequency of $16\frac{2}{3}$ periods per second. The compensating winding may be joined in series with the armature winding, or it may be short-circuited on itself. Motors for 500 h.p. are common and 3 000 h.p. has been attained. About 40 to 80 h.p. per pole is usual for large motors.

In the series-repulsion (or doubly-fed) types, power is supplied to both stator and rotor. However, this type has practically given place to the compensated series type.

In the plain repulsion motor all the power is transferred inductively to the rotor. The rotor voltage can be fixed independently so that no transformer is needed. At synchronous speed the transformer flux is correct for neutralizing the inductive effects of the exciting flux on the short-circuited coils; hence commutation conditions resemble those in a d.c. machine. At other speeds, especially at hyper-synchronous ones, the magnitude of this flux is not correct, so that all motors of the repulsion type are ill-suited for wide speed-ranges. The repulsion motor has a series characteristic because the exciting flux is produced by the main current.

Combining the two stator windings in the plain repulsion motor, the common repulsion motor with movable brushes is obtained. The brushes are in the short-circuited position when the brush axis coincides with the axis of the stator winding, in the neutral position when the brush axis is perpendicular thereto. In both positions the torque is zero. If the brushes are in the neutral position, no stator is required. The line voltage is applied to the stator winding and the motor begins to revolve in the opposite direction to that in which the brushes are moved. Thus both transformer and starter can be dispensed with.

By splitting the brushes into a fixed and a movable set, the brush shift is doubled, and finer speed regulation can be obtained. Further, no flux embraces the short-circuited coils when the brushes are in the neutral position.

Phase compensation is obtained by rotor excitation. These motors were used on the original electric rolling stock of the Brighton Railway, being practically the only type then available. The necessity of working near synchronous speed is a drawback, and the compensated series motor has replaced this motor for traction work.

Experimental Demonstration.

The characteristics of a single-phase series motor were demonstrated on an Oerlikon experimental machine which had two sets of brush gear, with which about eight series speed characteristics could be obtained for various tappings when run as a repulsion motor. The speed was varied by shifting the brushes, and the machine was reversed by putting the brushes in the other direction. By altering the connection again, the machine could be run as a shunt motor, the brushes being shifted, as in the repulsion motor, to make it start. When it reached about synchronous speed, the brushes were brought back into neutral. By applying the pressure in one direction the speed was raised above synchronism, and, by reversing it, it was brought below. The speed dropped slowly as the load was applied.

The motor would not work with a connection such as was used in a d.c. motor, because when a conductor left the top zone, as the

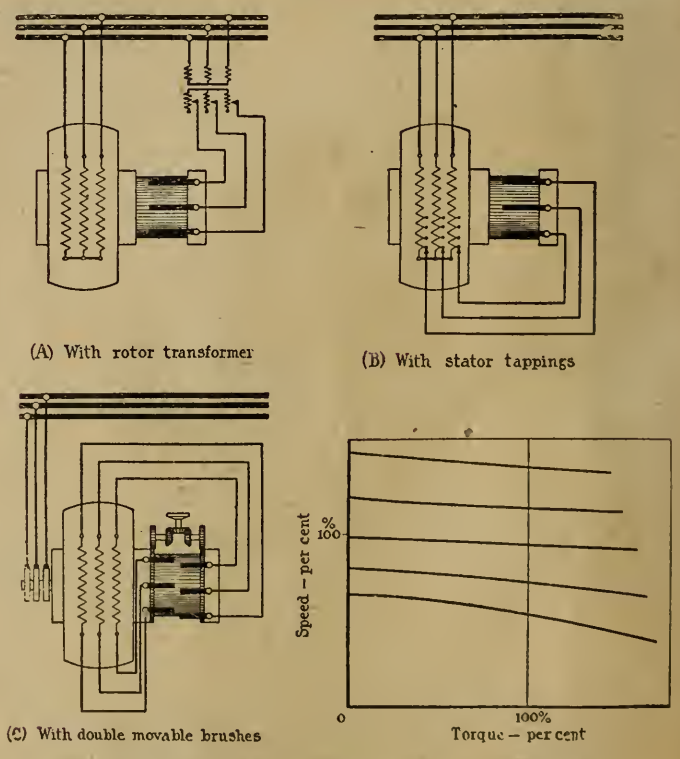
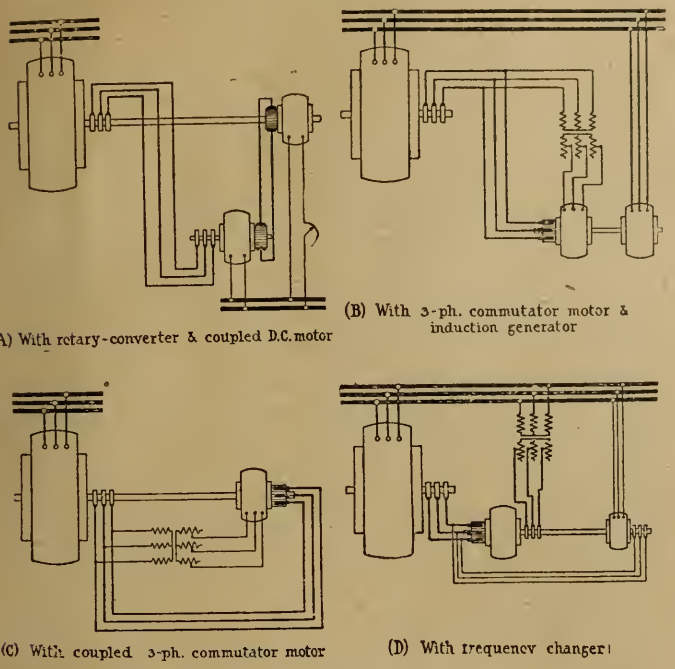


Fig. 4.—Three-Phase Shunt Commutator Motors.

armature rotated, it entered the bottom zone, and there was always a constant number of conductors in any part of the field, so that the fixed brushes would pick up what was taking place in that zone. Consequently the flux was steady and a steady E.M.F. was picked up. If there was an alternating flux, pulsating with a frequency of 25,

there would be a frequency of 25 between the brushes. In a d.c. machine the field winding could be connected either in series or in parallel with the armature, as the commutator acted as a frequency changer and the frequency of the pressure induced in the armature conductors was therefore converted to the frequency in the field system. The reason, therefore, that this machine would not work with a simple shunt connection was that, in order to get power, there must be an E.M.F. of rotation along the axis of the power component of the current. Mr. Atkinson obtained that by putting on another pair of brushes and providing a flux which secured an E.M.F. of rotation along the axis of the excitation flux, and then the E.M.F. of rotation along the vertical axis, combined with the current, gave the torque on which the action of the motor depended.

There was no doubt these a.c. commutator motors had all the drawbacks of the d.c. motor and the induction motor, in addition



(A) With rotary-converter & coupled D.C. motor

(B) With 3-ph. commutator motor & induction generator

(C) With coupled 3-ph. commutator motor

(D) With frequency changer

FIG. 5.—VARIABLE-SPEED SETS.

to a still greater evil. It was really a successful achievement that satisfactory a.c. commutator motors had been built, and he was sorry that our own firms and designers had done practically nothing in that direction. Except for what Mr. Creedy and a few others had done, these machines had been developed in other countries, although the pioneer types were invented in this country.

As regards single-phase motors with shunt characteristics, the shunt motor needs both main and exciting brushes.

The plain shunt motor is inferior to the single-phase induction motor. It possesses no starting torque; efficiency and power factor are lower, and the motor runs merely at one speed, *i.e.* synchronism. Some methods of overcoming these drawbacks are illustrated in Fig. 2.

Phase correction is obtained by injecting a fraction of the applied pressure into the exciting circuit.

A large starting torque is obtained by letting the motor run up to speed as a repulsion motor. The machine can then run as a single-phase induction motor. It is now usual to combine devices (B) and (C) in order to obtain a constant-speed single-phase motor with high-power factor and large starting torque.

Speed regulation is obtained by varying the exciting flux. An inductance is used to raise the speed; a capacity to lower it; or an auxiliary winding can be used.

In the doubly-fed type the speed is varied by regulating the pressure applied to the brushes in the transformer axis. This motor, the series-repulsion motor and the three-phase commutator types, belong to the class in which energy is supplied to both stator and rotor, power relations being definitely associated with synchronous speed.

Three-Phase Commutator Motors.

The use of a commutator with the rotor of the three-phase induction motor raises the frequency of the slip energy to the frequency of the supply. Hence this energy can be taken from, or returned to, the supply network, according as the speed is above or below synchronism.

The speed of the three-phase series motor is controlled by shifting the brushes. The direction of rotation is independent of the sense of the rotary field. If the motor, with a fixed ratio of stator to rotor turns, is designed for a high power factor, instability occurs at low speeds (*see* Fig. 3). A transformer is usually necessary to obtain the low rotor voltage.

A main transformer, rated for full power, is usually necessary only for severe conditions.

A rotor transformer, rated for the slip power only, is often all that is needed. If this transformer becomes saturated at a certain value of the rotor voltage (*i.e.* at a certain speed), racing can be prevented.

Where stability over the whole speed-range and a high power factor are needed, the ratio of the stator to the rotor turns can be decreased, as the speed rises, by one-half of the brushes being fixed and the other half movable.

Whereas the repulsion motor is the simplest type of single-phase commutator motor, the three-phase series motor is the simplest type of three-phase commutator motor.

The three-phase series motors had, however, the peculiar characteristic that there was an instabilty at low speeds, though there was a high power factor at high speeds. A device for overcoming the instability at low speeds was to use tappings on the stator winding, which served the same function as a transformer.

With Shunt Characteristics.

The speed of the three-phase shunt motor is varied by supplying a pressure to the rotor brushes, and the brushes are rocked through 180 deg. to pass from sub-synchronous to hyper-synchronous speed. The connections are shown in Fig. 4.

A variable-ratio rotor transformer, capable of transmitting the slip power to or from the commutator brushes, fixes the speed. A special connection can be used for altering the phase of the transformer voltage in order raise the power factor.

Sometimes it is possible to obtain a desired rotor pressure by taking tappings off stator windings.

Where gradual speeed control is required, brushes can be arranged in two equal sets, both movable and connected to the separate stator phases. Power is supplied through slip-rings to the rotor, while a special regulating winding may be employed as the commutator winding. Every brush position corresponds to a definite pressure and speed.

In the types of three-phase shunt motor previously mentioned, and in the three-phase series motors, the transformer E.M.F. becomes zero at synchronism, but in this machine it remains the same at all speeds, because the frequency of the current in the rotor winding is always that of the supply. In this respect the motor resembles the single-phase series motor; but in the latter the transformer E.M.F. can be neutralized, whereas in the former it cannot be. The relative motion between the revolving field and the rotor is constant, and at synchronism the frequency of the E.M.F. induced in the stator winding is zero. By starting from the neutral position, a starter can be dispensed with. Phase compensation is obtained by shifting the two sets of brushes unequally. The direction of rotation of three-phase shunt motors is changed as in an induction motor, *i.e.*, by reversing two stator leads.

Variable-Speed Sets.

Assuming from 15 to 20 H.P. per pole as a desirable limit for the output of a three-phase commutator motor, such motors cannot well be built for outputs above 300 to 500 H.P. However, it is often only desired to use the slip power of a large induction motor having a limited speed-range. The three-phase commutator motor is well suited to fulfil these conditions. Various ways of using the slip power are shown in Fig. 5. In many cases, phase compensation in the main motor is also aimed at. When the auxiliary motor is mechanically coupled to the main motor, the drive is suitable for constant output over the whole speed-range; otherwise it is suitable for constant torque. It is desirable to arrange that synchronous speed shall be in the middle of the speed-range, so that the rating of the auxiliary machines can be correspondingly diminished.

A Merseyside Confederation.

A definite step towards a MERSEYSIDE CONFEDERATION was taken at a meeting of Liverpool City Council last week when a resolution, proposed by Sir Archibald Salvidge for the formation of a special committee to confer with Government Departments and local authorities on both sides of the Mersey with a view to securing co-operation, co-ordination and (or) federation, with greater efficiency and economy in the control of local services and the improvement of cross-river communication by means of a bridge or tunnel, was carried unanimously. In his speech Sir Archibald referred to such matters as road traffic, tramways, electricity supply, &c. He did not suggest that any of these matters ought to be controlled in all their details by one central authority, but his view was that for the purpose of ensuring efficiency and economy the policy might with advantage be guided in all these matters by a central authority in whose hands would thus fall in large measure the control of finance, and to an extent, rating, in the areas of all the communities, leaving the constituent authorities their existing operating powers.

The Institution of Electrical Engineers.

There was a fairly full attendance at the meeting of the Institution of Electrical Engineers on Thursday in last week when Dr. Stanley Parker Smith delivered a lecture on "Single and Three-Phase Alternating Current Commutator Motors with Series and Shunt Characteristics."

The Library—Hours of Opening.

The President opened the meeting by saying that it had been found that though the library was well attended on the evening of meeting nights, on other evenings those taking advantage of the facilities were very few. It had therefore been decided to keep the library open on meeting nights, but to close it on other nights of the week.

On another page of this issue we give an account of Dr. Smith's lecture, this account being based to a large extent on the printed notes circulated beforehand, though some supplementary information which the lecturer gave in the course of his extempore remarks has been included. At the conclusion of the lecture which lasted about an hour and a quarter and was accompanied by a number of practical demonstrations, the President called upon Mr. F. Creedy to open the discussion. No better choice could have been made as Mr. Creedy has probably done more than any other British electrical engineer to bring the particular type of motor with which the lecturer dealt to a practical stage.

Some Practical Aspects.

Mr. F. Creedy therefore somewhat naturally confined his remarks to practical questions. He pointed out that it was possible to overcome the difficulty of transformer voltage being induced between the commutator segments by running the machine at nearly synchronous speed. The voltage between the secondaries was then purely a reactance voltage, as in the direct current machine, while the starting torque and power factor could be favourably compared with those of other types of single phase motors. Comparing the performance of single phase and direct current motors he pointed out that in the smaller sizes, *i.e.*, about 5 h.p., the efficiency of the former was only about 5 per cent. less that that of the direct current motor, while in the large sizes up to about 35 h.p. the difference was only about 3 per cent..

As regards weight the direct current motor was heavier than the single-phase motor of 1914 design by about 10 per cent. throughout the whole range of sizes, but the weight of the modern single phase motor was only about two-thirds of that of the corresponding direct current motor. In sizes up to 25 h.p. the cost of the single-phase commutator motor was from about 4 to 10 per cent. more than that of the direct current motor and this difference increased with the size. The single-phase motor of up-to-date design was smaller than the direct current motor of the same output. In variable speed machines it was necessary to keep the commutator voltage relatively low, say less than 100 V with outputs of 100 h.p. on a 50 cycle circuit. When the machine was operated constantly at near synchronous speed, however, the commutator voltage could be at least doubled or alternatively the commutator size could be halved, an arrangement which reduced loss and so increased the efficiency.

The British Designer Vindicated.

English firms had not undertaken the manufacture of a.c. commutator motors, not because they were lazy, but because they had been busily engaged in doing something else. The cascade motor at least was entirely a British product, and in any event, as the polyphase induction motor was an ideal form of drive, it was hardly necessary for them to sacrifice all its advantages when to do so was quite unnecessary. Neither did he agree with Dr. Smith that the commutator machine was the worst of all machines from a practical point of view.

Some Practical Machines.

Concluding, Mr. Creedy showed a slide of a multi-speed induction motor which gave six variable speeds and was operated very simply by means of a drum controller. Speed changes were obtained by altering the number of poles so that with 8 poles the motor started with 1·7 times the full load current and twice the full load torque, while with four poles it started with three times the full load torque and nearly eight times the full load current. An actual motor which could run at three speeds 1 000, 1 500 and 1 750 revs. per min. was exhibited.

Conditions in 1898.

Mr. Llewelyn Atkinson said that as far as he remembered the only previous occasion on which these motors had been the subject of discussion was when Mr. Creedy, as a student of the Institution, read a paper on commutator motors which gave a great deal of information.* He himself in 1898, on the occasion to which Dr. Smith had referred, had made the mistake of reading his paper before the Institution of Civil Engineers† from whose proceedings it was only unearthed by people who were specially interested. It should be noted that in 1898 the commutator was still a great trouble to designers, even of direct current machines, with the result that everyone was looking forward to a deliverance from their afflictions by obtaining a polyphase motor which had no commutator. For this reason he had found it very difficult to get manufacturers either in this country or elsewhere to carry out the necessary experimental work. The result was that his patents had been dropped to his own great financial disadvantage and to the disgust especially of German designers.

Conditions in 1921.

Even to-day the position had not changed very much, for notwithstanding the enormous advantage of using a variable pressure on the commutator no English engineer except Sir Philip Dawson had seen the advantage of using this type of motor for long distance electrification. Nevertheless, it was his (Mr. Atkinson's) opinion that for main line electrification high pressure alternating currents would have to be used, and that the employment of a motor of the type which they had been discussing that evening was therefore ensured. The same might be said for more general work where the low power factor of the induction motor gave rise to grave difficulties at the generating station and on the network. These difficulties were overcome by the use of the commutator motor with compensated windings or by injecting a compensated E.M.F. to obtain unity power factor. If supply engineers in this country altered their tariffs so that the buyer paid not for watts but for volt-amperes it would necessarily mean a revival in the use of these compensated motors and a saving in the capital now wasted in stations and mains. He thought that Dr. Smith had perhaps inadvertently used the word "compensation" in two different senses; one of the compensations was the balancing of the flux to reduce the reactance and the other was the compensation of the phase position. For the latter the term phase compensation was best, while for the other phase neutralisation would be a convenient expression. Dr. Smith had said that he did not know what repulsion meant. In his (Mr. Atkinson's) view it did not mean anything, the only repulsive thing about these motors being their names.

Results on the Brighton Railway.

Sir Philip Dawson said that since he first undertook heavy railway electrification fifteen years ago this was the first time he had heard anything good said about the single phase system. He was also glad to see that the fiction that the single phase machine was a foreign invention had been exploded. The results of tests which had recently been undertaken on the Brighton railway showed that the system of speed control employed gave a more even rate of acceleration than direct current would permit. He agreed with Dr. Smith that the compensated motor was best adapted for general applications and pointed out that comparisons as to the relative cost of single phase and direct current traction should not be made between modern equipment and that employed on the Brighton line. For instance, with the original motors the brushes lasted from 6 000 to 7 000, and sometimes attained 11 000 miles, while with the improved type of motor this figure rose to 40 000 or 50 000 miles.

Although commutation was not altogether good with the motors used on the Brighton railway, the average mileage of a motor coach was over 50 000 miles a year, and with this mileage the life of a commutator was about ten years. In the period under review the relative cost of alternating current and direct current equipment had altered considerably and at the present time alternating current equipment was only about 15 to 20 per cent. more expensive than 750 V direct current equipment.

It had been decided to use single phase traction in Switzerland, Sweden, Norway, Germany, Austria and some parts of the United States; the question of the system to employ was now-a-days purely financial. He had signed the unanimous report of the Railways Electrification Advisory Committee because it left the door open to any railway company to apply to the Ministry of Transport for permission to use a different system than the high tension direct current systems.

"Little Billie."

Prof. Ernest Wilson gave some details of his original alternating current commutator motor which according to the President was known to the students [of King's College, as "Little Billie." This motor resembled an ordinary direct current motor in that it possessed an armature with a commutator and a stator made up of laminated stampings with four polar projections. The motor originally was constructed for two-phase working, as in those days it was difficult to get polyphase currents, but the principle was

*See The Electrician, Vol. LV., pp. 21, 46, 85.

†See The Electrician, Vol. XL., p. 714.

generally applicable to all alternating current motors. The polar projections were wound with coils, and on each was a second winding which could be used as a transformer if necessary. The brushes could be moved relatively to one another when the machine was used as a repulsion motor.

Mr. F. J. Teago gave some details of a Schräger three-phase commutator induction motor and of a Scherbius motor which he had recently had under test.

Dr. S. P. Smith in reply said that having regard to the fact that the greater part of Europe had decided to use single phase traction, and that British railways would need the same system for their long distance lines where the traffic was sparse, the Brighton railway should be required to extend their electrification to Brighton as early as possible, and the work should be done only by British firms in order that they could be in a position to compete for future tenders.

Discussion in Newcastle.

In the course of the discussion which recently took place on Dr. Smith's lecture in Newcastle, Mr. F. H. Downie said a low frequency had an advantage with commutator motors as the size of the motor increased with the frequency.

Mr. A. T. Robertson explained that one of the difficulties in connection with the manufacture of a.c. commutator motors was the prodigious number of patents which had been taken out, and the danger of infringement. This was responsible to a large extent for the disinclination of manufacturers to build these motors. The speaker asked for information as to the use of a three-phase repulsion motor, capable of phase transformation, which was described in The Electrician in 1914, but this information was not forthcoming. Referring to the direction of rotation of the motor being independent of the sense of the rotary field, Mr. Robertson asked whether all a.c. commutator motors did not actually run with the rotation in the same direction as the rotation of the field, so that the frequency of the secondary circuit should always be less than the frequency of the primary circuit.

Mr. A. B. McLean said that the application of commutator motors to rolling mill reversing equipment or to winders was hampered by fact that the size of the auxiliary machines was comparable with the size of the main motor. This made any saving in running or capital costs over the Ward Leonard equipment very doubtful.

Mr. P. F. Allan thought the author was unduly severe on d.c. railway motors. The supposed extra weight was in the best possible position, well below the centre of gravity, whilst the use of a transformer fixed some height above the bogies would transfer some of this weight to a position above the centre of gravity. Whether commutating motors would prove more advantageous than the Ward-Leonard system was doubtful, whilst the problem of reversal was an additional disadvantage of such motors.

Mr. H. B. Poynder considered that the author was hard on the tap field arrangement for traction motors, and pointed out that with traction motors on a suburban system the maximum horse power was not required at maximum speed.

Dr. S. P. Smith in reply said in the early days of design efforts were directed towards the suppression of the transformer E.M.F. and the commutation was left to look after itself; now with the use of interpoles, both the reaction pressure and the transformer E.M.F. were suppressed. The direction of rotation of the series motor was always against the rotating field. The Ward-Leonard set gave excellent control and the automatic features were good, but it was a clumsy, costly and uneconomical arrangement which it was a pity could not be dispensed with.

Annual Exhibition of the Physical Society of London and the Optical Society.

The annual exhibition of the Physical Society and Optical Society was held on Wednesday and Thursday last week at the Imperial College of Science, London, and provided a great deal of interest.

Discourses were given by Sir Frank Dyson (Astronomer Royal) on the "Employment of Coarse Wire Gratings in Astronomy," by Mr. F. H. Glew on "Radium: its Application in Peace and War," and by Mr. A. A. Campbell Swinton on the "Johnsen-Rahbek Electrostatic Telephone and its Predecessors." Our readers will have been mostly attracted by the last named, which was delivered twice. The loudness with which conversation from an ordinary transmitter and wireless signals from various stations were reproduced was surprising. Dr. F. L. Hopwood also showed some interesting optical experiments.

There was a large attendance, and the time available was by no means more than sufficient for a detailed inspection of the apparatus shown by the fifty-five firms who exhibited. In what follows we give an account of the more novel exhibits of electrical interest.

The Emergency Alarm of the Marconi Company.

Much interest has been aroused recently in the emergency alarm introduced by the Marconi Company for use on board ship. The importance of such a device is that by its use the continuous attendance of an operator is rendered unnecessary, and consequently the *personnel* can be reduced. Visitors had the advantage not merely of seeing the alarm, but of proving for themselves that it is not affected by ordinary signals.

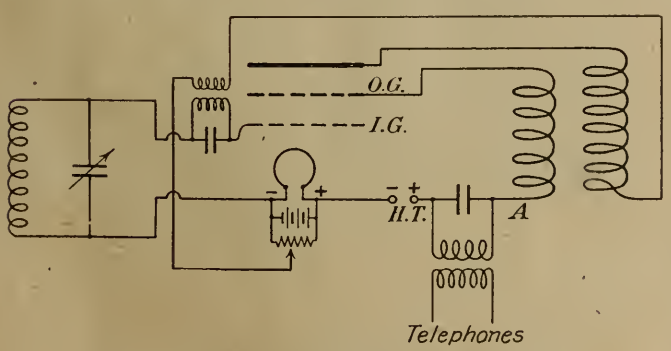


Fig. 1—Diagram of Four-Electrode Amplifier.

The device consists of a relay which serves to actuate two other relays; the action of the latter under the proper conditions causes a bell or bells to ring. In the following description, in order to avoid confusion, we shall speak of the first relay as "the relay," and shall refer to the subsidiary relays as "contact arms."

The Application of Four-Electrode Valves.

For the purpose of actuating the relay a four-electrode valve is used. Considering first the amplifier for ordinary reception, an extra terminal is fitted at a point in the H.T. circuit where the maximum change in voltage occurs. This is found to be at the point marked A in Fig. 1 (which applies to a four-electrode valve so used). The point A is connected through a condenser to the inner grid IG of a four-electrode valve actuating the relay. The arrangement of this valve is shown diagrammatically in Fig. 2. From this it will be seen that the outer grid OG is connected through a transformer T in series with a coil C to the H.T. battery. When the normal H.T. current (about half a milliampere) is flowing through this coil the tongue B of the relay is attracted into contact with the spacing stop S. When, however, a sufficiently strong signal is received the inner grid becomes sharply negative and the H.T. current is thus much reduced. The current from the plate to the filament is also reduced, and as this current is taken through the transformer T, this reduction is made to introduce a further momentary back E.M.F. in the H.T. circuit, so that there is a very marked reduction in the current through the coil C, sufficient to cause the relay tongue to fall on to the marking contact M. The making of this contact releases the negative charge on the inner grid, and consequently the current from the outer grid through the relay coil begins to grow again until the tongue of the relay leaves the marking stop. But if the signal is still going on, the inner grid then again becomes negative and the relay tongue falls back on to the marking stop as before, so that a continuous

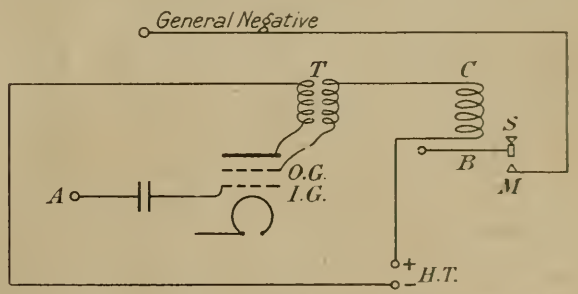


Fig. 2—Diagram of Four-Electrode Valve for Relay.

chatter results. When the signal ceases the tongue is able to rise to the spacing stop, where it will remain until another signal of sufficient strength arrives. The relay is thus self-restoring.

Some Difficulties in Responding to a Code.

There is, of course, no difficulty in merely arranging for a relay to be actuated by the variation of the current from the H.T. battery, but it is a much more serious matter to devise an arrangement which shall respond only to a prearranged code and be

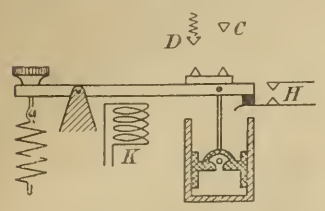


Fig. 3—Contact Arm No. 1.

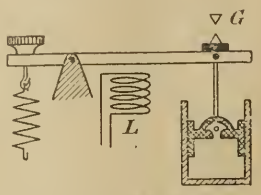


Fig. 4—Contact Arm No. 2.

insensitive to the ordinary signals. Briefly, the method adopted in the present device depends upon two selectors which pass through a cycle of operations in a certain time. Any strong signal is sufficient to start this cycle, but the cycle will only continue under a prolonged dash, and will only be completed if the dash is maintained for a definite period (within limits) followed by a space for a definite time. This cycle must be repeated three times for the bells to ring.

The arrangement will be best understood by referring to Figs. 3 to 6. The device may be said to consist essentially of three parts, namely, two contact arms with dashpots and a ratchet-operated contact, indicated in Figs. 3 to 5. There are two pawls, one for pulling the wheel round and the other for holding it against the action of a spring which would pull it back into its zero position. Fig. 6 is a simple diagram of connections, and shows the way in which these three parts are inter-connected.

Effect of a Strong Signal.

So long as the relay tongue is against the spacing stop a current flows from a local battery through the magnet coil K of contact arm No. 1 (Fig. 3), so that the normal position of this arm is down. But as soon as a strong signal causes the relay tongue to leave the

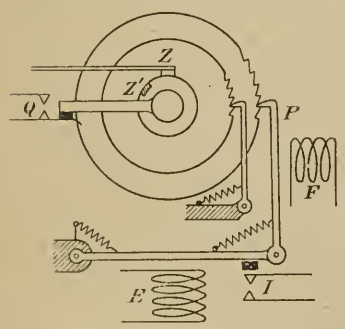


Fig. 5—Contact Disc.

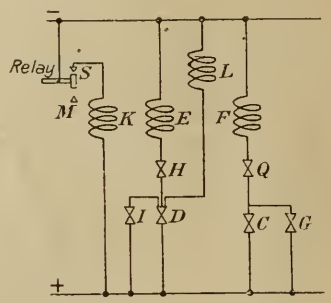


Fig. 6—Electrical Connections.

spacing stop this current is interrupted and the contact arm proceeds to rise, due to the spiral spring on the left. The movement of the arm, however, is slow, owing to the dashpot seen on the right. This consists simply of a piston sliding in a cylinder, the piston being fitted with a small ball valve, so that an upward movement is slow but a downward movement is quick, since the valve causes very little obstruction to the air when escaping. The time taken for the piston to rise the full height is five seconds.

The "Normal Emergency" Call.

The normal emergency call will consist of three dashes, each of four seconds, separated by spaces of one second, but these intervals may have rather large "tolerances."

When the first dash arrives the contact arm No. 1 begins to rise, and in doing so permits the contacts H to close. The importance of this will be seen later. A contact D is arranged at such a height as to be closed by the arm at the end of three seconds. Consequently if the dash lasts for not less than three seconds the contact D is made, and by referring to Fig. 6 it will be seen that this permits a current to flow through the coil E in Fig. 5 (H being already closed) and through L in Fig. 4. Consequently the lower limit for the dash is three seconds. If the dash lasts for a shorter time than this, the relay goes back to the spacing stop, the coil K is energised, and arm No. 1 is pulled down again before the contact D is reached. The effect of energising the coil L is to pull down arm No. 2 from the contact G (which is the normal position), and the effect of energising coil E is to pull down the pawl P, so that the wheel is brought round one step and held there, and the contact Q (which is in series with coil F) is made.

If the dash then terminates, the arm No. 1 is pulled down again by the relay, so that contacts D and finally H are broken. Consequently the coil E is de-energised, the pawl P rises to its original position ready for a further step, and the contact I is broken. It will be noticed that D and I are in parallel. Consequently coil L is still energised so long as coil E is energised, even though contact D is broken. It is only when arm No. 1 has fallen and broken contact H that coil L becomes de-energised through the action of coil E.

Thus, when arm No. 1 reaches the bottom of its stroke, arm No. 2 is liberated and begins to rise. This arm is adjusted so as to complete its stroke in 5 sec., by which time contact G is made. If this happens, the pawls are pulled out by the coil F and the wheel

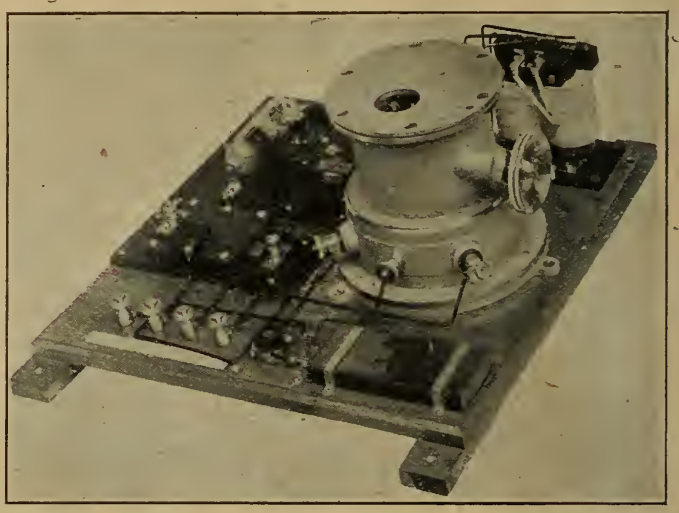


Fig 7—Relay Board of Marconi Automatic Alarm, showing Four-Electrode Valves Relay.

returns to its zero position. This would be the case if a normal dash were followed by a space of 5 sec. or more; the apparatus would be simply reset.

Time Element Devices.

Returning to arm No. 1, it will be noticed that there is a second contact C. Contact D is fixed on a spring; it is reached in 3 sec., as already stated, but does not stop the arm rising further, and so the contact C is reached in 5 sec. Contacts C and G are in parallel. Thus a dash must be between 3 sec. and 5 sec., for if it is less than 3 sec., contact D will not be reached, and if it is more than 5 sec. contact C will reset the contact wheel.

Assuming that the signal is being properly made, the first dash will be followed by a space of about 1 sec., followed in its turn by another dash of about 4 sec. As soon as the space starts (or, more correctly, as soon as arm No. 1 reaches zero position after

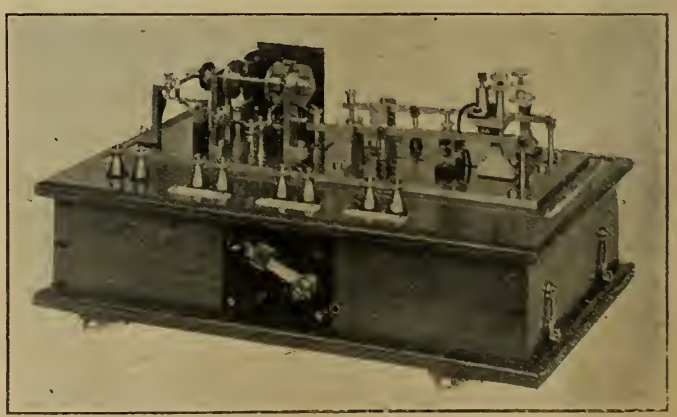


Fig. 8—Alarm Mechanism of Marconi Automatic Alarm, showing Contact Arms and Contact Disc.

a space starts), arm No. 2 begins to rise, arm No. 1 being pulled down. When the second dash starts, arm No. 1 begins to rise again, and what occurs depends on whether contact G is reached first by arm No. 2 or contact D by arm No. 1. Assuming that the signal is being properly made, the contact D will be made first, so

that arm No. 2 will be pulled down as before, and the contact wheel will be pulled round a second step. On the other hand, if the space is longer than 2 sec., arm No. 2 has a start of more than 2 sec., and since arm No. 1 requires 3 sec. to reach contact D, it follows that arm No. 2 will reach contact G first, which will result in the contact wheel being reset. It follows, therefore, that the space cannot be more than 2 sec. The shortest permissible space is about ¼ sec., due to the time which arm No. 1 takes to fall to zero position.

The third dash of the required length causes the contact wheel to take up its final position, thus making contact of Z with Z' (Fig. 5), but the bells do not ring until the relay returns to the spacing stop. When this occurs the bells continue ringing until the whole apparatus is switched off. If the final dash is too long the contact disc is released by contact C.

Effect of a Continuous Dash.

If a dash goes on continuously, arm No. 1 remains at the end of its travel, against contacts D and C, so that the contact disc returns to its starting position. If a space is too short arm No. 1 will not have time to get right down before it begins to rise again, and contact H will not be opened, so that pawl P will not be released and cannot pull the contact disc round a further step.

The ordinary Morse signals and atmospherics are not usually long enough to interfere with the working of the dashes and spaces here described. Two stations may cause arm No. 1 to rise somewhat and might possibly cause the device to operate, but this would rarely be the case. Interference from three stations is more serious, assuming always that the signals are sufficiently strong.

If the filament current fails or becomes too low the bells will also ring. Figs. 7 and 8 show the style of the apparatus.

The apparatus is now under test on one ship of each of ten commercial fleets and a set has been installed by the Post Office at the North Foreland wireless station so that regular observations may be made.

(*To be continued.*)

Amalgamation of Electricity Undertakings.

Two important resolutions were carried at the meeting last week of the Liverpool City Council. It was agreed that the electricity undertaking of Bootle Corporation (including the supply to the urban district of Litherland) be amalgamated with the Liverpool municipal electricity undertaking, and that the undertaking of the Liverpool District Lighting Company be acquired by the Corporation.

Referring to the first decision, Mr. Wilson, chairman of the Tramways and Electric Power and Lighting Committee, said that from the point of view of Liverpool, the arrangement was a most desirable one, as it would unify the system of distribution in Bootle and Liverpool, and unification would lead to a reduction in the price of electric current. It would also do away with the difficulty which had arisen in regard to the Dock Board supply. The difficulties with Bootle with regard to the maintenance of the tramway overhead equipment would also be removed. The terms arranged for the transfer of the whole Bootle undertaking to Liverpool Corporation in consideration of an annual payment of £7 500. Last year Bootle made a net profit on their undertaking of £6 342, and the Liverpool electrical engineer's estimate of the probable profit for next year was £10 000. The consumption in both Bootle and Litherland was a growing one, and it was anticipated that the output would be greatly increased. All the negotiations had been carried out in a friendly spirit, both sides having in view the desirability of securing a cheaper and more abundant supply of electricity on the Merseyside, for the benefit of the consumer and the trade of the port.

Dealing with the acquisition by the Corporation of the Liverpool District Lighting Company, Mr. Wilson said the agreement provided for an annual payment of £4 000, with the right to commute that payment, either by paying the sum of £60 000 in cash or by issuing mortgages, the interest on which would produce £3 600 per annum. The accounts of the company showed that for last year it made a profit of £6 640 on an output of 650 000 units. There seemed to be little doubt that the Corporation, with their more economical method of working, would be able considerably to improve on that result, so that the terms arranged were not likely to involve the Corporation in any loss. Objection was made by two members to the arrangement by which Liverpool was to pay Bootle £7 500 a year for ever. If Government permission is secured, the transfer will be carried through on April 1, and will come into operation on July 1.

Bootle Corporation have approved the agreement.

Electric Miners' Lamps.

In the new Safety Lamp Order of the Board of Trade particulars are given of the "Beam" Miners' electric cap and the "Adams" electric hand lamps which have been approved for general use. The "Beam" lamp is made by Wm. Paton & Co., Glasgow, and the "Adams" by Adams Bros., Longton. The "Thor" (type "M.") and the "Ceag" shaft and roadway lamps are also approved for use by officials or for special purposes.

At present there are thirty makes of approved electric lamps for general use and eighteen for use by officials or for special purposes.

Correspondence.

RECRUITING FOR TERRITORIAL ENGINEERS.

To the Editor of THE ELECTRICIAN.

Sir,—I shall be greatly obliged if you will allow me through the medium of your columns to call attention to the urgent need of this unit for recruits with electrical training. The work of "Corps Signals" is no doubt well known to most of your readers, but I may add that as now organised this unit consists of four Companies: Wireless, Construction, Cable, and Head Quarters with Artillery sections attached. It will be understood that it is difficult to organise and maintain such a unit without the close co-operation of electrical firms and employees.

I am sure I need not write at length with regard to the benefits a man and his employer both gain from his belonging to a unit such as this. To the man it means fourteen days free holiday in the summer usually by the sea with pay and an easily earned £5 bounty each year, whilst the knowledge which he acquires technically cannot come amiss in his civilian capacity. Further, Head Quarters provide a free club. Drills always take place at times fixed to suit men who earn their living. The gain to the employer is apparent after the first annual training, for the man is almost invariably a better servant as the result of his military training.

Another important point is that of economy. A Territorial unit costs a very small fraction of the cost of a corresponding Regular unit, and if the Territorial units are not recruited up to strength an increase of Regular or Militia units seems inevitable.

May I appeal to such of your readers as are themselves in a position to enlist or to give encouragement as regards leave for camp, &c., to their employees to do so, to give us the practical help of which we are in need.

Prospective recruits can enlist at our Head Quarters at Elverton Street, Westminster, any morning from 10 to 1 and any evening from 7 to 10.

I shall be very glad to furnish fuller particulars to any of your readers who may like to have them.—I am, &c.,

Westminster, January 4.

M. W. Emley,
Lieut.-Col. R.C.S. (T.),
Commanding 3rd (London) Corps Signal Coys.

THE EXPONENTIAL VALUES AND EXPANSIONS IN POWERS OF θ OF SIN θ AND COS θ.

To the Editor of THE ELECTRICIAN.

Sir,—Rigorous proofs of these important formulæ, such as are demanded by the pure mathematician, are too difficult for those engineering students whose mathematical attainments do not extend much beyond the elements of the calculus. To such—and probably they are the majority—the following method of *arriving at* these formulæ may be of service. It, therefore, seems worth publication in The Electrician.

Let $y = \cos\theta + j\sin\theta$ ..... (1)

Where j stands for $\sqrt{-1}$

Then multiplying (1) by j we get:

$$jy = j\cos\theta - \sin\theta$$

Also by differentiating (1) $\frac{dy}{d\theta} = -\sin\theta + j\cos\theta$

Therefore $\frac{dy}{d\theta} = jy$

and $y = Ae^{j\theta}$

Where A is a constant and $e^{j\theta}$ is to be taken as defined by the ordinary exponential series.

By (1) $\cos\theta + j\sin\theta = Ae^{j\theta}$

To find the constant A, put $\theta = 0$

We then get $1 = Ae^{0}$. Therefore $A = 1$

and $\cos\theta + j\sin\theta = e^{j\theta}$ ..... (2)

Writing $-\theta$ instead of θ and remembering that $\cos(-\theta) = \cos\theta$ and $\sin(-\theta) = -\sin\theta$ we get

$$\cos\theta - j\sin\theta = e^{-j\theta} \quad \ldots\ldots (3)$$

Adding and substracting (2) and (3) we get the exponential values of $\cos\theta$, and $\sin\theta$. and then writing $e^{j\theta}$ and $e^{-j\theta}$ as exponential series we get the expansions of $\cos\theta$ and $\sin\theta$. in powers of θ.—I am, &c.,

William Lucas.

London, N., Jan. 9.

THE THERMAL OHM.

To the Editor of THE ELECTRICIAN.

Sir,—May I make the following points in reply to the letter from Doctor Carl Hering, which appeared in your issue of the 6th inst.

Doctor Hering is quite right in pointing out that the employment of the thermal ohm is not new, and, as a matter of fact, quite early in my article I made the following observation:—"The following

notes lay little claim to originality. The simple principles emphasised were recognised by the earliest writers on cable heating, and several investigators have, to some extent, interpreted their results in the manner discussed."

If one were to seek the real originator of the expression one would be inclined to claim the honour—if the word "honour" can be applied to the introduction of a treatment so obvious—for Kennelly's pioneer article, which appeared in the "The Electrical World" as long ago as 1893.

After Doctor Hering's 1912 articles, and shortly before mine of last year, the Report of the British Research on Buried Cables was published. If he followed the report and subsequent discussion in detail, I am sure Doctor Hering will agree that there was still room for a wider appreciation of the advantages of the thermal resistance method.—I am, &c., P. Dunsheath.

London, Jan 7. 1822.

The Election and Trade.

By ERNEST J. P. BENN.

It used to be said that there is no politics in business, and we are still fortunately able to say that there are no party politics in business; for no political party, unless it be the Socialists, has yet succeeded in attaching itself to the business world in such a way as to make it necessary for trade associations and chambers of commerce to take a definite party line. That is a state of affairs which we hope may never come. Nevertheless, the business world is very deeply interested in the question of an election, whether it takes place within the next few weeks or in the autumn.

Industry and business are at the mercy of the politicians, irrespective of party. There is no party which does not intend to carry out its designs at the expense of the business community, and the time has arrived when business people in sheer self-defence are bound to throw off their old disinterest and take an active part in the selection of candidates and members for the forthcoming Parliament. Fortunately this is possible without infringing the rule which bars party politics from business. All the candidates who will presently submit themselves for our suffrages, with again the only exception of the Socialists, will explain to us how deeply interested they are in the question of economy. The business community, if it would only take the matter seriously, is strong enough to turn this extraordinary position to great advantage.

But although we have innumerable trade organisations there does not seem to be one amongst them which has thought it worth while to tackle this question of economy and taxation in detail. All those who have authority to speak for industry have told us that taxation must be reduced before trade can revive. Politicians take all such statements as *ex parte*, and continue to calculate how they can go on collecting taxes and relieving such distress as becomes troublesome. The direct method of the dole appeals so much more strongly to the simple political mind than the indirect method of sound economics. Business men know that the more there is collected and distributed as dole, the worse will employment become, but he does not appear so far to have thought it worth while to take the trouble to reduce this obvious truth to such a basis that the public and even the politician can be expected to understand it.

The Simple Question.

The simple question which every business man should ask himself is this. Supposing that taxation and rates were reduced by bringing down the income-tax from 6s. to 4s. 6d., reducing rates from their present height to 5s., and abandoning the excess profits duty and Corporation tax, how far should I be in a better position to offer employment to the unemployed? There is no reason why every business man should not take his rates and taxes for 1921, calculate how much he would have saved had they been at the new rate, and from the figures thus secured, arrive at an estimate as to his ability to employ. The saving in rates and taxes, however, means a great deal more than the direct employment of labour by the people who are spared part of their present burden. It at once creates further employment, and that by the most direct method. If the extra wages means extra business, that again makes further demand upon somebody.

The new rates of taxation suggested above would mean that in 1922 the business community would have at their disposal certainly not less than two hundred and fifty millions which last year was taken from them. There are something less than two million registered unemployed. It is conceivable that with two hundred and fifty millions to spare trade could absorb two million extra workers.

A Plebiscite of Industry.

I throw out the suggestion in the hope that the readers of this journal will write me on the subject. Benn Brothers, Ltd., owning nine trade papers, are in a unique position to test the feeling of the country on a question like this. We could, if it were thought desirable, conduct a sort of plebiscite of our nine industries from which statistics could be framed, which would take this question out of the realm of argument and speculation and bring it down to arithmetic. I should be glad, therefore, if the readers of the Electrician would be so good as to write to me and say whether if some simple form were devised they would be willing to go into their figures for 1921 and state their opinion as to the effect upon employment of reduced taxation in 1922.

Compensation for Deprivation of Employment

The arbitrator (Sir Wm. Mackenzie, K.C.), who recently heard evidence on the claims, made under Sec. 16 of the Electricity (Supply) Act by certain members of the staff of the Morley Electricity Department for compensation for deprivation of employment, has issued his award. The claims, which were supported by the Electrical Power Engineers' Association, were made by the chief engineer (Mr. J. E. Ellis), the chief assistant engineer (Mr. H. C. Crisp), and a charge engineer (Mr. A. Fisher). In April last Morley ceased to operate its generating station and commenced to take a bulk supply of electricity from Leeds. Messrs. Ellis and Crisp's claims were based on a loss of status, and Mr. Fisher's on loss of employment, because he was no longer in the service of the Corporation. Mr. Ellis also claimed for being deprived of the right to take pupils.

Basis of the Claims.

For Mr. Ellis it was stated that, although he had been retained by the Corporation at approximately the same salary as he would have received had the generating station continued to be in operation, he had suffered financial loss, as his status as borough electrical engineer had been considerably reduced. He also had premium pupils, who were a reliable source of income up to the period of the war, and he could justly expect to have that source of income renewed if the generating station remained in operation. Though there had been no formal agreement on this point, the privilege had been allowed by the Corporation.

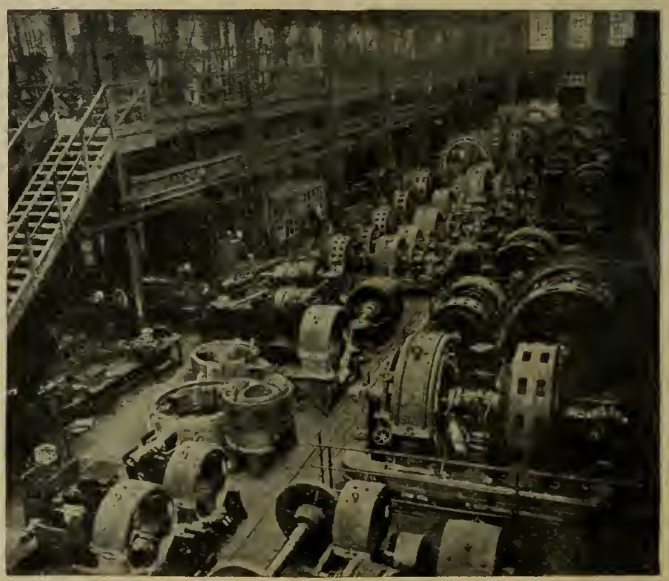
With regard to Mr. Crisp, it was said his position had been reduced to a degree similar to that of Mr. Ellis, and his duties were reduced to those of a minor character, such as wiring and meter testing, and the possibility of securing a position similar to that which he held prior to the arrangement had been materially reduced. It was also contended that both Mr. Ellis and Mr. Crisp had suffered loss inasmuch as the possibilities of advancement, either on the Morley undertaking or upon some other undertaking, had been considerably reduced, and that, therefore, both cases came within the ambit of Section 16 (3) of the Electricity (Supply) Act of 1919.

The Award.

Sir Wm. Mackenzie finds (1) that the claims of Mr. Ellis and Mr. Crisp on account of loss of status have not been made out; (2) that the permission or right to take pupils by Mr. Ellis had become a condition of service, and, therefore, as he had been placed in a worse position, he awarded him £140 compensation; that as Mr. Fisher had lost his employment he was entitled to £81. No costs were awarded.

Bruce Peebles' Heavy Test Plate.

The illustration shows part of the heavy test bed at the works of Bruce Peebles & Co., Edinburgh. At the time the photograph was taken (November 21st) some eleven Peebles-La Cour motor converters were under test, in addition to two 300 kW induction motor generators for Tasmania. The eleven motor converter sets were as follows:—



Part of the Heavy Test Bed at Bruce Peebles Works.

One 1 500 kW; three 1 000 kW; one 600 kW; five 500 kW; one 300 kW. The value of the machines was approximately £67 000.

The 1 500 kW converter mentioned above is for the Edinburgh Corporation, and the company have on hand at the present time for the Corporation, six 1 500 kW and two 500 kW motor converters, two 500 kW synchronous motor generators, and a three-machine battery booster, in addition to a large number of both vertical and horizontal auxiliary motors for the condensing and coal handling plant.

Electricity Supply.

In the early hours of Saturday there was a breakdown at the SOUTHPORT electricity works, and certain parts of the town were plunged in darkness for some time.

ARGYLL County Council have arranged to meet in Glasgow on Wednesday, Jan. 18, to consider the question of petitioning against, and, if necessary, opposing, the Grampian Electricity Supply Provisional Order.

At the adjourned monthly meeting of BELFAST City Council last week the question of the reorganisation of the electricity power-house was discussed at some length, and ultimately referred to the Council in committee.

The Borough Surveyor's Department of MANCHESTER Corporation is preparing a map 25 ft. square in connection with the inquiry to be held by the Electricity Commissioners next week into the South-East Lancashire Electricity District.

DARWEN Town Council have just entered into agreements with the Darwen Cotton Manufacturing Company, Harwood Brothers (1920) Ltd., and A. Carus & Sons, cotton manufacturers, for the supply of electricity for power purposes,

A 5 000 kW generating set, manufactured by Metropolitan-Vickers Electricity Company for STRETFORD Council's electricity station at Trafford Park, Manchester, was officially started on Monday by Coun. Sir Thomas Robinson, M.P., chairman of the Electricity Committee.

The old Davies-street generating station, and until recently a sub-station of the WESTMINSTER ELECTRIC SUPPLY CORPORATION, has been sold by private treaty for about £20 000. As soon as the machinery has been removed by the Corporation it is intended to reconstruct the building for flats.

A Provisional Order will be granted extending the borough boundary of WOLVERHAMPTON by the inclusion of several adjoining districts. The new borough will have an area of 14 000 acres, as against the present 3 000 acres. The population will be increased from 102 000 to 138 000.

At the monthly meeting of DOVER Electricity Committee last week the electrical engineer stated that the new plant would be working at the end of this month, and then there would be a saving of 50 per cent. (about 3 000 tons) on the amount of coal used per year. With the falling price of coal, the consumers are hoping shortly for a substantial reduction in charges.

There was a failure of the electricity supply on Friday afternoon at OLDHAM. Business in the centre of the town was brought to a standstill, and the newspapers were unable to publish until the evening. The "Manchester Guardian" states that a short circuit developed early in the morning at the bottom of Yorkshire-street, causing the underground electric cable to fuse. Fire broke out in the gas main conduits in consequence, and explosions occurred at several of the underground inspection chambers. Fires broke out along Union-street and Yorkshire-street, and in the afternoon further underground explosions occurred, which resulted in the cutting-off of the light and power supply in the principal thoroughfares and business houses of the town. Later in the evening most of the electricity supply had been resumed.

The question of what remuneration, if any, should be paid to Mr. C. F. McInnes, GRAVESEND Electrical Engineer, for the preparation of plans for the electricity extensions, involving £70 000-£80 000, and for the supervision of the work, was the subject of a heated discussion at the meeting of the Council last week. The Electricity Committee had recommended £200. Councillor Priestley (chairman of the committee) moved that instead of £200 Mr. McInnes should receive 1¼ per cent. on the contract. (He also read a letter from him stating that he could not undertake the extensions for £200.) This suggestion was objected to by several members of the Council, who maintained that £875, which 1¼ per cent. would amount to, was preposterous. Other members were strongly of opinion that the work came into the ordinary duties of the engineer, and if Mr. McInnes would not undertake them he must resign. Finally, it was agreed to refer the matter back to the Electricity Committee.

New Schemes and Mains Extensions.

WINCHESTER Town Council have received sanction to a loan of £1 000 for water-cooling plant in connection with the electricity undertaking.

DURHAM City Council are contemplating lighting the market place with electricity, and an estimate is to be obtained from the ELECTRICAL POWER DISTRIBUTION COMPANY.

MAIDSTONE Council have applied for loans of £3 300 for two 1 000 kVA transformers, £1 250 for mains, switchgear and transformers, and £700 for giving an increased supply to the Medway Milling Company.

It is proposed to light SPALDING by electricity. The town is to be canvassed for probable consumers, and a committee has been appointed by the Urban Council to investigate and report on the financial aspects of the proposed scheme.

TORQUAY Town Council have decided to apply for powers to enable them to carry out the terms of a draft agreement, whereby it is proposed to purchase and work the undertaking of the Urban Electricity Supply Company at Newton Abbot.

To meet increasing demands upon the supply of electricity, EASTBOURNE Corporation are spending upwards of £70 000 upon improving the plant of their undertaking. They have been asked to extend their mains to certain of the neighbouring villages.

The Town Commissioners have appointed a sub-committee to report on the question of lighting EDENDERRY by electricity. The report, it is understood, will be based on the fact that a dynamo in Alenbury's Mills will be available for the purpose at a reasonable figure.

In regard to the loan of £165 541, sanctioned by the Electricity Commissioners last July, HACKNEY Borough Council have decided to apply to the London County Council for the sum of £60 000, to be repaid with interest at the rate per annum current at the date of the advance.

HAVERFORDWEST Town Council at its last meeting discussed a scheme of lighting the town with electricity. Under the proposals the Council have the option at the expiration of twenty years of purchasing the undertaking. Negotiations in connection with the matter are still proceeding.

The Electricity Commissioners have approved the application of WORCESTER City Council for a loan for the extension of the generating station. At their meeting last week the Council approved the proposal to light the twenty-four new Corporation houses on the Bromyard-road by electricity.

With reference to the offer of the BOSTON DEEP SEA FISHING & ICE COMPANY to supply electricity to the town, the managing director of the NATIONAL ELECTRIC CONSTRUCTION COMPANY, which hold a Provisional Order, has informed the Town Council that his company intend shortly to take up the matter with a view to carrying out the obligations.

PRESTON Town Council have applied for a Special Order for sanction to supply electricity within the borough, the urban district of Fulwood, and the parishes of Broughton, Lea, Ashton, Ingol and Cottom, Woodplumpton, Barton and Penwortham, in the rural district of Preston, and to acquire and use for the purpose of a generating station land in the township of Penwortham.

The BURTON-ON-TRENT Electricity Committee recommend the Town Council to borrow £20 000 for the purpose of extending the electricity undertaking. The Corporation is to supply a large area in Derbyshire, Staffordshire, and Leicestershire under the East Midlands Electricity scheme, and the mains have already been extended for several miles outside the borough in various directions.

The village of SENNYBRIDGE (Breconshire), which is becoming known as a marketing centre and the *locale* of an excellent agricultural show, is now lighted electrically, current being supplied by a small hydro-electric station. A company was recently floated, and nearly all the business premises, as well as many private residences, are enjoying the advantages of electric lighting.

At last week's meeting of the Executive Committee of the Dublin Citizens' Association the opinion was strongly expressed that RATHMINES AND PEMBROKE should not proceed with their projected electricity scheme, involving an estimated expenditure of £50 000, in view of the probable incorporation of the two townships with the metropolis in the near future, and before the commercial possibilities of procuring electrical power from the Poulaphouca Falls of the Liffey had been thoroughly considered.

As the result of a joint meeting between the PRESTON AND BLACKBURN Electricity Committees last week, it has been decided to connect the new Blackburn station at Whitebirk with the proposed station at Preston with a duplicate main at an estimated cost of £138 000, the expenditure to be borne equally by the Blackburn and Preston authorities. Arrangements are to be made for supplying customers *en route*, and Mr. J. A. Robertson, electrical engineer of Salford, has been instructed to prepare a scheme for the supply of the district, his expenses to be shared equally between the two authorities. Blackburn and Accrington Councils are also contemplating a similar supply main, so that the whole of the district from Accrington to Preston will be linked up.

Alteration of Charges.

CANNOCK Urban Council have agreed to the recommendation of the Electricity Committee to make 8d. the maximum charge for electricity for lighting purposes.

WATFORD Town Council has decided to reduce the charge of electricity for the quarter ending March next by 10 per cent., making the increase over pre-war rates 70 per cent.

As from Jan. 1 the charges of electricity at ROTHERHAM have been reduced from 150 to 100 per cent. on pre-war rates for power and heating and from 75 to 62½ per cent. for lighting.

WOLVERHAMPTON Town Council have decided to reduce the charges of electricity to consumers by 10 per cent., meter hire by 35 per cent., and the rate per unit charged to the tramways from 2½d. to 1·16d.

BURNLEY Electricity Committee have acceded to the request of photographers that all electricity consumed in connection with the manufacure of photographs and photographic materials be charged at power rates.

The question of the possibility of reducing the price of electricity was discussed at last week's meeting of DERBY Town Council, but it

was decided that no alteration could be made, at any rate during the present financial year.

WINCHESTER Town Council has reduced, as from Oct. 1 last, the war addition to the basic price of current from 55 per cent. to 40 per cent., and application has been made for an Order fixing the maximum price of electricity at 9d. per unit.

The Ministry of Transport, in refusing to receive a deputation from WEYBRIDGE AND WALTON Councils protesting against the Ministry's decision to raise electricity from 10d. to 1s. per unit, point out that the maximum price can be revised at any time after Nov. 7, 1926!

From the 1st inst. the price for electricity for lighting at DUDLEY has been reduced from 80 per cent. to 60 per cent. over the rates specified in the agreement with the Power Company on the sale of the undertaking, on the understanding that no other price reductions are pressed for within at least the next six months.

LEEDS City Council have decided to reduce the charges for electricity for power from 80 per cent. to 50 per cent. over the 1916 charges, and for lighting from 80 per cent. to 70 per cent. above the 1916 rate. An amendment by the Labour Party that the increase in both cases should be only 50 per cent. on 1916 charges was rejected.

The WESTMINSTER ELECTRIC LIGHT CORPORATION announce that from the Christmas quarter's readings a reduction of ½d. per unit will be made on the first 1 000 units used in any one year for lighting purposes, and ½d. per unit on all units used for heating, cooking and power purposes. The reduction has been made possible by the decrease in the price of coal. From the date of the Christmas quarter's readings, therefore, the charges will be as follows:—Lighting, for the first 1 000 units 7½d. per unit, for the next 3 000 units 7d. per unit, for all units used in excess of 4 000 5½d. per unit; heating, cooking and power, if taken through a separate meter, 1½d. per unit.

ILFORD Urban Council has adopted the following decreased scale of charges for electricity:—Residential premises, 12½ per cent. per annum on rateable value, subject to an increase of 75 per cent., plus 2d. per unit, for March and December quarters, and 1½d. for June and September quarters; lighting 8d., or maximum demand system 9d. and 6d. Power, m.d. system, 6d. and 3d. per unit; first 500 units, per quarter, 5d.; next 1 000, 4½d.; next 1 000, 3¾d.; all over 2 500, 3½d.; 10 000 units and over, 3¼d. Heating, &c., March and December quarters, 3½d.; June and September quarters, 2d. For cinemas, vehicle charging, photo lamps, &c., a reduction of 12½ per cent. has been made, reducing total war increase to 112½ per cent. The minimum charge in the March and December quarters is 11s. 3d., and in June and September 7s. 6d. for each quarter.

Municipal Accounts.

The traffic returns for the READING CORPORATION TRAMWAYS show receipts from April 1 to Dec. 1 of £55 576, compared with £58 624 for the corresponding period last year.

The accounts of HACKNEY Borough Electricity Undertaking for the year ended March 31, 1921, show a net profit of £13 950. It has been decided to allocate £4 000 towards the relief of the general rates.

The accounts of HOVE ELECTRICITY UNDERTAKING for the year ended March 31 show the total income to be £39 703, as compared with £31 436 in the previous year. The total expenditure was £25 763, against £17 060, leaving a gross profit of £13 939 (£14 376). Of this sum, interest on capital absorbed £6 313, repayment of principal £4 043, taxes £618, leaving a net balance of £2,595, compared with £3 920 in 1920. Units generated numbered 1 593 428. With regard to the ALDRINGTON section, the total income was £3 385, against £2 560, and the total expenditure £2 529, leaving a gross profit of £856, against a deficit of £788 in the previous year. Of this sum, £239 went in interest, and £446 in repayment of loans, while £136 was absorbed by taxes. The net balance was £34, as compared with a deficiency of £1 223 on the whole account in the previous year. Units generated numbered 130 761.

Electricity in Birmingham.

In a review of the industrial developments for the past year, the "Birmingham Post" states that the output of electrical energy by the BIRMINGHAM Electric Supply Department was about 75 000 000 units in the year ended Sept. 30, compared with about 100 000 000 units in the preceding twelve months. New motors representing 9 282 H.P. were connected, against 10 977 H.P. During the last three months 660 new industrial and household supplies were connected, and at the turn of the year consumers representing a load of 3 500 kW were awaiting connection, and the decrease in the load due to the coal stoppage and industrial depression was rapidly being made good by new connections to the mains. The supply resources of the department are being steadily extended. Two 15 000 kW turbo-alternators are being installed at the Nechells generating station, and a similar set is on order. These additions will give a capacity of over 110 000 kW. Large additions are also being made to sub-stations plant and to the distribution system. Among industrial developments electric furnaces are making some headway in Birmingham, and electric welding is also likely to enlarge its sphere of operations. The use of electricity in connection with certain aspects of glass manufacture is also increasing.

Electric Traction.

DERBY Town Council has requested the Tramways Committee to consider the advisability of introducing penny fares.

LEEDS City Council have decided to allow twelve passengers to stand inside the trams in rush hours instead of eight.

The L.C.C. is negotiating with the London United Tramways Ltd. regarding a THROUGH TRAMWAY SERVICE FROM LONDON TO WIMBLEDON.

ST. ANNES tram receipts for November were £2 279, against £2 597 for the corresponding period of 1920. The receipts for the full period to the end of November amounted to £42 196, compared with £43 683.

The BLACKBURN Parliamentary Bill for powers to extend the tramways and run motor omnibuses, &c., has been rejected at the ratepayers' statutory meeting, and a plebiscite of the ratepayers will probably be taken.

By 1 073 votes to 72 the employees of the DUBLIN TRAMWAY COMPANY decided last week on a strike on the proposed reduction of 5s. a week and the refusal of the inspectors to remain members of the Tramway and Vehicle Workers' Union.

BURNLEY Tramways Committee have decided against the introduction of the "reversed" type of staircase in double-decked tramcars, and the Ministry of Transport has decided not to approve the construction of the "reversed" type.

The Ministry of Traction have appointed a committee to consider and report upon the CONTROL OF OMNIBUS TRAFFIC. Recently there have been demands by tramway undertakings for the regulation of the stopping places and routes of omnibuses, &c., and the whole question will be investigated by the new committee.

After passing a resolution by 34 votes to 24 at a special meeting recently in favour of SPAN WIRES IN PRINCES-STREET, Edinburgh Town Council have now decided by 37 votes to 22 against them, and the Ministry of Transport is to be approached with a view to obtaining permission for the erection of centre poles.

As foreshadowed in our issue last week, SCARBOROUGH electric trams are not to cease running. They have been purchased by a syndicate of London and Yorkshire tramway engineers. It is explained that the decision to close down was brought about by a demand upon the company for road repairs involving an outlay of between £4 000 to £5 000.

It has been agreed, by seventeen votes to fifteen, at the monthly meeting of the Town Council, to place electric runabouts on the UNDERCLIFF DRIVE between BOSCOMBE and BOURNEMOUTH Piers, but before definitely accepting an estimate as to the cost, further inquiries are to be made as to whether the proposed type of vehicles suggested will be absolutely satisfactory.

Petitions signed by some 500 night workers living in many of the south-western districts in London have been forwarded to the London County Council requesting an adjustment of NIGHT TRAMWAY SERVICES on the Brixton and Tooting routes which will more fully meet their needs. The reorganisation for which they are asking would give an independent night service from the Embankment on each route, an extension of the Brixton service to Telford-avenue and the Tooting service to Merton.

READING Tramways Committee have passed a resolution supporting the opinion expressed by the Municipal Tramways Association that the Roads Act of 1920 encourages wasteful and overlapping competition with municipal tramway and motor omnibus undertakings which will result in increased travelling charges, and is concontrary to the intention of Parliament, and that a request should be made to the Ministry of Transport that such competition should be subject to statutory regulation in the public interest.

At the annual meeting of the DOUGLAS (ISLE OF MAN) SOUTHERN ELECTRIC TRAMWAYS, LTD., it was stated that an agreement had been entered into with the Douglas Head Marine Drive Company, by which, at the end of the concession in 1926, the Drive Company would take over the tramways as a going concern, paying the agreed or arbitrated value of the mechanical and electrical plant and half the value of the permanent way. The number of service days in 1921 was 96 (1920, 130); passengers carried, 181 242 (267 671); car mileage, 25 240 (32 420); traffic receipts, £8 062 (£15 539); total receipts (less tolls), £8 062 (£11 763); expenses, £5 637 (£5 737); net profit, £2 425 (£6 025). On the ordinary shares a dividend of 5 per cent. was declared.

BIRMINGHAM Tramway Committee do not see their way clear to recommend a reduction in fares at present, but hope within a few months to be able to do so. It is estimated that during the current year, owing to the coal dispute alone, the committee's revenue was diminished by nearly £70 000. This was followed by the industrial depression. Since the beginning of July the income has decreased by upwards of £100 000, or an average of £4 600 per week, as compared with the corresponding weeks of last year, and, having regard to the considerable amount of unemployment still prevailing in the city, there does not appear to be any prospect of immediate improvement. It has also been necessary during the past year to spend large sums upon permanent way reconstruction works, chargeable to the year's trading of the department. There is now a downward tendency in wages, and to some extent in cost of material, but no appreciable benefit from these will result during the present financial year.

Personal and Appointments.

Mr. A. Simmons has been appointed manager of the Kent Coast Electrical Company, 85, High-street, Broadstairs.

Submarine Cables Trust have appointed Sir John Denison Pender, G.B.E., K.C.M.G., trustee in the place of the late Lord Balfour of Burleigh.

Mr. W. North-Lewis, J.P., has been appointed chairman of the Treforest Electrical Consumers Company, Ltd., in place of the late Mr. Hugh Bramwell.

The works staff of the British Insulated and Helsby Cable Company have presented a gold watch to Mr. George Lloyd on the occasion of his leaving the firm.

St. Annes Council have appointed Mr. Stanley Pendlebury as teacher of the electrical science class at the Technical School, in the place of Mr. J. Fairchild, resigned.

Mr. W. Rutherford, formerly managing director of Dick, Kerr & Company, and subsequently of the English Electric Company, has been elected a director of G. D. Peters & Company.

Mr. W. Prescott, of the head office staff of the Federation of British Industries, is to act as the representative of the Federation on a committee of the Institution of Electrical Engineers to consider the standardisation of electric wiring.

The regrading of some members of the technical staff of the Hackney Electricity Department has taken place. Mr. W. Barham has been placed in Grade 5 of the Schedule of the National Joint Board, and will be designated Constructional Engineer. Mr. E. Mathews is in Grade 6, and becomes Meter Superintendent. Mr. A. G. Hilling and Mr. E. Wilkinson are in Grade 6 of the Schedule, and are designated Assistant Distributing Engineer and Assistant Power Station Superintendent respectively.

Mr. N. W. Prangnell has severed his connection with C. A. Parsons & Company, at Heaton Works, and has started business on his own account as a manufacturer's area representative, with offices at 47, Pilgrim-street, Newcastle-on-Tyne. He has been appointed representative of the following firms :—Twiss Electric Transmission, Ltd., London Electric Firm, Electric Street Lighting Apparatus Company, Venner Time Switches, Ltd., Berry's Electric, Ltd., Scholey & Company, Ltd., Automatic Electric Furnaces, Ltd., Chadburns (Ship) Telegraph Company, Ltd (land interests), Ewart & Son, Ltd.

A statement has been issued by Senator Marconi, chairman of Marconi's Wireless Telegraph Company, with reference to his connection with the Banca di Sconto of Rome. He states that in consequence of his technical work requiring that he should be absent from Rome for considerable periods of the year, it was agreed that he should not be expected to take any part in the direction of the bank's affairs. He had not attended any meeting of the Board for about a year, and therefore knew nothing of what is responsible for the present situation. "The sequestration applies to the directors only until such time as each will have given evidence of his irresponsibility." Senatore Marconi is about to proceed to Italy.

On the recommendation of the Graduate Award Committee the North-East Coast Institution of Engineers and Shipbuilders have awarded a prize of £5 to Mr. Burn for his paper on "Diesel Engine Flexibility." This paper was read before the general members of the Institution at Newcastle last week, and Sir J. W. Noble, who presided, said it was the first occasion in the history of the Institution at which a paper previously read at the graduate section had been selected to be read before the general members. In view of the remarks of the Awards Committee, the paper had been submitted to the Reading Committee as being suitable for publication in the Transactions of the Institute. It was unanimously recommended that the paper be printed.

Business Items, &c.

A petition for confirming the resolution reducing the capital of P. R. Jackson & Company, Ltd. and Reduced, from £120 000 to £60 000 is directed to be heard before Mr. Justice P. O. Lawrence on Jan. 17.

Messrs. R. Wilson & G. Dickson have started business as electrical engineers at 183, High-street, Ayr. Mr. Wilson was for over twenty-six years manager of the electrical department of Reid & Company, 108, High-street, Ayr, and Mr. Dickson was the firm's leading electrician for over twenty years.

The Liverpool Electric Cable Company announce that as from Jan. 1 their London office has been removed from 219, Tottenham Court-road, London, W. 1, to 9, Playhouse-yard, Golden-lane, London, E.C. 1 (the offices of the London Electric Wire Company & Smiths, Ltd., with whom they are associated), at which address large stocks of ordinary types of rubber insulated cables and flexibles and C.T.S. cables and flexibles will be carried.

In connection with the large order entrusted to Braithwaite & Company (Engineers), Ltd., of West Bromwich and Newport, Mon., for a steel pipe 114 miles long, 6 ft. diameter, for supplying water to the city of Bombay, India, Royce Ltd., of Trafford Park, Manchester, have received an order from Messrs. Braithwaite for the full equipment of electrical overhead travelling cranes, eleven in number, for workshops which Messrs. Braithwaite are erecting to carry out the work.

T. H. Watson & Company (of Sheffield), Ltd., announce that the Ford Motor Company have placed an order for "Greaves-Etchells" electric furnaces with the Electric Furnace Construction Company (the American branch of T. H. Watson & Company, of Sheffield, Ltd). The order includes the largest electric steel-melting furnace yet designed. Its capacity will be 9 000 kVA and over 60 tons of steel, being fitted with six electrodes. Two "Greaves-Etchells" electric furnaces are already operating at the Ford works at Detroit, and, in addition to the large furnace mentioned above, two 10-ton "Greaves-Etchells" furnaces are ordered. The large furnace will be the principal melting unit of the new battery of electric furnaces for the Ford Company's River Rouge Works.

Mr. Ashley Pope asks us to state that he has commenced business on his own account at Toddington, near Dunstable. He is acting as agent for the Moorlands Engineering Company, of Leek, manufacturers of boiler-feed pumps, Brian pumps for refrigerating plants, and oil pumps, which are specially designed for dealing with fuel oils, syrups, and colloidal mixtures, and all liquids of high viscosity, also air and circulating pumps and auxiliary surface condensers, &c. He has also the agency for Crowther & Osborn for the counties of Middlesex, Essex, Hertfordshire, Bedfordshire, Buckingham, Oxfordshire, Berkshire, Surrey, Hampshire, Sussex and Kent. Crowther & Osborn are manufacturers of the well-known "Sceando" lamps, which are made in the usual standard sizes of 1 W and ½ W types. Mr. Pope is also specialising in street, workshop and shop lighting fittings.

Institution Notes.

The next salesmanship conference of the British Electrical Development Association will take place on Friday, Jan. 20, at 8 p.m., at the Chartered Institute of Patent Agents, Staple Inn-buildings, W.C. 1, when a discussion on "Salesmanship in Relation to Electric Heating and Cooking" will be opened by Mr. W. A. Gillott.

As a result of the experience obtained by keeping the library open every evening and Saturday afternoons during the last few weeks, the Council of the Institution of Electrical Engineers have decided that in future the library will be kept open until 9.30 p.m. on the nights on which are held the ordinary meetings of the Institution, the informal meetings, and meetings of the wireless and students' sections.

The annual meeting of the Iron and Steel Institute will take place on Thursday and Friday, May 4 and 5, at the house of the Institution of Civil Engineers, Great George-street, London, S.W. 1. The annual dinner will be held on the evening of Thursday, May 4, at the Connaught Rooms, Great Queen-street, London, W.C. Members are reminded that in March the Council is prepared to consider applications for grants from the Carnegie Fund in aid of research work. The latest date for receiving applications from candidates for election as members of the Institute is March 22.

The Chelmsford Engineering Society had an interesting discussion on "Gas *v.* Electricity" at their last meeting, held under the presidency of Mr. G. F. Barrett. Mr. C. Becket, of the British Commercial Gas Association, opened the discussion by enumerating the advantages which he contended gas had over electricity, dealing mainly with the comparative cost. Mr. C. S. Buyers, of Crompton & Company, spoke from the standpoints of light, heating, and power, and argued that electricity was superior to gas on each of those points. The expense of upkeep ought to be taken into account when considering the comparative costs, and he contended that electricity was cheaper than gas for many purposes. Mr. W. W. Mason, of the British Commercial Gas Association, said it was a disaster to the whole nation that the gas and electricity industries did not go hand in hand, but were at cross purposes. A discussion followed.

Many exhibits of interest to the electrical industry were shown at the exhibition at Birmingham in connection with the annual conversazione of the Council of the Midland Institute. A demonstration was given by the Electrical Engineering Department of the University of Birmingham of the application of the thermionic tube to the reproduction and amplification of transmitted speech and music. The Midland Institute Scientific Society's exhibit, which takes up nine rooms, included an automatic alarm by the Marconi Company and the Elverson oscilloscope, by means of which it is possible accurately to observe the actual behaviour of high-speed machinery. Other interesting scientific exhibits were a sound mill (by Mr. W. Bentley), a synchronised pendulum, a ripple tank, demonstrating wave motions as applied to some of the phenomena of light, the spectrum of an electric spark, dictograph telephone, spot-welding machinery, engineering and survey instruments.

Obituary.

The death is announced of Mr. F. Foord Kelcey, C.B.E., a former Professor of Mathematics at the Royal Military Academy, Woolwich.

The death is announced of Sir William Matthews, K.C.M.G., a past-president of the Institution of Civil Engineers and a well-known harbour engineer. He was created a C.M.G. in 1901 and a K.C.M.G. in 1906, and was a representative of the Institution of Civil Engineers on the main committee of the British Engineering Standards Association.

Telegraph and Telephone Notes.

Wombwell Town Council has been informed by the Postmaster-General that, unless unforeseen difficulties arise, a telephone exchange will be installed in the town without further delay.

At a conference at Sheffield, last week, between the Japanese Commercial Mission to England and prominent Sheffield business men, the latter urged the importance of the improvement of telephonic communication in Japan, and asked for reciprocity in shipping, particularly in coastal traffic.

Press telegrams at reduced rates for Austria, Lithuania, Poland, and Czecho-Slovakia are now accepted at post offices, on the usual conditions, between 9 a.m. and 12 noon, as well as between 6 p.m. and 9 a.m. Press telegrams for Esthonia and Latvia are accepted between 9 a.m. and 11 a.m., as well as between 6 p.m. and 9 a.m.

The Telegraph Money Order service with British Overseas Dominions, Dependencies, &c., will be extended on Jan. 2 to Kenya and Uganda. A special feature of the service is that the telegrams of advice may be sent at the deferred rate, which reduces the telegraph charges by one-half. The full-rate service is available for cases of special urgency.

A singular accident occurred to the 6.55 train from Worthing one morning last week. It had not proceeded far on its way to London Bridge when, according to an official statement, a telegraph wire which had broken, probably owing to the gale, caught the handle of one of the carriage doors and wrenched it off, with the result that four windows were smashed. There were no personal injuries, and the train was only delayed for seven or eight minutes.

The new London Telephone Exchange, which is to be erected in Wood-street, E.C., will, when completed, be the largest in Europe. The site has already been acquired at a cost of £50 000, but the actual date when building operations will be begun has not yet been decided. The new exchange will be known as a three-unit exchange, and will cater for 30 000 subscribers. As, however, no single exchange can consist of more than 10 000 lines, the new exchange will have three separate names, each with 10 000 lines.

Since the London Toll Exchange was opened in September last there has been a steady increase in the use of the service from 30 534 calls in September to 34 188 in December. The official records show that only 5 per cent. of the "Toll" calls made throughout the day fail to secure immediate connection, and have to be booked for completion later, and about half of the calls so booked are received during the "rush" hours of the morning, when all lines are taxed to their maximum capacity.

A new underground telephone cable has been laid between Liverpool and Manchester. It consists of 160 pairs of copper wire, each weighing 40 lb. per mile. It is 36½ miles long, and the connecting up of the comparatively short lengths in which it can be drawn into the ducts required 160 000 soldered joints, each one of which had to be electrically tested. Notwithstanding the length of the cable, its speaking efficiency, owing to the loading and balancing, is equivalent to that of a standard telephone cable nine miles in length. A cable is also to be laid between Manchester and London. Comparing the conditions which existed in 1896, when the trunk lines were taken over by the Post Office, and those existing to-day, it is stated that in 1896 there were only 23 circuits between Liverpool and Manchester. Of these 13 were constructed by the late National Telephone Company, five by the Mutual Company, and five by the Post Office, all of which were carried on pole lines, and rarely were the whole of the 23 circuits in working order on the same day. Prior to the completion of the new cable there were 173 trunk circuits between the two centres, 132 underground and 41 overhead. The new cable brings the total up to 333, of which 292 are underground and 41 overhead.

Imperial Notes.

Eastwood, Dundas, and Hornsby (N.S.W.) Councils are considering a joint electric supply scheme.

The Victorian Electricity Commission has approved a scheme for electricity supply in Benalla (Victoria).

The Board of the Karachi Electric Supply Corporation recently decided to order additional generating plant from England.

A new electric furnace with a capacity of 500 tons per month is in operation at the Vereeniging works of the Union Steel Corporation.

Mr. J. H. Butters, manager of the Tasmanian State Hydro-Electric Department, has approved the electric supply scheme drawn up by Mr. Lord for Scottsdale (Tasmania).

The Government of Jamaica propose to introduce another Bill during the 1922 session of the Legislative Council to authorise the State to use streams which run through private property for the development of hydro-electricity.

The State Hydro-Electric Department is continuing its investigations into the facilities for developing electric power locally for the towns on the North-West Coast of Tasmania, as it is believed that this will be more profitable than transmitting energy from the central plateau.

St. George (N.S.W.) County Council is borrowing £100 000 for a new electricity supply works for the towns of Rochdale, Bexley, Kogarah and Hurstville. The portion of the Illawarra railway serving these districts is being electrified, and is expected to be completed during the present year.

According to a correspondent of the "Times" Trade Supplement, all the hydro-electric power available in India is being used to the utmost by cloth mills and iron foundries. Cloth production is bound to expand very materially when the new hydro-electric works under construction are completed.

A poll of the ratepayers of Coraki (N.S.W.) has resulted in favour of establishing electricity supply in the town, and the Council has instructed T. W. Bridger & Co. to prepare plans and specifications. Negotiations for the purchase of electricity in bulk from the Moonembar Coal Company will probably be opened.

The Secretary of State for India has now approved the main principles of the recommendations of the Stores Purchase Committee, referred to in a recent issue of The Electrician, and Mr. J. S. Pitkeathly, superintendent engineer in the electrical and mechanical branch, Delhi, has been appointed chief controller of stores.

Sir John Monash (chairman of the Victorian Electricity Commission) states that coal mining at Morwell, where the Victorian Government intends to erect an electric power-house, will begin about the middle of the present year. The construction of the conduits for the cooling water from the Latrobe River has been commenced.

The Tasmanian State Hydro-Electric Department has made an offer to supply electricity to the municipalities of Kingston, Franklin, Huonville, and Port Cygnet, in the Huon district, south of Hobart. The Department offers to supply at £12 per E.H.P. per annum, but it is believed that Port Cygnet Council can do better by improving its existing plant.

A South African Press report states that the site belonging to Messrs. Steel, Murray & Company, Durban, has been purchased on behalf of the National Mutual Life Association of Australasia. The present building will be demolished and a modern building erected. United Kingdom manufacturers of materials likely to be required for the new building may deem it desirable to furnish H.M. Senior Trade Commissioner in South Africa (P.O. Box 839, Johannesburg) with copies of their catalogues and price lists.

A message from Johannesburg states that the Industrial Federation on Monday rejected the offer of the Chamber of Mines, and unanimously endorsed the resolution in favour of a strike, to start that evening. It is stated that the Federation Executive decided that for the present the essential services are to be maintained, including lighting in outside districts, hospitals, mines, &c., and the water supply. Except Johannesburg, the reef towns obtain their light and power from the Victoria Falls Company, and probably they will be affected. Victoria Falls power generation stations have only enough coal for a few days.

Cape Town Corporation have removed their restrictions on the use of electric current and power, and an immediate impetus has been given to the local market for fittings, cooking and heating apparatus. Contrary to the general impression, the bulk of the electrical plant of this type sold in South Africa is of British, and not American, manufacture, the "British and South African Export Gazette" states, and, although a certain amount of German competition is being felt, there is reason for saying that the British article is preferred, even if the price is slightly higher. Taking the Union's trade in electrical material and machinery as a whole, it is significant that, unlike many lines, purchases last year were greatly in excess of those in 1920, the business in cooking and heating apparatus alone being worth £35 692 in the first nine months of 1921, as compared with £28 195 for the same period in 1920.

Foreign Notes.

A scheme for electrifying all the railways in Norway is to be considered by a committee of the National Engineers' Association.

The November imports of German goods into this country show a drop of £18 746 under the heading of scientific instruments and domestic glassware.

The President of Brazil has issued a decree sanctioning the law which gives effect to arrangements for joining up railway and telegraph communications between Brazil, Paraguay and Bolivia.

The Esthonian Government has contracted with a German electrical works for mill equipment for the national dye industry, comprising generators, motors, &c., valued at 3 500 000 marks.

The co-efficient of increase in the French Customs Duty on dynamo brushes of artificial carbon, partly of copper, and on dynamo brushes of copper and graphite alloy, has been altered to 1·8, and that on other armatures to 5.

It has been provisionally agreed that the three former German submarine cables in the Pacific are to be allocated as follows:—To the United States the cable from Yap to Guam, to Japan the cable from Yap to Naba and the Japanese mainland, to Holland the cable from Yap to Menado.

A big trust has been formed in Berlin, under the title of the "Wirthschaftstelle für Handel und Industrie in den Osten," for the purpose of trading with Russia and developing its resources. The "Times" states that banking, commercial and industrial undertakings, as well as technical and scientific institutions and labour organisations, are all represented on the Trust, whose first business will be to increase the transport facilities of the country. Negotiations are proceeding with Messrs. J. P. Morgan & Company for the formation of a German-American fund of $250 000 000 for carrying on the business. This movement appears to be of considerable importance, and British engineers and manufacturers would do well to watch developments very closely.

The affairs of the Lisbon Tramways Company appear to be going from bad to worse. For 1919 there was a net profit of £74 505, and

for 1920 a net loss of £120 006. The results for 1921 will be even more adverse, as the company suffered from a long strike early last year, and the Portuguese exchange is operating adversely. A short time ago an agreement was made with the Government to grant an increase of wages to the employees, pending the appointment of a Commission to enquire into the financial position of the company. The report of the Commission was favourable to the company, and suggested several methods for an increase in the receipts, but no steps have been taken by the Government to adopt the suggestions of the Commission. An appeal has been made to the Portuguese Prime Minister, calling upon the Government to comply with the terms of the agreement, but up to the present no action has resulted. The company carries about 70 000 000 passengers per annum, and over £1 500 000 of British capital is at stake in the undertaking. The company has just paid the half-year's interest on its Debenture Stock.

Electrification Schemes in Japan.

Plans for the ELECTRIFICATION OF JAPANESE RAILWAYS have been drawn up by the Electrification Investigation Commission. It is proposed to electrify the following sections of line, which have an aggregate mileage of 2 000 :—

Kyoto-Kobe (47 miles), Minatomachi (*via* Kitsu-Kyoto) (51 miles), Kobe-Himeji (34 miles), Moji-Hakata (48 miles), and Osaka-Tennoji (6 miles).

The above are suburban railways, on which there is heavy railway traffic. On the under-mentioned there is a steep gradient with many tunnels, and there is abundant water power for utilisation on these routes :—

Odawara-Numazu (26 miles), Maibara-Imasho (47 miles), Hachioji-Shiojiri (116 miles), Nagova-Shinooi (151 miles), Fukushima-Yonezawa (26 miles), Yashiro-Kashima (94 miles), Kameyama-Nara (46 miles), Utsunomiya-Nikko (25 miles), Koriyama-Niigata (172 miles), Oguda-Shinjo (58 miles), Takasaki-Yokokawa (18 miles), Karuizawa-Naoetsu (92 miles).

On the Numazu-Kyoto section (244 miles) and the Omiya-Fukushima section (151 miles), shortening of the line is required, and water power can be utilised, while on the Himeji-Shimonoseki section (295 miles) the increase of transportation capacity and the shortening of the line are required. For the Imasho-Naoetsu (181 miles), Nagoya-Kameyama (38 miles), and Ohmiya Takasaki sections (46 miles) water power is available, and on Kokura-Wakamatsu (56 miles) and Muroran-Yubari sections (90 miles) increased carrying capacity is required, and coal can be obtained at low prices.

Electrification of Italian Railways.

The ELECTRIFICATION OF THE ITALIAN RAILWAYS is progressing rapidly. Work is nearing completion on the Genoa-Pisa-Spezia-Leghorn, and on the Bologna-Florence and Bologna-Faenza lines. Work on the short line from Rome to Anzio, on which the three-phase high-tension system will be used, is well advanced, as is also that on the Benevento-Foggia line, in the south of Italy, which is being electrified experimentally on the direct-current system.

The next stage in the Government programme (which provides in all for the electrification of 4 000 kms. of railroad trunk lines, comprising about 10 000 kms. of track), includes the electrification of the important Bologna-Verona-Brenner line, which will become increasingly important for the development of Italy's trade with Central Europe, the Voghera-Milan, the Voghera-Piacenza, the lines serving Trieste, Gorizia and Julian Venetia, down to Fiume, the Milan-Chiasso, the Milan-Bologna, and several other lines in Central Italy.

The power required for running these railways will be supplied mostly by the hydro-electric installations built by private corporations, supplemented by some big generating stations which the State railroads are erecting—*i.e.*, the central station at Bardonecchia, now nearing completion, two others in Central Italy which will utilise the waters of the Reno and the Limentre now being rendered available by great hydraulic works in course of execution, and a central station near Scanno, in the Abruzzi, fed by the waters of the Sagittario. Great engineering works recently visited by the Minister of Public Works and a representative committee of members of Parliament and the Press, are now being carried out in connection with this station. A barrage some 80 ft. high is being built, which will form an artificial lake with a content capacity of 3 600 000 cubic ft. The water will then run through a tunnel 6 kms. in length, passing through the mountains some 12 000 ft. below their summits, and will fall a drop of some 350 metres through three-high-pressure pipes, each 780 metres in length, setting in motion three groups of three-phase alternators, generating 45 000 H.P. of energy. It is estimated that these works will be completed in 1924.

In a report to the Senate it is stated that over 350 miles of railway line have been electrified, and 300 more miles will be converted this year, including the Rome-Tivoli and Rome-Anzio-Nettuno lines. The Ronco line is approaching completion and when this work is finished the Turin-Rome railway will be operated electrically. Orders have been let for the supply of 111 electric locomotives at a cost of 165 million lire, but the Government have authorised the Railway Administration to raise 169 million lire for the acquisition of 120 additional electric locomotives.

Trade with Canada.

Commencing with the 1st inst., all GOODS IMPORTED INTO CANADA must be marked with the country of origin, but "the name of a manufacturer or his trade mark, accompanied by the name of the country or a place in a province, state, or other division of a country where the goods have been manufactured or produced, will be accepted as sufficient indication of the country of origin."

In his report on the conditions and prospects of British trade in Canada, Capt. E. J. Edwards, H.M. Senior Trade Commissioner, states that now is the crucial time for British manufacturers to regain or obtain trade to which they have more right than a foreign country, and the Canadian Government and people have shown in a marked way their desire to encourage imports from the United Kingdom in preference to the United States. Canadian importers and merchants are anxious to trade with the United Kingdom, but they do not wish to deal with agents whose field of operations covers the United States and Canada.

During the year ending March 31, 1921, the total machinery imported into Canada (excluding agricultural) amounted in value to $44 642 000, of which no less than $40 767 000 represented importations from the United States, while the United Kingdom was responsible only for $3 546 000. Although the last-mentioned figures are more than double those of the preceding year, they are anything but satisfactory, especially as during that period United States trade increased by six and a half million dollars. Tenders for plant are usually invited in a hurry, and the question of delivery is a predominant factor. Naturally, United States engineering firms benefit by this Canadian characteristic. There is seldom sufficient time for specifications to be obtained and sent home so that United Kingdom manufacturers may tender. Consequently adequate local representation is essential, either by branch houses or by agents. The agents should be technical men, with an expert knowledge of the various types of machinery they are trying to sell and the uses to which these are put. They should be so qualified that where there is not sufficient time to mail particulars to their United Kingdom principals they are able to put the salient points succinctly in a cable. United Kingdom engineering firms are urged, when replying to a Canadian inquiry, to remember the proximity of the United States, and therefore to quote their very lowest prices and to give the most forward delivery date possible, which must be rigidly adhered to should the order eventuate.

H.M. Trade Commissioners in Canada should be kept supplied with illustrative and descriptive catalogues of all classes of machinery and engineering work. Canada's engineering and machinery requirements are considerably in excess of what might be imagined from her population. At a rough estimate, 700 000 hands are engaged in manufacture, and much of the machinery and equipment required in the work in which they are employed is not made in the Dominion, but has to be imported. In addition, her extensive water power is being steadily developed, and there is a constant demand for hydro-electric plant. Though United Kingdom manufacturers cannot be said totally to have neglected the Canadian market, in the majority of cases the efforts have been somewhat spasmodic and generally rather superficial. The machine tool trade is very important, and the leading machinery supply houses in Canada are desirous of buying from the United Kingdom. In the past it is said that British prices were much higher than those of the United States and deliveries uncertain. However, during the past few months the situation has improved; but prices are still high, especially on heavy machine tools for railroad shops, shipbuilding plants, &c.

Danish Tariff Revision.

A Bill has been introduced in the Danish Parliament providing for a revision of the DANISH CUSTOMS TARIFF. The following are amongst the proposed duties and exemptions under the revised Tariff :—

Accumulators, transformers, resistances, and other electric regulators, relays, alternators, switches, electrometers, voltmeters, galvanoscopes, telephone and telegraph apparatus (including switchboards, lamps, &c.), searchlights, electro-medical apparatus, electric ovens, bell and signalling apparatus, wireless telegraph and telephone apparatus, &c., 7½ per cent. *ad val.* Articles destined for electrical installations, consisting mainly of wood, porcelain, faience, or other earthenware, ebonite, testonite, ambroin, and the like, are dutiable as manufactures of those materials. Unmanufactured balata, guttapercha and indiarubber, and reclaimed rubber, duty free. Manufactures of ebonite, 10 per cent. *ad val.* Manufactures of guttapercha, indiarubber, not specified, 5 per cent. *ad val.* Physical and similar instruments, 7½ per cent. *ad val.* Earthenware and porcelain articles for electrical installations (other than insulators), such as safety boxes, switches, plug contact boxes, safety plugs, &c., if in combination with metal, 10 per cent. *ad val.* Dynamos, generators, motors and converters, and stators, rotors, armatures and commutators, &c., for such, 7½ per cent. *ad val.* (Machines imported in a knocked-down condition are dutiable as complete machines. If electrical machines are imported in combination with other machines, either fixed to such machines or on a common base, the whole article is dutiable as an electrical machine.) Rails and sleepers for railways and tramways, free. Wire of copper, brass, bronze and yellow metal, 5 per cent. *ad val.* Accumulator plates and electrodes of lead, soldered together, 5 per cent. *ad val.* Tramway vehicles, with or without axles and wheels, 5 per cent. *ad val.*

Tenders Invited and Accepted.

UNITED KINGDOM.

West Hartlepool. Jan. 16.—Supply of about 634 tons of steel tram rails. Particulars from the Borough Engineer.

Glasgow Corporation. Jan. 16.—Electric wiring and fitting in connection with Craigton Housing Scheme. Specifications, &c., from Mr. R. B. Mitchell, 75, Waterloo-street, Glasgow.

Newcastle-under-Lyme Corporation. Jan. 17.—Supply and laying of about 600 yards of lead-covered, steel-armoured distributing cable. Specification from the Borough Electrical Engineer.

Manchester Education Committee. Jan. 18.—Electric wiring and fitting of Embden-street, Every-street, and Bangor-street municipal schools. Specifications from the Education Offices, Deansgate, Manchester.

Edinburgh Corporation. Jan. 19.—Electric lighting installation in Public Washhouse, Causewayside, Edinburgh. Specification, &c., from the City Electrical Engineer, Dewar-place, Edinburgh.

Chorley Guardians. Jan. 21.—10 B.H.P. motor for the laundry of the Poor Law Institution, Eaves-lane, Chorley. Specification from the Clerk, Union Offices, Chorley.

Hindley Urban Council. Jan. 21.—Electric motor, centrifugal pump, pipes, &c. Particulars from the Surveyor, Council Offices, Hindley.

Worthing Corporation. Jan. 23.—One Diesel engine and c.c. dynamo; and vulcanised bitumen-sheathed paper-insulated concentric and triple concentric cable. Specifications, &c., from the Borough Electrical Engineer.

Lewisham Board of Guardians. Jan. 23.—Repairing of electrical installation at the Children's Home, Goat House Bridge, Norwood Junction. Particulars from the Clerk, Mr. W. R. Owen, 394, High-street.

Salford Guardians. Jan. 31.—Small alterations and additions to electric wiring and fittings in Pavilion B of the Infirmary at Pendleton. Particulars from the Clerk, Poor Law Offices, Eccles New-road, Salford.

Hampstead (London) Borough Council. March 15.—Supply of various stores for six or twelve months, including electrical engineers' stores and oils for the electricity station. Form of tender, &c., from the Town Clerk.

Metropolitan-Vickers Electrical Company, Cardiff.—Wiring for the electric lighting and heating of their new premises in Custom House-street.

Aylesbury Corporation.—300 kW converter, with e.h.t. and l.t. switchgear. Specifications, &c., from the Borough Electrical Engineer.

AUSTRALIA.

Victorian Railway Commissioners. Feb. 15.—*Hydraulic pig iron breaker, including tools, gears, accessories and spares, for Bendigo workshops. (Contract No. 34 191.)

Deputy Postmaster-General, Brisbane. Feb. 15.—*Telephone apparatus and parts, including bells, buzzers, chambers for transmitters, induction coils, condensers, cords. (Stores schedule No. 544.)

New South Wales Government Railways and Tramways Department (Electrical Engineer's Branch).—Feb. 22, 1922.—*Supply, delivery, erection and maintenance of one 5 000 kW 50 cycle turbo-alternator with condenser and accessories, at Zarra-street power house, Newcastle. (Contract No. 556.) Tenders, on proper forms and accompanied by a preliminary cash deposit, to the Secretary for Railways, Phillip-street, Sydney, N.S.W. Local representation is essential.

Commonwealth of Australia. March 8.—Switchboard apparatus and parts (schedule 545). Particulars from the Supply Officer, Room 101, Australia House, Strand, London, W.C. 2.

Victorian Railway Commissioners. March 8.—*Thirty-five cabin transformers for power signalling. (Contract No. 34 863.)

Deputy Postmaster-General, Brisbane. March 15.—*Protective apparatus, including arresters, carbon blocks, fibre fuses, protectors and terminals. (Stores schedule No. 546.)

Commonwealth of Australia. March 15.—Protective apparatus. Particulars from the Supply Officer, Room 101, Australia House, Strand, London, W.C. 2.

Municipal Council of Sydney (Electricity Department). April 24.—*Supply, delivery, and erection of two 2 000 kW rotary converters; one 10 000 to 12 000 kW turbo-alternator.

NEW ZEALAND.

Lyttelton, Public Works Tenders Board of New Zealand. Jan. 31.—*Two complete sets of 3 phase automatic oil circuit breakers suitable for 6 600 V, 1 200 A capacity, four sets of disconnecting switches for isolating the oil switches, and one 6 600 V air break lever operated switch for main transformer switches at Lake Coleridge power house. Tenders to the Secretary, Public Works Tenders Board, Government Buildings, Wellington.

Public Works Department, Wellington. Feb. 28.—*Supply and delivery, ex ship's slings Lyttelton, of a bank of three 11 000 V reactances, complete, for the Lake Coleridge electric power scheme.

Public Works Tenders Board, Waikato Power Scheme. March 6.—*(Section 45) two 2 500 kWa alternators, three-phase, 50 cycle, 5 000 V, at 166⅔rds rev. per min., with a power factor of ·8. Excitation at 220 V. (Section 46) two 3 100 H.P. water turbines of the double-runner Francis type to operate the generators mentioned in Section 45. (Section 47) two exciter sets, each consisting of one 200 kW d.c. generator, and one 350 H.P. asynchronous motor, together with a Tirrill regulator. The generator shall have an output of 220 V, with a full-load current of 7 000 A. The motor shall be of 350 H.P., with a power supply of 400 V, three-phase, 60 cycle. The synchronous speed of the sets shall be 750. (Section 48) four Stoney sluice gates for the pits, appertaining to the turbines mentioned in Section 46. Tenders to the Secretary, Public Works Tenders Board, Government Buildings, Wellington.

Auckland Harbour Board. April 25.—Four double-barrel electric winches for the Central Wharf, Auckland. Specifications from W. & A. McArthur, 18-19, Silk-street, Cripplegate, London, E.C. 2.

SOUTH AFRICA.

Public Works Department of the Union of South Africa. Feb. 1.—Conduit and conduit fittings. Particulars from the Electrical Engineer, Public Works Department, Pretoria.

BULGARIA.

Bulgarian Department of Posts. Feb. 14.—*Bronze in plates and bars, iron and steel plates and bars, and insulating materials.

Bulgarian Department of Posts, Telegraphs, and Telephones. February 20.—*2 000 telephone instruments for table use, with local battery and magneto. Also for spare parts for these instruments.

Bulgarian Department of Posts. Feb. 27.—*Electricians' small tools, including 900 pairs pincers, 20 brazing lamps, 100 soldering irons, 1 500 bits, 300 axes.

Bulgarian Department of Posts. March 8.—*Porcelain insulating tubes for telephones (10 000), insulating tubing (impregnated paper) for telephones (2 200 metres), ebonite caps (1 700), and insulated copper wire (1 000 metres).

The tender of R. Kendale & Sons has been accepted for wiring and fitting at the Municipal Technical College, Bath.

Aberdeen Corporation have accepted the tender of Bell & Robertson for electric equipment in workshops at the police stables.

Battersea (London) Council have accepted the tenders of Veritys, Ltd., for a 30 H.P. open-type motor, £104 5s. 9d.; and the Igranic Electric Company for a starter switch, £26 11s. 6d.

Blackpool Tramways Committee have accepted the tender of the British Insulated & Helsby Cables, Ltd., for a high-tension feeder cable, and that of the Pirelli General Cable Works for a low-tension feeder cable. The cost is to be charged against the new £30 000 cable loan.

The Victorian State Government has confirmed the acceptance by the Victorian Electricity Commissioners of the tender of John Thompson & Company (Wolverhampton) for steam-raising plant for the Morwell power house at £282 318. It is stated that of this amount £137 110 will be expended in Australia.

The New Zealand Government have accepted tenders from British firms for £100 000 worth of plant for the installation of a hydro-electric plant to supply Wellington and the surrounding district. Further tenders, Reuter states, are still under consideration. American and Swedish firms also tendered.

Manchester Corporation have accepted the tenders of the British Thomson-Houston Company for tramcar motors and controllers, the Metropolitan-Vickers Electrical Company for tramcar motors, G. Bellington for wiring and sub-service cables to houses on Newton Heath Estate. A licence has been given to the British Thomson-Houston Company to sub-let the contracts for h.t. oil switches and transformers and lighting arresters to the International General Electric Company (U.S.A.) and for trip-circuit batteries to the D. P. Battery Company in their contract for switchgear for High-street sub-station.

Edinburgh Town Council have accepted the following tenders in connection with the tramways undertaking:—Peckham Truck Engineering Company, 53 trucks, £9 010; Metropolitan Vickers Electric Company, for 106 interpole ventilated, light weight traction motors, of the box-frame type, of approximately 40 H.P., at 600 V on the one-hour rating, £18 000; British Thomson Houston Company, 106 controllers, suitable for magnetic track breaking with interpole motors, £5 814; Electro Mechanical Brake Company, 53 car sets of grid resistances (suitable for mounting on car platform), £742; N.B. Steel Foundry Company, 250 car wheel centres, £500; 250 tram tyres, £881 5s.; machining wheel centres as necessary, £231 5s. 125 axles, 4-in., £781 5s. 125 pairs wheels and axles, £2 187 10s.

Catalogues Required.

*The Director of the Public Works Department, Bagdad, Iraq, is anxious to obtain catalogues, designs, specifications, prices, &c., of machinery and equipment, including electric lighting and power plant, small electric sets with fans and accessories, farm tractors, road tractors and agricultural machinery, excavating machinery, irrigating pumps, piping and pipe fixtures, well-boring plant and casings, cement and concrete mixers, quarry plant, woodworking machinery, pumping plants, motor-cars, refrigerating apparatus.

* *Particulars from the Department of Overseas Trade.*

Miscellaneous.

NOTTINGHAM Corporation have decided to reduce by 7½ per cent. the salaries of all officials receiving less than £750 a year.

LIVERPOOL City Council have approved a recommendation to reduce the war bonuses of officials receiving over £1 000 per annum by 50 per cent. from Jan. 31.

A start has been made on the work of clearing the Wembley site of the BRITISH EMPIRE EXHIBITION OF 1923. On Tuesday H.R.H. the Duke of York cut the first sod.

A fire which broke out at CAUDON HILL granite quarry on Sunday night completely destroyed the electric power house and two-thirds of the machinery was put out of action.

The Reading Education Committee have decided to purchase a RITTER ELECTRIC MOTOR AND DENTAL APPARATUS for use in the dental clinic at a cost, including installation, of £82.

A spark from a fire in the storeroom of the METROPOLITAN-VICKERS ELECTRICAL COMPANY'S premises in Chapel-walk, Sheffield, last week ignited a roll of paper, and caused a small blaze in the storeroom, which contained electric fittings. The outbreak was soon extinguished by the Sheffield Fire Brigade.

A Canadian company, which holds the British patent rights in an ELECTRIC PLATE AND DISH WASHING MACHINE, wish to get into touch with firms in the United Kingdom open to undertake the manufacture and sale of this article. Further information may be obtained at the office of the High Commissioner for Canada, 19, Victoria-street, London, S.W. 1.

We regret that a printer's error occurred in the setting of JOHNSON & PHILLIPS' ADVERTISEMENT on page xvi. of our last issue. The words "Fig. 2" should have appeared below the bottom left-hand panel instead of "Fig. 3." "Fig. 3" should have appeared below the bottom right-hand panel instead of "Fig. 4," and "Fig. 4" above the top right-hand panel instead of "Fig 2."

Some of the members of the Coal Mining Association are, says the Central News Agency, discussing a co-operative scheme for the RECONSTRUCTION of the BRITISH COALFIELDS, with a view to bringing order out of the existing state of chaos. The scheme includes the introduction of coal-cutting machinery where it has not already been installed, the erection of pit-head baths, and greater use of electricity.

PERPETUAL MOTION has again been discovered, this time by Mr. Richard Ulram, of Jersey City. He claims to have finished a machine, which he calls "the world's greatest invention," and he has organised the Perpetual Motion, Power, Heat & Light Company, with a capital stock of 25 million dollars, to develop the invention! The machine is stated to be "a cross between an electric washer and the old stone mill. It has more parts than a watch, and more wheels than a ten-carriage railway train."

Speaking at the CONFERENCE OF THE WORKERS' INSTITUTE at Balliol College, Oxford, on Saturday, Mr. A. P. M. Fleming dealt with the subject of the use and value of records and statistics. He had seen in batches of boys admitted at the works entrance eye and ear troubles, tonsilitis, &c., which would pass undetected in the ordinary way. But under the record system the boys were sent back, and in the great majority of cases the parents had things put right by proper treatment, so that the boys, parents, employers, and, above all, the community, were saved from the lingering disadvantage which in the past—and even to a considerable degree in modern times—hampered industry.

The fourteenth annual issue of the "ELECTRICAL ENGINEERS' DIARY" has recently been issued, and contains a mass of useful information for consulting and contracting engineers, manufacturing firms, and supply houses. Nearly every branch of the industry and every practical application of electricity (including cooking and heating) is catered for. The information given seems to have undergone extensive revision. There are a number of useful technical tables and statistics, including lists of central station showrooms and electrical shop windows, the Wiring Rules of the I.E.E., the Regulations as to Electricity in Factories and in Mines, lists of streets in the London area in which mains are laid, particulars of the supply undertakings in the United Kingdom, &c. We notice that in a few cases the price of gas is wrongly given, but in the main the information is correct. The Diary is published at 10s. 6d. net by S. Davis & Company, 30-31, St. Swithin's-lane, E.C. 4.

Traveller's Wages Claim.

At the City of London Court last week Mr. R. S. Butler, commercial traveller, sued the B.T.T. Electric Lamp & Accessories Company for £3 10s., salary and expenses in lieu of notice. Plaintiff said that about Oct. 20 last he was employed by Mr. Taylor, of defendant company, as a traveller and representative at £3 per week, with 10s. for expenses, 2½ per cent. commission, and a week's notice each way. On the Friday of the first week of his employment he was told to see Mr. Ayton, the sales manager. He waited until ten minutes past seven, and then, thinking he had waited long enough, and that Mr. Ayton had gone for the day, left. On the Saturday he was told he ought to have waited. He received his week's salary, and on the Monday was told he could not start again. He claimed that he was entitled to notice.

For the defence, Mr. Ayton said the plaintiff was told by him that it was to be a week on trial, but plaintiff denied that he was engaged for a week on trial.

The Registrar gave judgment for plaintiff for £3, disallowing the claim of 10s. for expenses.

Companies' Meetings, Reports, &c.

The directors of ROYCE, LTD., have decided not to pay an interim dividend on the preference shares.

An interim dividend of 9d. per share, free of tax, on the ordinary shares is announced by HEAD, WRIGHTSON & COMPANY.

The KAMINISTIQUIA POWER COMPANY has declared its regular quarterly dividend on the common stock at the rate of 6 per cent. per annum.

The tramway and electricity receipts of the ELECTRIC SUPPLY COMPANY OF VICTORIA, LTD., for the three months ended Sept. 30 last were £34 109 and the expenses £24 930.

A meeting of the holders of MEXICO ELECTRIC TRAMWAYS 5 per cent. first charge debentures will be held on Feb. 8 for the purpose of considering resolutions sanctioning certain proposed modifications of the rights of the debenture holders.

The report of the PROVINCIAL TRAMWAYS COMPANY for the year ended Sept. 30, 1921, shows net revenue received from subsidiary companies of only £20 900, as against £40 916, while a claim by the authorities for £12 454 for E.P.D. for 1918 has resulted in a big strain on the company's resources. In the circumstances there is no dividend on the ordinary shares, as compared with 7½ per cent. for 1919-20, and no appropriation can be made this time to reserve and depreciation account, which a year ago was allocated £10 000.

The ANGLO-AMERICAN TELEGRAPH COMPANY announces the following dividends to the close of last year:—Balance of £1 10s. per cent. on the consolidated ordinary and on the preferred stocks, less tax, making £3 15s. per cent. on consolidated ordinary and £6 per cent. on the preferred; and a first and final of £1 10s. per cent. on deferred stock for 1921, less tax. It has also been decided to pay a bonus of 2s. 3d. per cent. on the undivided ordinary stock and 4s. 6d. on the deferred, free of tax, all payable on Feb. 1, to holders registered on Dec. 31.

In the course of his speech at the annual meeting of the STEAUA ROMANA (BRITISH), LTD., in London last week, Sir Charles Greenway, Bart. (the chairman), stated that the company, conjointly with the local power company, had, on a 50-50 per cent. partnership basis, started the erection of a new electric power station, to be called "Steaua Electrica," to supply its own requirements and also those of other consumers. This power station is situated at Floresti, and the company would have the first call on its output. It was hoped that it would be working before the end of this year.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, 116-118, Chancery-lane, London, W.C. 2.

A. G. BURRELL & COMPANY, LTD. (178 803), 28, Change-alley, Sheffield. Registered Jan. 3. Manufacturers and dealers in systems and installations of every sort used for the purpose of synchronising or distributing time. Nominal capital, £5 000 in 1 500 6 per cent. cumulative preference shares and 3 500 ordinary shares of £1. Directors: J. W. Molden and W. E. Spearing. Private company.

CHARLES H. CHAMPION & COMPANY, LTD. (178 837). Registered Jan. 4. Producers and suppliers of electrical apparatus. Nominal capital, £10 100 in 1 000 preference shares of £10 each and 2 000 ordinary shares of 1s each. Directors to be appointed by subscribers. Qualification of directors, one share. Subscribers: H. Marcotty, 71, Castlenau-mansions, Barnes, S.W. 13; C. H. Champion; and G. H. Leslie. Private company.

HENDERSON & THORNTON, LTD. (178 865). Registered Jan. 5. Producers and suppliers of electrical apparatus. Nominal capital, £2 000 in 500 preference shares of £1 each, and 1 500 ordinary shares of £1 each. Directors: F. Higgs, Station Works, Hinton-road, Herne Hill, S.E.; B. C. Aldous; J. A. Henderson; and L. Thornton. Qualification of directors, one share. Private company.

RAPSON TYRE & JACK COMPANY, LTD. (178 851), 85, Gracechurch-street, E.C. Registered Jan. 4. Electrical and general engineers, &c. Nominal capital, £40 000 in 40 000 shares of £1 each. Directors: F. L. Rapson and G. G. Warr. Qualification of directors, £500. Remuneration of directors, £500 each. Private company.

STERLING ACCESSORIES, LTD. (178 768). Bangor House, Shoe-lane, E.C. Registered Dec. 31. Electrical, telephone and general engineers. Nominal capital, £1 000 in 1 000 ordinary shares of £1 each. Directors: C. J. Margerison and A. Handley. Qualification of directors, £200. Permanent directors, £300. Private company.

THERM SAVING APPLIANCES, LTD. (178 856). Registered Jan. 4. Iron founders, mechanical and electrical engineers. Nominal capital, £5 500 in 5 000 preferred shares of £1 each and 10 000 deferred shares of 1s. each. Directors to be appointed by subscribers. Qualification of directors, £1. Subscribers: A. E. Fournier, 18, Fleet-street, E.C., and B. L. Diddams. Private company.

Marconi's Wireless Telegraph Company announce that from the 1st inst. the charge for private RADIO TELEGRAMS FROM THEIR POLDHU STATION to ships at sea has been reduced from 2s. 6d. per word to 1s 2d. per word, plus the ship charge, which is usually 4d. per word.

Arrangements for the Week.

FRIDAY, Jan. 13th (to-day).

INSTITUTION OF ELECTRICAL ENGINEERS.

(SCOTTISH CENTRE, STUDENTS' SECTION.)

7.30 p.m. At the Royal Technical College, Glasgow. Paper on "The Protection of Alternating Current Circuits," by Mr. E. T. Pounds.

EDINBURGH ELECTRICAL SOCIETY.

8 p.m. At the Philosophical Institute, 4, Queen-street, Edinburgh. Paper on "A Chat on Storage Batteries as Applied to Electric Traction," by Mr. L. Brookman.

ELECTRO-HARMONIC SOCIETY.

8 p.m. At Cannon-street Hotel, London, E.C. Smoking concert.

SATURDAY, Jan. 14th.

BIRMINGHAM AND DISTRICT ELECTRIC CLUB.

7 p.m. At the Grand Hotel, Colmore-row, Birmingham. Presidential Address by Mr. N. Deykin.

MONDAY, Jan. 16th.

INSTITUTION OF ELECTRICAL ENGINEERS.

(WESTERN CENTRE.)

6 p.m. At the Merchant Venturers' Technical College, Bristol. Lecture "On the Work of the British Electrical Development Association and upon Advertising in Connection with Engineering and Electricity Development Generally," by Mr. J. W. Beauchamp.

INSTITUTION OF ELECTRICAL ENGINEERS.

(LIVERPOOL SUB-CENTRE OF THE NORTH-WESTERN CENTRE.)

7 p.m. At the University, Liverpool. Cinematograph films to be exhibited on "High Tension Switchgear Tests," by Mr. P. Torchio, described by Dr. C. C. Garrard; "Telephone Inventors of To-day," and "Electricity in the Home," by Mr. F. Gill, O.B.E.

TUESDAY, Jan. 17th.

INSTITUTION OF ELECTRICAL ENGINEERS.

(NORTH MIDLAND CENTRE.)

7 p.m. At the Metropole, King-street, Leeds. Paper on Single- and Three-Phase Alternating Current Commutator Motors with Series and Shunt Characteristics," by Dr. S. P. Smith.

INSTITUTION OF ELECTRICAL ENGINEERS.

(NORTH-WESTERN STUDENTS' CENTRE.)

7.30 p.m. At Houldsworth Hall, Deansgate, Manchester. Paper on "Switching Systems and Lay-Outs," by Mr. F. Gough.

ENGINEERS' CLUB, MANCHESTER.

7.15 p.m. At Albert-square, Manchester. Address on "The Relationship of Finance to the Engineering Industry," by Mr. H. G. Williams.

WEDNESDAY, Jan. 18th.

INSTITUTION OF RAILWAY SIGNAL ENGINEERS.

3 p.m. At the Institution of Electrical Engineers, Savoy-place, London, W.C. Resumed discussion on "Three-Position Signalling," by Mr. A. E. Tattersall.

INDUSTRIAL LEAGUE AND COUNCIL.

7.30 p.m. At Caxton Hall, London, S.W. Lecture on "Use and Abuse of Combines and Trusts," by Mr. R. Young, O.B.E.

THURSDAY, Jan. 19th.

INSTITUTION OF ELECTRICAL ENGINEERS.

6 p.m. At Savoy-place, London, W.C. Joint meeting with the Institution of Heating and Ventilating Engineers. Discussion on "The Utilisation of Waste Heat from Electrical Generating Stations," with Introductory Papers by Mr. C. I. Haden and Mr. F. H. Whysall.

FRIDAY, Jan. 20th.

INSTITUTION OF MECHANICAL ENGINEERS.

6 p.m. At Storey's Gate, London, S.W. Paper on "Some Observations on a Producer-Gas Power Plant," by Mr. H. S. Denny, C.B.E., and Mr. N. V. S. Knibbs, B.Sc.

INSTITUTION OF ELECTRICAL ENGINEERS.

(LONDON STUDENTS' SECTION.)

7 p.m At Savoy-place, London, W.C. Paper on "Some Applications of the Thermionic Valve to Telephony," by Mr. L. T. Hinton.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Lecturette on "Geology in its Relation to Engineering."

ROYAL INSTITUTION.

9 p.m. At Albemarle-street, London, W. Discourse on "Soap Films and Molecular Forces," by Sir James Dewar, F.R.S.

Catalogues, Price Lists, &c.

The ENTERPRISE MANUFACTURING COMPANY have issued their January price list.

A. P. LUNDBERG & SONS have issued a leaflet dealing with their SERIES-PARALLEL SWITCHES.

Among the new catalogues just published by the OVERSEAS ENGINEERING COMPANY is List No. 195, dealing with the "Overseas-National" electric lighting outfits, and List No. 28, which deals with the "Zenith" slow-speed, four-cycle oil engines.

ELECTRICAL COMPONENTS, LTD., are determined to make a good year of 1922, and a leaflet, entitled "The Challenge of 1922," is full of vigorous determination, which is bound to meet with success. The firm have just issued an abridged price list of electrical accessories (No. 93), and the reductions shown in many instances bring prices down to pre-war levels.

Forty Years Ago.

(THE ELECTRICIAN, JANUARY 14TH, 1882.)

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—The next meeting of this society takes place on the 19th inst., when an inaugural address will be read by the president-elect, Lieut.-Colonel C. E. Webber, R.E.

WHY ELECTRICIANS USE GAS IN THEIR OFFICES.—The correspondent of a provincial paper says that the reason why Mr. Swan, of Newcastle, uses gas in his factory is because the electric light is "the light of the future," and that Mr. Swan evidently knows this.

RAILWAY SIGNALLING.—Mr. A. W. Tuer writes to the "Daily News" under this heading, suggesting that if "passengers were made acquainted with the state of the signals as they pursued their journey (which I think could be managed by means of an automatic electric indicator fixed in each compartment), neither driver nor guard dare for an instant neglect them."

THE FUTURE.—A glimpse into the future is afforded in an extract from a speech recently delivered at a preliminary meeting in Paris of the company which has been formed to work M. Marcel Duprez's system of transmitting power by means of electricity. M. Bontoux was the speaker. He said:—"The division of electric energy is destined to effect an entire revolution in this sphere. The day will come, and sooner than is imagined, when the artisan family will see enter their dwelling, by means of a magic wire, the force which is now so costly to them, and this will be the democratisation of force for the benefit of the working classes." What a Utopian Republic is here foreshadowed!

The "TEXTILE RECORDER YEAR BOOK FOR 1922," a copy of which we have received from the publishers, John Heywood, Ltd., will be principally of interest to electrical engineers from the short accounts of the various processes involved in textile manufacture which it contains. From these they will be able to gain some idea of the problems which have to be met in adapting the electric drive to textile requirements. A certain amount of useful information about the electric drive is given, but the editor is a little lukewarm as to its advantages. Nevertheless, it continues to develop, principally, no doubt, because it provides a convenience and flexibility which it is difficult to translate directly into figures.

Prices of Metals, Chemicals, &c.

TUESDAY, JAN. 10.

		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£68 10 0	—	5s.
Electro Wirebars ..	,,	£74 10 0	—	10s.
H.C. wire, basis	per lb.	0s. 11 3/16d.	—	1/16d.
Sheet	,,	0s. 10½d.	—	
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze wire, basis.....	,,	1s. 3 3/16d.	—	1/16d.
Brass 60/40—				
Rod, basis	,,	0s. 7½d.	—	—
Sheet, basis.....	,,	0s. 10¼d.	—	¼d.
Wire, basis	,,	0s. 10⅜d.	—	⅛d.
Pig Iron—				
Cleveland Warrants	per ton	£5 5 0	—	—
Galvanised steel wire, basis 8 SWG	,,	£22 0 0	—	—
Lead Pig—				
English	,,	£26 0 0	—	—
Foreign or Colonial ..	,,	£24 7 6	—	—
Tin—				
Ingot	,,	£167 0 0	—	£3 15 0
Wire, basis	per lb.	2s. 3½d.	—	⅜d.
Aluminium ingot		£120 0 0	—	—

Salammoniac.—Per cwt. 65s.-60s.
Sulphur (Flowers).—Ton £12 10s.
,, (Roll-Brimstone).—Per ton £12 10s.
Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.
Copper Sulphate.—Per ton £28 10s
Boric Acid (Crystals) —Per ton £65.
Sodium Bichromate.—Per lb. 6d.
Sodium Chlorate.—Per lb. 3½d.
Rubber.—Para fine, 1s. 1½d.; plantation 1st latex. 10⅛d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Co., Ltd.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Bankruptcy Information.

DEPLEDGE, Robert Adrian, 53, Frodingham-road, Scunthorpe, Lincolnshire, electrical engineer. First meeting, Jan. 18, 11 a.m., Official Receiver's Office, St. Mary's Chambers, Great Grimsby. Public examination, Feb. 2, 11 a.m., Town Hall, Great Grimsby.

WILLCOX, Albert John, The Garage, Farnham Common, Bucks, electrical engineer, &c. First meeting, Jan. 16, at 11 a.m., 29, Russell-square, London, W.C. 1. Public examination, Feb. 10, 11 a.m., Town Hall, Windsor.

Companies Winding-up Voluntarily.

ELECTRICAL DEVELOPMENT & FINANCE CORPORATION, LTD. W. B. Stone, 90, Cannon-street, E.C., appointed liquidator.

FOUNTAYNE LAMP & ENGINEERING COMPANY (1910), LTD. Mr. B. R. Heaton, New-square, Lincoln's Inn, London, appointed liquidator. Meeting of creditors at liquidator's office, on Wednesday, Jan. 18, at 12 noon.

PLANET ELECTRIC COMPANY, LTD. S. H. Swallow, 67, Broad-street-avenue, London, E.C. 2, appointed liquidator.

Liquidator's Notice.

ELECTRICAL DEVELOPMENT & FINANCE CORPORATION, LTD. (in voluntary liquidation). Meeting of creditors at the offices of Cash, Stone & Co, 90, Cannon-street, London, E.C. 4, Tuesday, Jan. 17, at 2.30.

Edinburgh Gazette.

WILSON, R. Anderson, mechanical and electrical engineer, 19, Waterloo-street, Glasgow. Estates sequestrated Jan. 4. Meeting to elect the trustee and commissioners on Monday, Jan. 16, at 12 noon, Faculty Hall, St. George's-place, Glasgow. Fergusson & Ross, writers, 30, Renfield-street, Glasgow, agents.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

FULLER HEATH & CO., The Old Brewery, Earl-street, Westminster, S.W., electrical engineers. £10 8s. 1d. Aug. 25.

GAUNT, Mr. 15, Cambridge-place, Paddington, and SAYER, Mr. 117, De Beauvoir-road, Dalston, formerly trading as Gaunt and Sayer, electricians. £26 0s. 10d. Oct. 4.

HASLIN, John Joseph, 50, Nestfield-street, Darlington, electrical welder. £16 15s. 6d. Oct. 5.

HILL, Geo., 22, Chantrey-lane, Grimsby, electrician. £13 13s. 2d. Oct. 28.

LEVER, J., & SON, 1, Radipole-road, Fulham, electrical engineers. £55 9s. Oct. 18.

NEAL WOOD & CO., 5, Smallgate, Beccles, electrical engineers. £14 6s. 6d. Nov. 3.

OWEN & SON, Westcombe-hill, Blackheath, electrical engineers. £10 11s. 8d. Nov. 3.

VEVERS, Mr. J., 45, Queen-street, Maidenhead, electrical engineer. £14 12s 1d. Aug. 31.

WHITEHEAD, Henry John, 62, West-hill, Wandsworth, S.W. 13, electrical engineer. £54 16s. 10d. Oct. 21.

WYATT, Mr. A. J., 16, Hykeham-road, Bracebridge, electrical engineer. £12 1s. 10d. Nov. 7.

Bills of Sale.

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1882 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

BROADHURST, William Gladstone, 18, Meadow-way, Weald Village, Harrow, electrical engineer. Jan. 9. £100.

OWEN, Arthur Leo, 24, Norfolk-road, Littlehampton, electrician. Jan. 6. £40.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

BRITISH THOMSON-HOUSTON COMPANY, LTD., London, E.C., manufacturers of electrical machinery. Registered Dec. 17. Trust deed dated Nov. 30, 1921, securing £3 000 000 debenture stock, to Royal Exchange Assurance Corporation, E.C.; charged on properties as set out in second schedule to trust deed (subject, as to certain premises, to trust deed dated March 10, 1902), also general charge. *£152 295. June 1, 1921.

MIDLAND COUNTIES ELECTRIC SUPPLY COMPANY, LTD. (late TRAMWAYS LIGHT & POWER COMPANY, LTD.), London, E.C. Registered Dec. 22. £400 000 debenture stock, secured by trust deed dated Dec. 14, 1921; charged on shares and debenture stock of various companies, also general charge. *£344 150 (debenture stock), £200 000 (notes). March 15, 1921.

NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY COMPANY, LTD. Registered Dec. 22. Trust deed dated Dec. 9, 1921, supplemental to and modifying provisions of trust deed registered Oct. 29, 1913, by increasing limit of debenture stock which may be issued thereunder to £2 000 000 and increasing rate of interest payable on the debenture stock thereby secured; also registered Dec. 22, acknowledgment of further indebtedness (supplemental to trust deeds registered Oct. 29, 1913, and Dec. 22, 1921), securing £750 000 second debenture stock (additional); charged on electrical lighting and power undertakings and lands and premises now comprised in trust deed, and certain shares, also general charge (except uncalled capital). *£3 014 658. April 5, 1921.

Satisfaction.

CREED & COMPANY, LTD. (late CREED, BILLE & COMPANY, LTD.), Croydon, telegraphic engineers. Satisfaction registered Dec. 29, £3 000, registered Jan. 22, 1920.

Receivership.

TREDELECT DYNAMOS, LTD. N. Bell, of 78 and 79, Wool Exchange, Coleman-street, was appointed receiver and manager by order of court, dated Dec. 21, 1921.

Bankruptcy Proceedings.

BARNETT, Bernard, electrical engineer, 104, Whitechapel-road, E. A meeting of creditors was held last week at the London Bankruptcy Court. Debtor had stated that in 1914 he took a lease of a house, shop and factory premises at 104, Whitechapel-road, where he began business. In March last he executed some work at premises belonging to M. Heller and R. Cederman, and later on these two gentlemen entered into partnership with him, the idea being to extend the business to the West End. On July 29 last his two partners served him with notice of dissolution of the partnership, and a receiver was appointed. Debtor estimated his liabilities at between £500 and £800, and valued his assets at £800. He attributed his present position to over-confidence in his manager, book-keeper and partners. There was no quorum of creditors present, and the meeting was adjourned to allow an opportunity of appointing a trustee.

PRIVATE MEETING.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

AUTOMOBILE ELECTRICAL REPAIRERS, LTD. (in voluntary liquidation), Euston-road, London, N.W. A meeting of creditors was held recently at the offices of Cole, Dickin & Hills, Kingsway, W.C. Mr. N. J. Dodd, the liquidator of the company, submitted a statement of affairs, which showed unsecured liabilities of £815. Of that amount £263 was due to the trade, £44 to the bank, and the balance represented the unsecured amount due to the debenture holders. The claim of the bank amounted to £194, but they held securities valued at £150. The assets of the company were only estimated to realise £200, from which had to be deducted £40 for preferential claims, leaving net assets of £160. The latter amount was insufficient to meet the claims of the debenture holders, which amounted to £513, and there was no balance available for the ordinary creditors. The company was incorporated in January, 1920, with a nominal capital of £1 000. The issued capital was £795. The debentures were in order, and it was pointed out that there was nothing available for the creditors. No resolution was passed, and the voluntary liquidation of the company will therefore be continued by Mr. Dodd. The following are creditors:—Brown Brothers, London, £14; Burrow & Company, Ltd., Cheltenham, £10; General Electric Company, London, £47; W. S. Jeal & Ebury Engineering Company, Ltd., London, £15; Perra Engineering Company, Blackpool, £59; C. A. Vandervell & Company, London, £15; Collins Electrical Company, London, £32.

Patent Record.

APPLICATIONS FOR PATENTS

September 14, 1921.

24 388 Dowdeswell. Commutators.
24 389 Wilson. Armature coil winder.
24 396 Lamb. Electric signs, &c
24 413 Qtenby. Combination electric lamp, horn, and switchboard.
24 441 Harrison, Pooley & Wreford. Submersible electrical apparatus.
24 442 Austin, Pooley & Wreford. Portable electric combination tools.
24 443 Haines, Pooley & Wreford. Portable electrically-driven apparatus.
24 468 de Coninck. Application of rheostatic converter system to regulation of synchronous motors.

September 15, 1921.

24 501 Corlin. Time Switch. (13/1/21, Denmark.)
24 502 Lawrance. Trollies for tramways.
24 528 Green, Willson & Jamieson. Switches.
24 529 Klug. Tide power generating systems.
24 531 Westinghouse Lamp Co. Manufacture of glass. (16/10/20, U.S.)
24 562 Akt. Ges. Brown, Boveri et Cie. Protection of polyphase circuits on earth connection. (16/9/20, Switzerland.)
24 564 Stone (J.) & Co. & Watkins. Governor for electric motor, &c., operating pump in hydraulic system.
24 579 Symonds. Electric signalling and telegraph devices, &c.

September 16, 1921.

24 593 Wilkinson. Wind-driven dynamos.
24 597 Efandem Co. & Eaton. Electric terminals.
24 598 Efandem Co. & Eaton. Electric hand lanterns.
24 607 Nicholas & Roberts. Electric lighting sets for motor vehicles, &c.
24 622 Dutt & Godfrey. Storage battery.
24 635 Zachauer (F. H.), Metallwarenfabr. & Grünthal. Electric water heaters.
24 636 Rodger. Clock-operated electric switches.
24 641 Rogge. Electric pocket lamps. (22/9/20, Germany.)
24 650 Cubitt. Switches.
24 652 Parkin. Wireless telegraph devices.
24 654 British Lighting & Ignition Co. & Tuppen. Contact breakers.

September 17, 1921.

24 681 Pinkerton. Electrical clock time switch.
24 692 Lancashire Dynamo & Motor Co. & Whitmore. Electric machines.

September 19, 1921.

24 745 Kilvert. Self-regulating magneto.
24 759 Bedson. Insulator blocks of h.t. switchgear, &c.
24 761 Horton & Preston. Electric lead terminals.
24 764 Latour. Electro-magnetic wave transmitting systems. (21/8/15, France.)
24 765 Latour. Electro-magnetic wave transmitting systems. (20/11/15, France.)
24 769 Churchill. Electric vehicles.
24 774 Farquharson. Magnetos.
24 780 Klauck. Trolley heads for tramcars.
24 808 B. T.-H. Co. (G. E. Co.). Motors.
24 782 Munro. Sockets or bases for trolly poles.
24 783 Page. Electric alarm system for detecting a damaged seat.
24 812 Allmanna Svenska Elektriska Aktiebolaget. Transformers. (2/7/21, Sweden.)
24 823 Rueff. Electric lamps
24 825 Bartholomew. Telautography.
24 847 Automatic Telephone Mfg. Co. Telephone systems. (1/10/20, U.S.)
24 848 Automatic Telephone Mfg. Co. Telephone systems. (22/9/20, U.S.)
24 856 Loveland. Electric lighting from magnetos, &c.
25 031 Beaver. Electric joints

September 20, 1921.

24 865 Hadwen & Willis. Coupling for electric cables, &c.
24 892 Davis & Reeves. Electric heaters.
24 893 Sunderland Forge, &c., Co., Wight & Pack. Electric signalling systems.
24 911 Whittingham. Electrically testing and comparing strength of magnets.
24 925 B. T.-H. Co. (G. E. Co.). Electric discharge apparatus.
24 926 B. T.-H. Co. & Young. Magneto-electric machines.
24 930 Hoffmann. Automatic safety device for electric connections.

September 21, 1921.

24 968 Bishop & Chadwick. Bodies of trackless trolly cars, &c
24 984 Gascoyne. Resistance board or panel for tandem lamp circuits.
25 014 Krupp (F.) Akt. Ges. Mounting electric conductors in casings. (10/2/21, Germany.)
25 027 B. T.-H. Co. (G. E. Co.). Electric tensioning devices.
25 031 Claremont. Electric joints.
25 041 Metropolitan-Vickers Electrical Co. Chietham & Smethurst. Electric relay devices.
25 055 Union Bag & Paper Corporation. Switch. (22/7/21, U.S.)
25 056 Firley & Weil. Safety switches for kinematograph projection apparatus. (21/9/20, Czecho-Slovakia.)
25 060 Williams. Electrical connection and lighting boxes for mines, &c.
25 061 Lewitski. Receivers for wireless telegraphy. (21/9/20. France.)
25 062 Schneider. Receiving devices for electric waves. (13/7/21, Germany.)
25 076 Prangnell. Valve for wireless apparatus.
25 077 Prangnell. Coil for wireless apparatus.

September 22, 1921.

25 082 Mansbridge. Air-tight joint for sealed electrical apparatus.
25 088 Battersby & Hefford. Electric soldering iron.
25 097 Shores. Current collecting trollies on tramcars, &c.
25 104 Mead. Ignition and lighting for motor vehicles.
25 145 Metropolitan-Vickers Electrical Co. & Hill. Synchronous electric machines.
25 148 B. T.-H. Co. (G. E. Co.). Motor control.
25 157 Rose. Distributors for electric ignition systems.
25 158 Radio Communication Co. & Scott-Taggart. Production of oscillating currents, &c.
25 161 Firley & Weil. Safety switches for kinematograph projection apparatus.
25 170 Soc. Generale Le Prométhée. Electric radiators. (22/9/20, France.)
25 187 Marriott. Radio receiving systems. (22/9/20, U.S.)

September 23, 1921

25 192 Zeiss. Reflector search-lights (24/9/20, Germany.)
25 217 Tucker (J. H.) & Co. & Gaffney. Fuse or distribution boards.
25 232 Quasei Arc Co. & Strohmenger. Electric welding or fusing deposition of metals.
25 233 Kratt. Electric immersion heaters.
25 234 Kratt. Electric water heaters.
25 247 Lodge Fume Co. (Metallbank u. Metallurgische Ges.). Insulator for electrodes of electrical gas purifiers.
25 248 Lodge Fume Co. (Metallbank u. Metallurgische Ges.). Electrical gas-purification.
25 249 Evans-Jackson (Takenchi). Starting arrangements for squirrel-cage induction motors.
25 257 B. T.-H. Co. (G. E. Co.). Electric control systems.
25 272 English Electric Co. Driving gear of locomotives, tramcars, &c.
25 276 Thor Electric Safety Lamp Co. Miners' lamps, &c.
25 279 Midgley. Junction boxes for electrical connections.
25 282 Chloride Electrical Storage Co. (Ford). Storage battery plates.
25 284 Soc. E. Spengler & H. Chenx. Switches. (23/9/20, France.)
25 295 British Power Railway Signal Co., Tinsley & Gall. Transformers.

September 24, 1921.

25 325 Wall. Electric condensers.
25 327 Theobald. Electric light conduit fitting.
25 328 Radio Communication Co. & Scott-Taggart. Electric discharge devices.
25 348 Hutchison & Spowart. Trollies for electric vehicles
25 388 B. T.-H. Co. (G. E. Co.). Motor control.

September 26, 1921.

25 408 Strawson. Air-cooled transformer tank.
25 411 Illingworth. Cut-out.
25 428 Credenda Conduits Co. & Davidson. Electrical connectors.
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The "Electrician" Index.

Copies of the Index to Vol. LXXXVII of The "Electrician," which concluded with the issue of December 30 last, are now available, free of charge. Applications should be made to the Circulation Manager, The "Electrician," 8, Bouverie Street, London, E.C.4.

Notes of the Week.

Scottish Hydro-Electrical Schemes.

Though few new electrical schemes will come up for consideration in the forthcoming session of Parliament, two interesting Provisional Orders, which are being promoted by the Hydro-Electric Development Company and the Ayr Corporation for the development of the water power of the Grampians and of Loch Doon respectively, may be noticed. The Grampian scheme is a modification of the proposals put forward last year, which were discussed at length in The Electrician of January 14, 1921. This scheme, it will be remembered, was withdrawn owing to the opposition of the riparian owners and the salmon fishery interests. The chief modifications seem to be that four sites for generating stations instead of five are specified, and that the company desires to be relieved of the usual restrictions which are imposed on power companies supplying electricity for lighting.

An All-British Project.

The scheme is interesting as being the first British hydro-electric development which will rely exclusively upon water power for the generation of electricity for bulk supply to authorised distributors and for other purposes. Though there is already evidence of opposition from the fishing and other interests, the proposals of the company, we are glad to see, are receiving a good deal of sympathy and support. We need scarcely add that we wish the promoters every success in their efforts to secure statutory authority for a project which will have a most beneficial effect on the industries and social life of the Highlands.

The Loch Doon Scheme.

The proposals of Ayr Burgh are of a much more modest character. The Provisional Order deals with electricity supply, tramways and omnibuses, and several other subjects. It is intended to acquire about eleven acres of land at Dalmellington for the erection of hydro-electric works, and power is sought to construct various specified works in order to be able to employ the water of Loch Doon for generating electrical energy and to lay mains, erect overhead lines, &c. Ten years are to be allowed for the completion of the works.

Miscellaneous Powers.

The Order also extends the area of supply to Girvan, Maybole and several neighbouring parishes, and various miscellaneous powers are sought for the better management of the Burgh supply undertaking. In the first place it is desired to increase the maximum charge to 1s. per unit, and to impose a minimum charge for any amount of energy up to 15 units at the rate of 15s. in the March and December quarters and of 10s. for 10 units in the June and September quarters. Power is also sought to revise prices and methods of charging every three years, to construct sub-stations under streets, to lay mains in private streets, to discontinue supply where electricity is used contrary to the terms of the agreement, to erect overhead poles, to supply electricity in bulk, and to equip and maintain showrooms. It will be seen that some of these powers would be conferred by the Electricity Supply (No. 2) Bill, if and when passed, and there is a precedent for practically every one of them in Acts obtained in recent years by municipal authorities.

High-Speed Wireless.

On another page of this issue we give an abstract of a Paper by Col. A. G. T. Cusins, which was recently read before the Wireless Section of the Institution of Electrical Engineers. This Paper describes the low-power high-speed wireless apparatus which has been developed for military purposes at the Army Signals Experimental Establishment.

Those who have observed the progress of "wireless" during the last twenty years will be inclined to be sceptical at the revival of a promise heard at frequent intervals since the earliest days. They will remember a little sourly how favourable previous results have been over short distances, but they will not thereby be readily led to agree with Col. Cusins that it is reasonable to suppose that much greater distances can be traversed as the power is increased. For ourselves we think that for the ranges required for military sets the apparatus described by Col. Cusins constitutes a very practical and valuable achievement, but at the same time a study of the previous history of wireless development might be undertaken with advantage by those who so frequently and so eagerly neglect the very considerable difficulties which have to be overcome in applying to high powers the methods which experience has shown to be successful at low powers. The debate on Col. Cusins' Paper carried the meeting on almost to eight o'clock—two hours' steady talking. Some speakers contributed matter of value, and it is probable that others would have given a quantitative investigation of the relative merits of the apparatus had there been time. But this was prevented by the amount of time taken up in the reading of the Paper. We have often pointed out that where members are anxious to take part in the discussion the exigencies of time make essential a considerable shortening of the period occupied in reading the Paper, and in this particular case certain parts which were read might well have been omitted.

I.E.E. Informal Meetings.

It has long been known that the ordinary meetings of the Institution of Electrical Engineers are apt to be somewhat formidable to a proportion of the members, many of whom might be prepared to speak at smaller gatherings on less highly technical, but even more debatable, subjects. The original objects of the informal meetings were, therefore, to facilitate discussion of a rather wider range of subjects than is possible at ordinary meetings, and to enable members to make contributions which would otherwise be withheld on account of modesty or unfamiliarity with the subject under discussion. As far as London is concerned these objects have been admirably achieved, while the discussion on the drives of power station auxiliaries, which inaugurated the Manchester informal meetings, indicates that these local meetings will have an equally successful future. The subject chosen, forms an illustration of a type of discussion which is less concerned with description or the elucidation of principles than with the correlation of actual experience on matters of common interest to both manufacturers and supply engineers.

A Place for Minor Papers

In the course of his evidence Mr. Wilson referred to the brought before the ordinary meetings of the Institution is limited by a number of factors, and that, however strenuous the session, a vast field of technical activity must remain unrecorded. There, therefore, is a place for what may be termed minor Papers, as distinct from the major Papers which form the bulk of the Journal. Such a minor Paper may consist of a symposium of very short contributions on a given subject, or of a round-table discussion. Contributions to the discussion on ordinary Papers are often prepared beforehand, and at the meeting the effect conveyed is naturally one of lack of co-ordination. Less formal discussions might prove to have more unity, and, with careful editing and abbreviation, should prove valuable additions to the Journal. Their introduction would have the effect of enabling more justice to be done to every branch of a complex and many-sided industry, and, in their attempts to make the Institution more useful to the general membership, their organisation is a matter to which the Council might well give their attention.

Drives for Power Station Auxiliaries.

The vital importance of reliability in the operation of power station auxiliaries appears from the discussion at the first informal meeting of the Institution of Electrical Engineers in Manchester, which we summarise elsewhere in this issue. The steam is clearly being superseded by the all-electric drive, duplicate supplies being arranged to minimise risks of a total stoppage. The enormous increase in the size of main generating units at large stations necessitates turbo-alternator sets and transformers for station service of some magnitude. It is also gratifying to find such a consensus of opinion in favour of one form of supply, alternating being preferred to direct current. Power engineers in this country rightly value continuity of supply, and may therefore safely be trusted to ensure this for their auxiliaries as well as for the outside consumer. The discussion in general, therefore, confirms the views we expressed in a recent Editorial Note.

Dumping of German Lamp Bulbs.

Important evidence was given last week by Mr. Christopher Wilson before the Committee appointed under Part II. of the Safeguarding of Industries Act. This portion of the Act deals with dumping, upon which Mr. Wilson is expert, as he has had long and extensive experience of the electric lamp trade. From Mr. Wilson's evidence, which is reported in another column, it will be seen that at present German lamp bulbs can be placed on the English market at 56s. 4d. per thousand, or considerably less than the cost of the British labour charges for the product. If the present demand for a duty of 33⅓ per cent. be conceded the price of the German bulb would still be less than 55 per cent. of the actual cost of the British article! It is interesting to learn that Germany is the only real competitor so far as bulbs are concerned, for, although Holland and Belgium also manufacture bulbs, either the output is not so good or the price is much higher.

Duty Required to Increase Employment.

Mr. Wilson stated that the fundamental cause of the present unemployment in the industry was the low price, caused by the depreciation of the mark, at which Germans can put their bulbs on the English market, and he thinks that a duty would tend to assist employment here, this benefit being increasingly felt as the foreign currencies recover. No doubt this is true, but at the present time the German mark is more likely to depreciate than to appreciate, and this depreciation may more than counterbalance the 33⅓ per cent. duty which is demanded by the manufacturer.

Cause of German Superiority.

In the course of his evidence Mr. Wilson referred to the superior equipment of the German glassworks and to the more extensive experience and higher technical skill of the German workman. These are, no doubt, very important factors in the situation, for it is common knowledge that many British glass manufacturers have been carrying on without up-to-date plant and equipment. In these days it should be obvious that no duty will save a manufacturer

unless he installs modern furnaces, and although lack of capital and heavy taxation have hitherto prevented many British firms from modernising their plant and methods, the time has come when the true facts must be faced and a real effort made to put their houses in order.

Unauthorised Connections to Mains.

A DECIDED increase in the number of unauthorised connections to the mains of supply authorities is noticeable. We have, in fact, had to chronicle several cases of the kind during the past two or three months, and we are afraid that many of those who make these irregular connections do not appreciate the result of their action. It cannot be too strongly emphasised that, apart from any question of fraud, it is illegal for a contractor or consumer to connect up premises to the supply mains without the sanction of the electricity undertaker. There are several reasons why this should be so, not the least that a main may thereby be overloaded and the other customers deprived of their supply. A case of this kind recently occurred at Chester, where an electrician employed by consumers put in larger fuses than had been allowed for, with the result that the fuse in a street box blew, and neighbouring consumers were deprived of their light for an hour or two. Though there was no fraudulent intention, we are glad to see that a fine of £5 was inflicted.

Electric Vehicles at Islington.

THE Borough of Islington will shortly have one of the largest municipal fleets of electric vehicles in the Metropolis. In March last eleven vehicles were acquired for the purpose of watering the streets and collecting refuse, and now four more 2½ ton electric dust vans have been purchased. A report states that, in the Council's experience, one motor vehicle is equal to two horse-drawn vans for dust collection, and to four horse-drawn vehicles for street watering, and therefore a large economy is effected by using electric vehicles instead of horses. We notice, however, that for the repayment of the loan of £6 100 for the dust vans only a period of five years is allowed by the London County Council. This is too short, considering that the life of the "electric" is as long as that of the petrol or steam vehicle, and the result is that the heavy interest and sinking fund charges place it at a disadvantage during this period. The Electricity Commissioners allow a minimum of seven years for the repayment of all loans for motor vehicles, whether electric, petrol, or steam, and we think that the useful life of the electric vehicle can safely be taken to be not less than this figure. Where only five years is allowed for paying back a municipal loan, it would be more economical if the money were provided out of the rates than borrowed.

Dr. Edward Hopkinson.

THE death of Dr. EDWARD HOPKINSON, which we record on another page of this issue, removes not only a pioneer but the bearer of a name which will always be honoured by those who work in electrical science and industry. JOHN HOPKINSON, it is hardly too much to say, was the father of the electrical industry as we know it to-day. BERTRAM HOPKINSON, a son who, like his father, met his death in untoward circumstances, was no less a practical scientist, whose work was of the highest importance in the development of aviation. EDWARD HOPKINSON in his turn did much to solve the early problems of electric traction, and by his knowledge and enterprise built a foundation on which others might erect a worthy superstructure. Into the wider field of politics he brought a breath of freshness and sincerity which that arid plain sadly needs. These are men who can sorely be spared.

British Tenders for Foreign Orders.

COMPLAINT is often made that British firms are unsuccessful in the competition for colonial and foreign orders, and that their tenders are frequently passed over in favour of those of German or American origin. It is therefore well to consider some of the causes of this want of success. In the first place price is not the only element considered by the customer, for prompt delivery and efficiency of product may be regarded as equally important factors. In the next place, some of the conditions of the contract in these foreign tenders are very onerous, and British firms naturally desire to obtain modifications of them. On the other hand, foreign firms, and particularly the Germans, who are just now extremely anxious to recover their foreign trade, are willing to accept exacting conditions.

Two Methods Contrasted.

A GOOD example of the methods of the two countries is to be found in the results of the tenders recently invited by the Rand Water Board for electric pumping plant. The Board's requirements were advertised in the columns of THE ELECTRICIAN. Many tenders were received, and the contract for steel pipes went to a German firm, mainly on account of the low price—£276 223 compared with £392 476, the lowest British tender. An order for electric pumping plant also went to Germany, and the Board's engineer, reporting on the tender of the successful firm, said that they had fully grasped the Board's requirements. "The electric motors were larger and heavier, the insulation of the windings was of a better quality, and the temperature rise at full load less than that put forward by a British manufacturer. Moreover, the whole of the Board's general conditions and specification, including penalties, terms of payment, etc., and the whole of the prices were firm, and not subject to any variation in exchange, freightage, etc."

Work for the B.E.A.M.A.

On the other hand it was reported that some of the British tenders were subject to exceptions and reservations, and that one firm intimated that they were not prepared to accept the following: The guarantee as to the insulation resistance, full penalties for low efficiency, testing plant at their works under load, the clause as to responsibility for mistakes, penalty for late delivery, the Board's engineer as sole arbiter, and the terms of payment. In addition they required modification of the tests applied to the plant after erection. We are not surprised, therefore, that the engineer advised the Board not to consider that particular tender. Some of the conditions are no doubt unfair and might prove burdensome to manufacturers, but to attempt to make, when tendering, such sweeping alterations in the specification was, to say the least, unwise. It would have been better to make a protest against unfair conditions before tendering, or not to submit a tender rather than to submit one with so many modifications. Such matters, too, would be better dealt with by the B.E.A.M.A. than by individual firms. It is a question they will, no doubt, take up.

Other Work of the Commissioners.

THE long delay between the provisional delimitation of an Electricity District and the holding of the enquiry,

to which attention was called recently in connection with the West of Scotland area, may perhaps be explained by the pressure of other work which is being imposed on the Commissioners. For it must not be supposed that the whole of their time and energies are devoted to surveying the existing electricity supply resources and to mapping out the United Kingdom into electricity districts. There is a constant flow of applications for Special Orders, for sanction to borrow loans, to extend generating stations and to use overhead lines. In addition, the various forms, regulations, &c., used by the Board of Trade, are undergoing revision so as to bring them into line with the altered conditions and the modern requirements of the industry. Some of these revised forms have already been issued, but we understand that the Regulations for securing the safety of the public and for ensuring a proper and sufficient supply of electrical energy are at present being overhauled, and new editions may be expected during the course of the year.

Overhead Lines.

Among the forms which have recently undergone revision is the Memorandum setting out the information to be submitted in connection with proposals for the use of overhead lines. If rural districts are to reap the advantages of a cheap supply of electricity, extensive use must be made of overhead lines. It is true the Commissioners have shown themselves friendly towards all applications for overhead wayleaves, and the revised Memorandum seems to indicate that overhead distribution is to become a regular and usual, rather than an exceptional, method of supply. Still, we think that further powers will have to be obtained in order to overcome the obstructive tactics of some landowners and local authorities. We recently noted a case in the Midlands where an impossible rent was demanded for a pole, and we also reported an instance of work on an important overhead line in North Wales being held up for months on account of the opposition of a landowner. Though Sections 21 and 22 of the Electricity (Supply) Act have greatly enlarged the powers of the Ministry of Transport, it is still possible for an obstructive property owner to hold up a useful supply scheme for a long time, and we think it is time to devise a ready means of overcoming this difficulty. We may add that those interested in the latest forms and regulations of the Commissioners will find them in the forthcoming edition of the Electrical Trades Directory and Handbook.

The I.E.E. and the Cinematograph.

An interesting departure from the daily round of Papers and discussions was made by the Institution of Electrical Engineers last week, when the theatre was turned into a cinema. Who can say after this that the Institution neglects the march of progress? Three films were shown: "Investigations and Tests on High-Tension Switchgear," by Mr. P. P. Torchio, with explanatory notes by Dr. C. C. Garrard; "Telephone Inventors of To-Day" and "The Audion," by Mr. F. Gill. For the first of these subjects the slow-running cinematograph forms an exceedingly valuable means of demonstrating phenomena about which little is known by the ordinary electrical engineer, while the other two have a human appeal, which, judging by their reception, undoubtedly made them as interesting to the electrical engineer as to the general public. Without wishing to be ungracious, we may add that it is quite time the aid of the cinematograph was enlisted to aid electrical demonstration.

Signs of the Times.

A correspondent in a Sunday newspaper complains of the failure of those residing in Kingsway, London, "to make easy the path of customers to their doors." He gives a pathetic account of his attempts to find "Imperial House," and suggests, if numbering of the premises is not possible, the setting up of at least four boards, one at each corner of each end of the street, with the names of the houses placed upon them in order, so that he who walks may read. Now, strange as it may seem, this is really an electrical question, for Kingsway is becoming a street in which electrical engineers must take a greater and greater interest. Therein are to be found at least two associations for helping electrical interests to help themselves and at least two large manufacturing firms anxious and willing to assist in this endeavour to the best of their abilities. We should hate to think that anyone entering Kingsway in an endeavour to buy either a turbo-alternator or an electric iron, or both, to say nothing of a wireless mast, should have any obstacle put in his way. Perhaps Mr. Beauchamp, who was until quite lately an inhabitant of that thoroughfare, will see to it that electric signs of appropriate brilliancy, quaintness, and appeal are erected to direct the wayfarer after things electrical. It is certainly a case where usefulness and artistry might be well combined.

1921—Some Technical Landmarks.

In the last two issues of The Electrician we have dealt with the electrical history of 1921 in its broadest aspects, and with the progress that has been made in the development of wireless communication respectively. Technically, however, progress, though perhaps less spectacular, has also been occurring in other fields. It is therefore proposed to discuss here certain advances which have taken place during the year, which consist in the definite adoption in engineering practice of ideas or discoveries which have, in their early stages, been considered as purely scientific or laboratory devices, or of new products developed as a result of research.

New Materials—Stainless Steel.

Commencing with new materials, the year saw the introduction on a large scale of stainless steel as a material for steam turbine blading. Although this material has been available for several years, it was until lately scarce and costly. It is now being made on a considerable scale, and so is likely to find wider application.

The property of rustlessness and non-staining was originally aimed at, and the earliest use was for cutlery, where its application is almost automatic. It is highly remarkable that the special properties are obtained as a result of the addition of a single ingredient, namely, some 11 to 14 per cent. of chromium. In spite of this simple addition, the actual procedure in the production of this material requires skill and care. A brief recapitulation of its properties only can be given, thus:—The maximum resistance to corrosion is obtainable in the hardened condition. Corrosion is not produced by the weaker acids, but sulphuric and hydrochloric acids attack it readily; it

is therefore not a substitute for the resistant irons "duriron" or "tantiron." The steel does not scale when heated up to 800°C. or 850°C., and the strength at 700°C. only falls to half of that at 600°C. These properties show that it is specially suitable for the valves of internal-combustion engines, for which purpose a suitable metal has long been sought.

Rustless iron has also made its appearance, and this, being free from carbon, will allow of a wider range of applications even than in the case of stainless steel.

Transformers and Rectifiers.

Apparatus for the transformation of currents is of such great use and importance for a variety of purposes that it is obvious much thought is being expended on these devices, resulting in advances of no small moment. The mercury rectifier of the laboratory, with its brittle glass or quartz bulb, has for some years been a thing of the past, and the steel vessel rectifier which has taken its place has been steadily developed on the Continent until it is now a standard article of engineering construction. Until recently, however, there were but few examples of mercury rectifiers installed in England, although the list of such equipments is growing rapidly.

The Departure of an Old Friend.

It seems hard that an old friend like the rotary converter should have to go, but the higher efficiency of the mercury rectifier is the explanation of the modern tendency either to replace the rotary, or, at any rate, to instal a mercury rectifier in place of an additional converter.

The main advantages of mercury rectifiers may be briefly summarised by saying that although they may cost somewhat more than a rotary converter or motor-generator of equal output, they have a higher efficiency, need less attention, have a longer life and require less costly lifting appliances in the station owing to their light weight. The facts that no consumption of mercury takes place and practically none of the cooling water are also of importance. As an example of the efficiency obtainable it may be stated that for a mercury rectifier of 225 kW the efficiency, inclusive of auxiliary apparatus, is 94·5 per cent. The weight of even a much larger size, namely, 700 kW, is only 1 000 kg. (2 200 lbs.).

Electric Transmission at One Million Volts.

For a number of years before the war, although the voltage at which the transmission of electrical energy was effected had been steadily rising, the value of 150 kV had not been exceeded in practice. The past year has witnessed the commencement of yet another forward and upward step. The Southern Californian Edison Co., which operates in the region where transmission voltages are highest, has now completed its Big Creek No. 8 station, which is the first of a chain of stations that are intended to operate at 220 kV pressure. The lines are at present operating at 150 kV pending the completion of the other stations, but there appears little doubt that the installation will work quite satisfactorily at the higher voltage, as it has done at the lower pressure hitherto made use of.

Having now come to within a short distance of a quarter of a million volts as transmission voltage, some new experiments which have been carried out in the course of the year by the General Electric Co., of America, with a transformer capable of giving over a million volts, are of more than passing interest, in that they portend, not an immediate extension of the high-voltage range, but an acceptance of the possibility that it may be necessary or desirable to proceed, later, to higher pressures. For this reason it is easy to comprehend that a far-seeing concern like the company mentioned is desirous of obtaining experimental proof whether the laws that have been established for voltages up to, say, 250 kV will hold at pressures which are four times as great.

Technical Details.

Reliable technical details, which were not available until after the close of the year, show that the tests were made with a 1 000 kVA transformer built specially for this high pressure and operated at 60 cycles. Inspection of the main results which have emerged from the tests reveals remarkable, yet, from the technical standpoint, satisfactory, behaviour so far as spark-over voltage, corona, and stress on insulators in cascade are concerned. These matters are fully dealt with on another page of this issue.

Spark-over Voltage.

The needle gap spark-over voltage curve shows no distortion, and is, in fact, a continuation of the straight line, as for lower voltages, in which the sparking distance increases roughly about 1 in. for each 10 kV. At 1 050 kV the sparking distance is 112 in., *i.e.*, 9 ft. 4 in., so it is obvious from this that the spacing question will be of importance. Actually, the insulators at the transformer terminals are some 15 ft. in length.

Corona.

The corona starting point, it is found, can be calculated from the known laws; the *stress on a string of, say,* 22 *suspension insultors in series*, however, would, if calculated on the low-voltage behaviour, be approximately 200 kV, and since each insulator used had at lower pressures an arc-over voltage of 75 kV, even so long a string as 22 insulators in series would be expected to aro over entirely. Contrary to expectation, it is found that, actually, it does nothing of the kind, because, owing to the corona effect, the string is automatically graded as regards stress.

Size of Conductor.

The size of conductor which should be used for such voltages is a novel problem and introduces new conceptions, since a high-voltage conductor half-an-inch in diameter is even now considered enormous. Assuming tubular conductors to be used, each would have to be 5 in. in diameter for a spacing of 20 ft. apart! The one undesirable property at 1 000 kV is that a small percentage increase in voltage means a large actual increase, and thus the losses would be enormously increased if the line voltage were to rise even a small percentage above the critical point for which the conductor was designed.

Losses in Line.

The losses observed in the experiments show, for instance, that for the three conditions as to pressure: 1 000 kV, 1 000 kV + 10 per cent., and 1 000 kV under rain (which lowers the critical voltage), the losses would be 0 325 kW, and 1 080 kW per mile, respectively, and in order to diminish this loss the diameter of the conductor would have to be increased to 6.5 in. The capacity of such a line (three-phase) with conductors of 6·5 in. and 20 ft. spacing is such that the charging current per mile of line would be 4·43 A, and the kilovolt amperes per mile 7 650. It is obvious from these figures that the introduction of much higher pressures than 250 kV will undoubtedly mean the tackling of a host of new problems; but the experiments have shown that such voltages are by no means impracticable, and so a much-debated question has received its answer.

Auxiliary Features in Automatic Telephone Systems.*

A New "All-Relay" System Particularly Applicable to Small Installations.

By W. AITKEN, M.I.E.E.

Small automatic switches are one of the most interesting and useful developments in the telephonic art. There is a great field for these both as private installations in works, warehouses and offices, and in connection with exchange service as private branch exchanges (P.B.X.), village exchanges, and the like.

This new circuit by the AUTOMATIC TELEPHONE MANUFACTURING COMPANY marks a distinct advance on present relay practice, but the author believes a mistake has been made in pursuing the ideal of an "all-relay" design. The author's model switch for small installations uses relays for the connecting means and simple stepping switches to set up the connection.

In small switches, simplicity of apparatus and circuits is essential. An all-relay system attains simplicity of apparatus at the expense of multiplication of relays and complication of circuits. It will be noted from the diagram that the preselection of an idle connection-circuit to join two lines together is most simple and efficient, but that the connection-circuits are overburdened with relays, which might be readily replaced, to a large extent, by a simple stepping device. The circuit is interesting in showing how the cycle of operations in four relays energises a relay for every impulse of a digit, so that this relay can be made the connecting relay to the called line.

The arrangement is most suitable for small exchanges having a capacity up to 28 lines, but may readily be increased. The diagram shows the circuits of a 19 line switch having three "connection-circuits" to allow of three simultaneous conversations. These can be increased as required by the traffic.

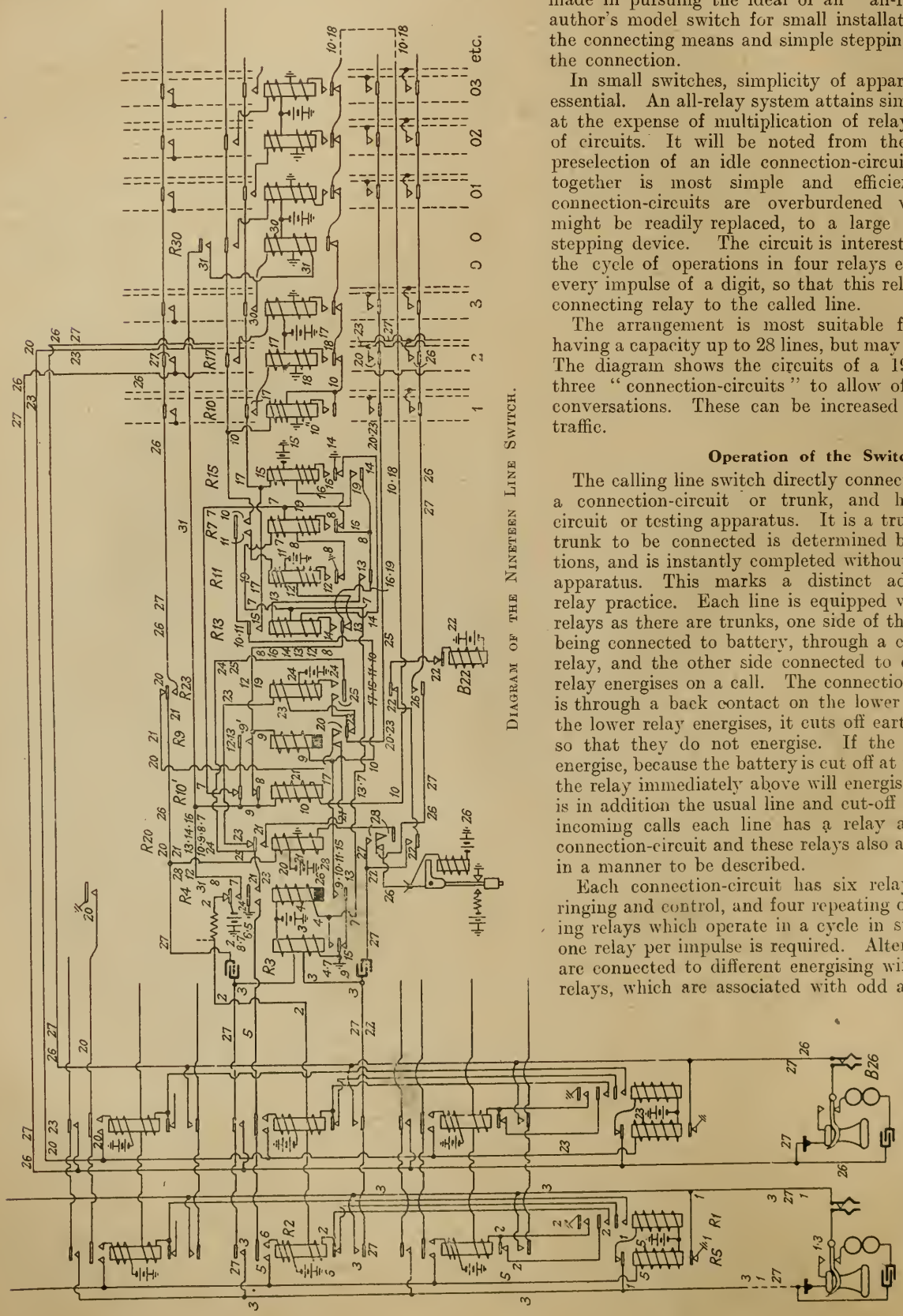

DIAGRAM OF THE NINETEEN LINE SWITCH.

Operation of the Switch.

The calling line switch directly connects a calling line with a connection-circuit or trunk, and has no intermediate circuit or testing apparatus. It is a true preselector, as the trunk to be connected is determined by the prior connections, and is instantly completed without the aid of common apparatus. This marks a distinct advance on previous relay practice. Each line is equipped with as many simple relays as there are trunks, one side of the energising winding being connected to battery, through a contact on the guard relay, and the other side connected to earth, when the line relay energises on a call. The connection to the relay above is through a back contact on the lower relay, so that when the lower relay energises, it cuts off earth from those above, so that they do not energise. If the lower relay fails to energise, because the battery is cut off at the guard relay, then the relay immediately above will energise, and so on. There is in addition the usual line and cut-off relays per line. For incoming calls each line has a relay associated with each connection-circuit and these relays also act as counting relays in a manner to be described.

Each connection-circuit has six relays for battery feed, ringing and control, and four repeating or impulsing responding relays which operate in a cycle in such a way that only one relay per impulse is required. Alternate counting relays are connected to different energising wires from the impulse relays, which are associated with odd and even numbers of impulses, and numbered 1 to 9 and 01 to 00 in a 19 line equipment, to agree with the subscribers' numbers. Relay 0 is a switching relay to bring into operation a second holding circuit.

Other features will be described in the operation of the circuits.

The circuits are numbered in the order of operation as follows:

1. When the receiver of S is lifted R′ energises. Assume No. 1 connection-circuit busy, that is, circuit 2 open. Assume No. 2 to be called.
2. Connecting relay R2 energises.
3. Impulse and feed relay R3 energises over loop.
4. Guard relay R4 energises. Circuit 2 is opened and connection-circuit 2 is made busy to other callers.
5. Cut-off relay R5 energises. R′ de-energises.
6. R2 holding circuit.
7. Repeater relay R7 energises.
8. R7 holding circuit.
9. Impulse relay R3 de-energises on first break at dial. R9 energises for the duration of the impulses.
9′. New path to battery.
10. First counting relay R10 energises; also R10′ to open circuits 7 and 8. The latter remains closed over 9′.
10″. R10 holding circuit.
11. Repeater relay R11 energises. Opens circuit 8 and R7 de-energises. Opens circuits 10 and 11.
12. R11 holding circuit.
13. R3 re-energises at the end of the first impulse and R13 energises. Circuit 12 open. R11 de-energises. Circuit 13 opened.
14. R13 holding circuit.

End of first, or odd number, impulse 1.

15. R3 de-energises on break at dial for second impulse, R15 energises.
16. R15 holding circuit.
17. Second counting relay R7 (even) energises.
18. R17 holding circuit in series with R10′. Circuit 10 open and R10 de-energises.

R3 re-energises at end of impulse.

19. R7 re-energises, partly over circuit 7, circuit 16 open and R15 de-energises.
8. R7 holding circuit. Circuits 10 and 11 are prepared for the next impulse (if any).
20. If line No. 2 is busy R20 will energise over the holding circuit.
21. R20 holding circuit.
22. Busy tone is given to caller.

If the line is idle R20 is not energised and ringing current is applied.

The number having been called R9 de-energises. R10′ remains energised. Circuit 8 is open and R7 de-energises.

23. R23 energises to complete the loop.
24. R23 holding circuit.
25. Called line made busy.
26. Ringing circuit to called line. R20 does not energise until called party answers. Ringing is by polechanger, in which the pendulum connects battery and earth alternately to line, about 20 times per second. Ringing is cut off when R20 energises.
27. Loop talking circuit, current fed through R3.
28. Battery feed for called party through R20.

The connection is broken down when the caller's receiver is replaced, when R3 and R4 de-energise.

30. When 0 is dialled (ten impulses) R30 energises, partly over circuit 17.
31. R30 holding circuit. Circuit 18 is open to de-energise all counting relays of lower value and succeeding relays are built up by impulses as before described.

A connection has thus been completed between the two telephones shown over the contacts of R2 of the calling line and R17 to the called lines. The talking circuit is divided by condensers and battery fed to the calling line over R3 and to the called line over R20. The transmission efficiency is standard.

Surface Leakage.

By G. L. ADDENBROOKE.

Some eighteen months since I bought a portable form of hair hygrometer which I thought might be applicable to certain purposes I had in view. On testing it I found that, though it deflected sufficiently, the maker's scale bore no relation to the indications of the instrument. I therefore proceeded to calibrate it myself, and finally found I had succeeded in doing so fairly, and that the scale seemed decently stable and sufficiently accurate for my purpose.

Having done this, I hung it up in a sitting-room I constantly use, and near it placed a gold leaf electroscope, an electrophorus, a small Leyden jar, and a few other appliances for electrostatic experiments. Noting the humidity of the atmosphere by the hygrometer reading, I proceeded from time to time to try a few simple experiments. At the time I first did so the hygrometer indicated 80 per cent. humidity, and the experiments were not easy. The electrophorus required a little warming before it would excite properly and would not keep charged long, and the leaves of the electroscope would not remain expanded at the same angle, but fell too quickly for good reading.

The Effect of Dry Weather.

At last came a spell of dry weather, when the humidity indicated had fallen to 60 per cent., and now things were quite different. The electrophorus once excited was found to keep its charge for hours, and the leaves of the electroscope maintained their angle for some time; other experiments also went off quite in text-book style. Similar alternative results were obtained a number of times during the past year.

Quantitative Studies.

An attempt was then made to study the results quantitatively. For this purpose a gold leaf electroscope was charged and the time it took to fall to half charge noted when the humidity was about 60 per cent., and the experiment was repeated on the next occasion when the humidity reached 80 per cent. Two different electroscopes were also used, one insulated with ebonite, another with sulphur, and the effects were similar in both cases. The leakage would be proportionate to the time of fall of the leaves and the resistance inversely to this, speaking approximately. But the fall with the drier atmosphere took something of the order of twenty times as long as when the humidity was 80 per cent., or the steady field resistance was evidently some twenty times greater at 60 per cent. humidity than at 80 per cent. The question arises, How does this come about? Assuming that there is some relation between the amount of moisture in the film causing the leakage, and the humidity of the atmosphere, it is hard to see how a reduction of this from 80 to 60 per cent., or, say, by 25 per cent., should alter the surface resistance some twenty times. Assuming that the moisture is deposited on the surfaces in an even film, it does not appear very probable that 25 per cent. decrease in humidity would evaporate everything but one-twentieth of the existing moisture, and therefore I put this explanation on one side, though for some time I could not find an alternative.

Not long since, however, I came across the account of some experiments on the moisture deposited by breathing on clear glass surfaces. It was pointed out that if this was done and the surface was examined while the moisture was evaporating, the play of colours produced and the appearances did not agree with what might be expected if the film was even gradually got thinner.

Microscopic Examination.

On examination of such a film under the microscope it was found that the film was not even, but consisted of multitudes of small, separate half-globules of dome shape, with something approaching bare glass between. It was evident that the deposition of moisture was round nuclei. Now it seems a fair assumption that such nuclei must exist abundantly on the surfaces of all insulating materials, and that, although invisible, moisture condensed on their surfaces is almost certainly in this form. Consider such a film placed in a drier atmosphere. The amount of evaporation might not make much difference in the resistance to a current passing across the globules, but evaporation from the very thin intermediate spaces might render some of these almost or quite bare. In the latter case a current would have to take a devious path and the resistance be greatly increased. This seemed a reasonable supposition for carrying a plausible explanation a little further, to which I think something more now may be added.

Other Analogies.

There has recently been published by Sir George Beilby a very interesting book, accompanied by a large number of micro-photographs, describing his work on metallic and other surfaces. In the course of such work he studied very

thin films of oil and other substances on water under the microscope, and gives several illustrations of the results.

He was able to start with relatively thick films and then gradually attenuate them. At first the films were continuous, but at a certain critical point began to reticulate; the surface tension parallel with the surface could no longer support the strain, a clear break occurred, and the material gradually broke up into more and more definite ridges and separate globules with open spaces between. It is difficult to describe the appearance; the photographs themselves should be seen to properly grasp what actually occurs. On inspecting these photographs there seems no doubt that a continuous path for a current would be formed through the inter-connection of the ridges formed, but it would be a very devious one, and if such phenomena occurred with the moisture on an insulating surface, it might well account for the great alteration in resistance found as described above.

Observations on Sir George Beilby's Lines.

Following up the suggestion contained in this work of Sir George Beilby, I have made some microscopic examination of the moisture films obtained by breathing on glass and watching the moisture evaporate.

A little difficulty was found at first in seeing the phenomena clearly, but, after some trials, it was found that the most suitable illumination was an Abbe condenser well stopped down, and using a 1 in. defective and fairly low eyepiece. The small globules of moisture then stood out well, both with daylight and artificial light. They are primarily rounded, and very interesting to watch as they gradually vanish by evaporation from the outside to the centre, but apparently evaporation for some time has the general effect of flattenng the globule without diminishing its size; it is only when it has apparently got flattened down all over to a certain thin stage that the edges begin to contract, and, when this stage is reached, the contraction is rapid in a now saturated atmosphere. It is evident that, at this point, when the traces of visible moisture are almost vanishing, and can only be seen by careful lighting, there is a very unstable state, when any slight changes in the humidity of the air make great alterations in the state of the moisture film.

At the same time this visible film is certainly thicker than the invisible film with which we usually have to deal electrically, and its behaviour can only be used as some guide towards the conditions obtaining when the film is invisible.

Characteristics of the Visible Film.

When the visible film is first observed it looks much like a simple layer of bubbles on water, in most cases the edges touch and are clearly defined. Contrary to my expectation, the bubbles do not seem to centre on any particles of dust visible, but, when very small, these latter seem to gravitate to the edges. There is no visible nucleus, but the shape and size of the globules seems to be determined by the state of the surface underneath, which looks as if it were mottled in some way as to its properties, as if, perhaps, it were made up of flattened crystals having some definite characteristic over the face exposed.

Unfortunately, having to consult an oculist some time since, he advised me not to undertake work which involved serious observation through optical instruments, and therefore I feel it would be imprudent of me to pursue this part of the subject, and one of my objects in drawing attention to these matters is that possibly what I have said may attract the attention of someone who could do so, and to whom I would be happy to give such help as I could.

Regarding the electrical characteristics of leakage with both continuous and alternating potential differences, I would refer to a Paper I read before the Physical Society in 1912. The whole subject would repay much further study.

Is Surface Leakage Inevitable ?

We are accustomed to take surface leakage as inevitable, and to accept it as a necessary nuisance, but, if the question is seriously considered, it is wonderful what a limiting factor it is becoming in a number of important and different directions, and, though looked on as of secondary importance, it seems to me that the time is coming when it is well worth studying in itself. A better and more exact knowledge of its magnitude and the conditions under which it acts would be useful, and might reveal unexpected characteristics which could be utilised for its better control.

OBITUARY.

Dr. Edward Hopkinson, M.P.

We regret to record the death of Dr. Edward Hopkinson, M.P., which took place at his home in Alderley Edge on Sunday last. Dr. Hopkinson, who was born on May 28th, 1859, was the fourth son of John Hopkinson, and brother of Dr. John Hopkinson. He was educated at Owens College, where he was Dalton Mathematical Exhibitioner. In 1877 he gained an exhibition in mathematics at Emmanuel College, Cambridge, and later a foundation scholarship. He graduated as Tenth Wrangler in the Mathematical Tripos of 1881 and became a Fellow of his college in 1883. In 1881 he took the degree of doctor of science in the University of London in the branch of electricity and magnetism, treated mathematically. In the following year he became assistant to Sir William Siemens, and continued with him till the latter's death.

Early Distinctions.

During this time he carried out experiments at Portrush on the first electric tramway in the United Kingdom, and a Paper read by him on the undertaking gained a silver medal from the Society of Arts. After Siemens' death Dr. Hopkinson designed and carried out the equipment of the Bessbrook and Newry electric tramway, which is worked by water-power. For a Paper on the construction and working of this tramway the Institution of Civil Engineers awarded him a gold medal and the Telford premium.

In the year 1884 he joined Mather & Platt, and took charge of their electrical engineering department. In 1887 he became a partner in the firm, and, when the firm was converted to a limited company in 1892, he was one of its managing directors. In 1899, when the business of Dowson, Taylor & Company was acquired, he was appointed vice-chairman, a position he held until his death He was also vice-chairman of the Chloride Electrical Storage Battery Company.

Dr. Hopkinson took out many important patents, many of them in collaboration with his distinguished brother, Dr. John Hopkinson. They were the joint inventors of the "Manchester" dynamo and motor, and of various improvements in connection with dynamos and the applications of electricity. They were also the joint authors of a Paper on Dynamo Electric Machinery, printed in the "Transactions" of the Royal Society.

Work on Electric Traction.

He was a pioneer of electric traction, and his firm undertook the first large contract for working a full-gauge railway electrically, Dr. Hopkinson being responsible for the design of the locomotives. The City and South London Railway, opened by the Prince of Wales in November, 1890, was then the largest application of electric power to locomotion. The characteristic feature was the employment of separate locomotives with the armatures of the motors built directly on the axles without the intervention of gearing. The undertaking was described in a Paper read by him before the Institution of Civil Engineers in 1893, for which he received the Telford premium and the George Stephenson medal. He also designed, and his firm undertook, the original electrical equipment of the Douglas and Laxey Electric Tramway, the Snaefell Mountain Railway, and the Blackpool and Fleetwood Tramroad. The Snaefell Railway was remarkable for having a continuous gradient of one in twelve over a four miles track, ascended at a uniform speed of nine miles an hour. It was worked by simple adhesion, every axle of the cars being driven by an electric motor. The Douglas and Snaefell lines were the first on which large fixed batteries were used.

Professional Qualifications.

Dr. Hopkinson was a past president of the Institution of Mechanical Engineers, a member of the Council of the Institution of Electrical Engineers and the first chairman of its Manchester section. He had also been president of the Manchester Association of Engineers, a vice-president of the Manchester Steam Users' Association, and chairman of the Associates of Owens College. He served on the Indian Industrial Commission which sat from 1916 to 1918, and he was a member of the Industrial Fatigue Research Board of the Department of Scientific and Industrial Research. He entered Parliament in 1918 as Unionist Member for the Clayton division of Manchester, but he took little part in party politics. He married Minnie, daughter of the late John Campbell, of Rathfern, county Antrim.

High-Speed Wireless Telegraphy.*

By Lt.-Col. A. C. T. CUSINS.

The author, who is the head of the Army Signals Experimental Establishment, describes apparatus which has been designed and experimented with between London and Cologne via Aldershot. The aim of the equipment is to provide apparatus which shall enable wireless communication to be carried on mechanically, both in transmission and in reception, at speeds up to the maximum of Wheatstone apparatus. The system is recommended for handling telegraph traffic to the Continent, for replacing sections in an important line which are liable to interruption and for Press work.

The Paper records the development of low-power apparatus which in the hands of operators of average ability enables wireless telegraphy to be carried on by mechanical operations both in transmission and in reception, either by itself or in continuation of a line system; and this at all speeds up to the maximum of Wheatstone apparatus.

For some time the Post Office have been conducting trials of the apparatus here described and traffic between London and Germany has been carried on a single wire and earth between the Central Telegraph Office, London, and Aldershot, then from Aldershot to Cologne by military wireless, and from Cologne military wireless station to the German Post Office by wire. Through transmission has also been carried on with a certain amount of steady success, using Wheatstone transmission and Creed printer reception, the working speed being up to 100 words a minute.

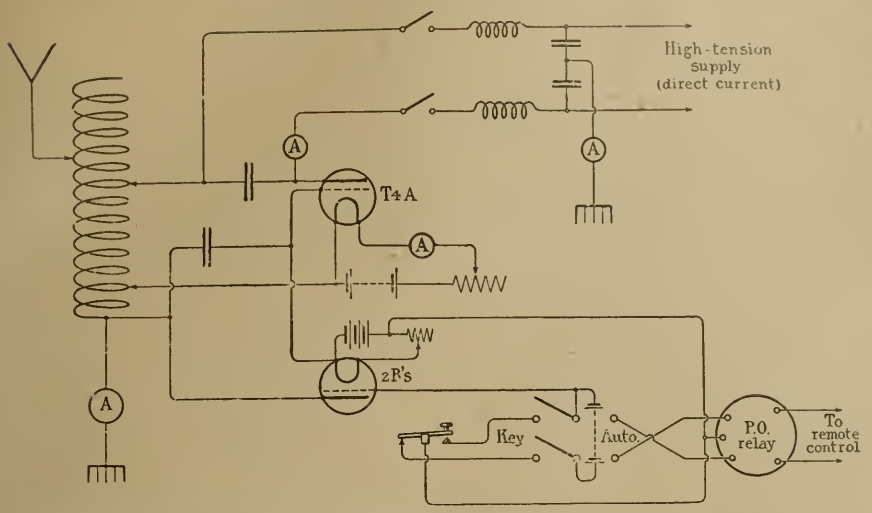

Fig. 1.—Continuous Wave Set for Field Use, with High-Speed Attachment.

The actual set at Aldershot which is now working to Cologne operates on an aerial consisting of two 300 ft. wires between 70 ft. masts. The earth resistance is 6 Ω, and the aerial current 10 to 12 A. This power is sufficient for fair conditions, but there is need for a larger factor of safety.

Circuit Arrangements.

A circuit diagram is given in Fig. 1. In this, the actual Wheatstone instrument is shown as being at a distance from the transmitter, the signals being relayed to the latter through a Post Office relay. By operating on the grid filament circuit of small "B" control valves the resistance of their anode-filament paths may be varied enormously and, if the latter be used as the grid leak of the main generating valve "T_4A," its oscillations may be controlled over the full amplitude. This action is almost instantaneous. Sets up to 6 kW can be keyed practically without sparking.

Reception.

In Fig. 2 is given a complete theoretical diagram of a receiving set which was for some time an accepted pattern. All switches, &c., are omitted for the sake of simplicity.

The oscillations were received on a tuned aerial (loop) which was loosely coupled to a tuned oscillation circuit shunted by the grid-filament path of the first valve of a 3-valve high frequency amplifier. The high frequency amplifier had an amplification factor of about 750 on three valves and was extremely stable. With a 3 per cent. variation of wave length the signal strength was reduced to 30 per cent. of the maximum.

The final anode circuit of the high frequency amplifier was coupled to the grid circuit of a Turner valve relay† which was provided with a special means of high speed quenching. In order to preserve a correct spacing of Morse signals it was necessary to quench or re-set the relay about four times per dot, and practical experience has shown that to receive 200 words per minute the quenching rate should be at least 540 per second—a rate obviously too great for the mechanical movement and highly inductive winding of the Post Office type relay which had been used for quenching the original Turner valve relay. Various methods of high speed mechanical make and break were tried, but finally additional valves were employed to give an intermittent high voltage supply to the anode of the valve relay in the manner indicated in Fig. 2.

The Singing Valve.

A valve, called the "singing valve" in Fig. 2, was caused to oscillate at a frequency between 1 000 and 3 000 periods per second, and its grid was connected through a large resistance to the grid of a second valve labelled "control valve." The filaments of these two valves are connected together with the result that the grid of the control valve is made alternately positive and negative, and, as the anode filament path of this valve is part of the anode circuit of the valve relay, the latter is quenched at the frequency to which the singing valve is adjusted.

Amplification.

The anode current of the valve relay is amplified by a single valve direct-current amplifier which in turn operates a double-current valve relay. By this means when a signal is being received a current of 40 mA passes, via the bottom valve, through one coil of the Post Office relay and 10 mA through the other. When there is no signal the conditions are reversed, and although the relay or recording instrument is not actually supplied with double current, the effect

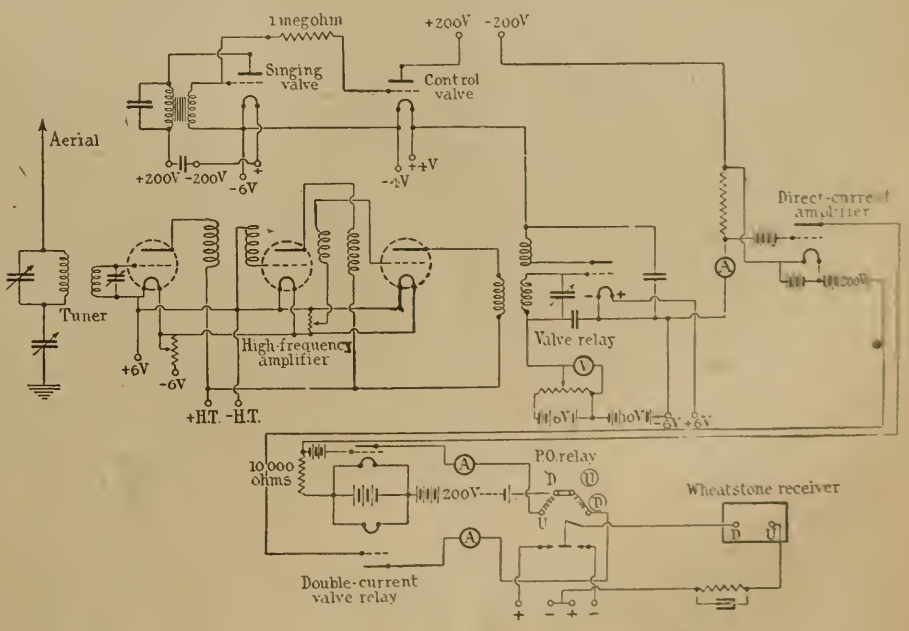

Fig. 2.—Theoretical Diagram of Receiving Set.

*Abstract of a Paper read before the Wireless Section of the Institution of Electrical Engineers.

† *See* The Electrician, Vol. LXXXIII., p. 4.

is the same as that of a true double current of half the value. With this arrangement the Post Office relay Wheatstone receiver can be made to operate at the fastest speed of the standard transmitter.

Recent Modifications.

The apparatus described has been superseded by a type employing a self-quenching relay which is set to one definite frequency, this frequency being obtained whatever the wave-length of the incoming signal by heterodyne. The need for adjustment of the whole set on change of wave-length is thus avoided. Perfect signals have been obtained at 3 000 words per minute with a chemical inker, for which standard Wheatstone slip may be prepared by passing it through a solution of potassium iodide. A complete remote control system has been devised. By this means traffic may be dealt with at some point other than the wireless station.

Conclusion.

The speed at which it is possible to work is at least as great as the speed at which the Wheatstone apparatus itself will work, and, with a specially constructed transmitter and chemical inker, speeds over 1 000 words per minute have been recorded.

The greatest range over which the system has been operated at the time of writing is 400 miles. Using 10 A (key held down) in the transmitting aerial a very fair factor of safety was obtained at the receiving station over this distance, so that it is reasonable to suppose that much greater distances can be traversed as the power is increased.

Possibly little is to be gained at present for general utility purposes in pushing up the speed to more than about 100 words per minute.

Suggested Use of the System.

Many uses for the system will occur to anyone knowing its capabilities, but a few examples may be given.

(1) For the handling of telegraphic traffic to the Continent. A system independent of submarine cables and land line maintenance would *ipso facto* be more reliable.

(2) For replacing, in an important line, any sector liable to interruption without reducing the speed of operation—since an ordinary Post Office relay serves as the transmitter key (at high speed) and the signal received also operates a similar relay.

(3) For Press work. Suppose, for example, a single transmitting station situated at some point in Great Britain. To this station would be sent by various channels the news of the day. At this station the news would be punched up and radiated at, say, 120 words per minute. At each important town in the kingdom publishing a newspaper a receiver would be installed operating a direct printing-telegraph machine. By this means, one single transmission of news would result in the news being received in plain English through the country simultaneously. The development of this scheme is left to those concerned, but the possibilities are immense.

The examples so far given are based on what has actually been achieved. If it is permissible to assume that the power handled can be increased, and consequently the range, a startling prospect is opened up.

DISCUSSION.

Sir Charles Bright opened the discussion with a reference to the "coming of age" of wireless telegraphy and the great practical advance which had taken place since the question of an Imperial Wireless Chain was first considered by the Government. The speeds of working considered practicable by Col. Cusins were higher than those for cables of normal dimensions. There was a great need for the development of wireless for the distribution of news and the fostering of trade throughout the Empire. He agreed with the Prime Minister of Australia. It mattered not what particular system be used so long as something was done, and done quickly.

Mr. R. Carpenter emphasized the particular adaptability of Creed apparatus to wireless telegraphy. The Creed high-speed system was the only one employing the Morse code, and it was in consequence much less fastidious than other systems; it corrected both bad signals shape and spacing.

Mysteries.

Mr. F. G. Creed, defined his position as that of a mechanic: one who produces machines. To him wireless and the valve were mysteries. Electricity was easy to move, and he therefore believed in the valve for high-speed work, but we must consider all our resources. He had seen high-speed working with a selenium valve in Norway in 1913. Last year Mr. Cox of the Pacific Cable Board had exhibited a selenium valve in which a magnification of 50 000 was obtained, the apparatus having a period of 1/100 sec. He could see a great shrinking in the effective size of the world, and a probability that someone would seize control.

Mr. L. B. Turner considered that anyone with the triode to his hand and his coat off could evolve the apparatus which was described. Atmospherics remained the dominant problem. At low speeds our defence was tuning and a low decrement. At high speeds this defence failed. In aural reception the operator disliked the ringing effect produced by overmuch tuning; the ear preferred a crisp signal. This disadvantage did not apply to Col. Cusins' apparatus. Had Col. Cusins made experiments at long wave lengths and noted atmospheric interference?

The Words per Minute Factor.

Mr. E. H. Shaughnessy enquired the reason for the stated extreme selectivity of the Turner relay. To his knowledge Messrs, Hinton and Gill had recorded high speed on the tape in 1918. He questioned the limit of 90 words a minute assigned by Col. Cusins to the dictaphone. In 1913 the Post Office invited tenders for apparatus to record 100 words per min., and the Marconi Company gave a very satisfactory demonstration for three days and nights at that speed over 500 miles. The results were given in the "Post Office Electrical Engineers' Journal" for July, 1914. The practical results of some recent regular Post Office working were for a certain six hour service, 40 messages per hour; for another, seven hour service, 47 messages per hour, both at high speed; a twelve hour service at hand speed of 21 messages per hour, and a ten hour duplex high-speed service 109 messages per hour. If the Turner gear was not used, what was? What was meant by change in nature of signals? Were they cooled or heated or what? Many of the general statements at the beginning and end of the Paper were doubtful. Working at 1 500 metres over 400 miles did not prove much. The distribution of news was a more complicated problem than might superficially appear.

A Remarkable Piece of Work.

Prof. G. W. Marchant challenged Mr. L. B. Turner's statement that any suitably-equipped person might have turned out the apparatus described, and he thought it represented a very creditable piece of work. He considered more traffic could be handled by wireless than by land lines.

Capt. H. Round considered the Paper described a remarkable piece of work—in fact, one solution of the old conundrum, "Given nine valves, what can be done with them?" What were the relative values of plain rectification and trigger action? Mr. Turner seemed to confuse filter and resonance circuits. The Turner relay was a single resonance device; he preferred a filter circuit, *i.e.*, several series resonance circuits in cascade. He preferred to submit his further remarks in writing.

Mr. J. Scott-Taggart enquired whether experiments had actually been carried out in bridging long distances by relays, and if so what was the effect of the outgoing signals upon those being received? What advantage had the Turner relay over amplification and rectification? A number of circuits were described, and Col. Cusins was asked to say whether they had been tried.

The hour being then 7.55, the Chairman (Prof. G. W. O. Howe) did not add to the discussion, and Col. Cusins announced that he would reply in writing to the various points which had been raised.

Coil Ignition for Motor Cars.*

This book is described as "a manual for the motor mechanic, owner-driver, and all interested in coil ignition systems." The author also says that it "may be correctly termed a course of electricity for the average chauffeur," but we cannot subscribe to that description, though we have no doubt that he makes many mental reservations in his interpretation of the phrase, "A course of electricity."

The author is convinced that coil ignition will, before long, be universally adopted in the United Kingdom, on the ground of its greater reliability, smaller first cost, and lesser running costs when compared with magneto ignition. He regards the magneto as a superfluous piece of machinery if it be conceded that the car carries a set of accumulators for car lighting. It is not our function here to agree or to disagree with this view.

There are chapters on the manufacture of an ignition coil, on the general details of the ignition system, and on coil ignition systems in use—this last filling nearly half the book and being quite up to date. Accumulators are dismissed briefly in eight pages. We wonder why.

We consider that the price of the book is much too high and quite disproportionate to that of the same publishers' "Technical Primer" series. The author naively remarks that "the price of the book will be repaid a dozen-fold through fewer repair bills," and is of the opinion that "every owner of a motor-car should obtain a copy of this work and give it to his chauffeur, who is sure to appreciate it." Criticism is disarmed.

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* Coil Ignition for Motor Cars. By C. Sylvester, A.M.I.E.E., A.M.I.Mech.E. (London: Sir Isaac Pitman & Sons, Ltd.) Pp. xi.+228 10s. 6d. net.

Electrical Transmission at 1 000 000 V.

A short time ago we noted the successful conclusion of some tests which had been carried out at the Pittsfield Works of the American General Electric Company, with pressures rising up to 1 000 000 V, with a view to confirming by actual experiments the applicability of the law which had been previously established for lower voltages. Owing to the courtesy of the British Thomson-Houston Company we are able to give some further details of these tests.

Previous tests made up to 250 kV and experiments with needle and sphere gaps, as well as with line insulators at nearly double this voltage, had established spark-over curves which predicted the corona and spark-over characteristics at 1 000 000 V, but, with the present theoretical and probable future practical interest in view, it was decided to obtain actual data from experiments.

As is well known, commercial apparatus has already been built for 220 kV operation, but, for possible future developments, although no deviation from the established laws was expected, no actual data could be established without further experiments.

The results of these tests were as follow :—

(*a*) The spark-over curve between points showed no discontinuity. The spark-over at 1 000 kV was found to be about 105 in.

(*b*) The spark-over curve between 75 cm. spheres showed no great deviation from calculated values.

(*c*) Tests were made on strings of line insulators and the spark-over voltages were as expected ; for instance, a string of eighteen standard suspension insulators arced over at about 900 kV, while a string of twenty-two insulators did not arc over at more than 1 000 kV.

(*d*) Visual corona tests were made on 3½-in. diameter brass-tube lines operating single-phase. The corona starting voltage (about 900 kV) checked with the calculated value.

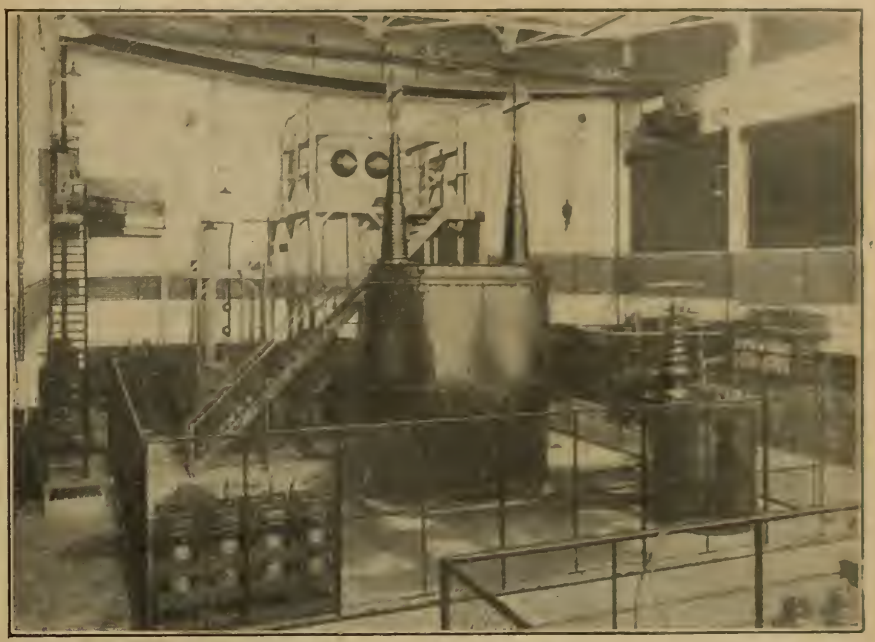

Fig. 1.—High Voltage Engineering Laboratory at the Pittsfield Works of The General Electric Company, where the transmission of electricity at 1 000 000 V was recently successfully accomplished. In the foreground is shown a transformer designed for 750 000 V.

Fig. 2.—Electric Current at 1 000 000 V arcing across a needle gap 9 ft. wide in the experimental tests.

There is one point which is particularly gratifying in connection with the production of this new limit of voltage, namely, as has been the case in previous advances, the transformer is the first part of the equipment to be produced for a given voltage. Switching devices, line transmission material protective devices, &c., have always been later developments in the art of making a complete transmission system for a given voltage.

Our illustrations show the apparatus employed for making these interesting tests, and the appearance of the arc passing across the 9 ft. spark gap.

Spark-Over Conditions.

In commenting further upon these tests in a recent issue of the "Electrical World," Mr. F. W. Peek, junior, points out that the minimum spark-over voltages for a given conductor-separation is between sharp points. Such points are likely to occur on transmission line conductors, and this minimum separation is therefore determined by the needle gap curve. This curve follows a straight line, which is subject to considerable variations with humidity and pressure, with the sparking distance between 9 kV and 10 kV per inch. The measured needle gap spark-over curve shown in Fig. 3a has no discontinuity. It is simply an extension of the approximately straight line needle-gap curve of the lower voltages and the curves with both ends isolated and one end earthed are practically coincident. A spark-over voltage curve for spheres 29·5 in. in diameter is given in Fig. 3b. No discontinuity was observed in this curve either, but accurate measurements could not be made up to 1 000 000 V when one sphere was carried because the sphere was not large enough.

Corona Tests.

Visual corona tests were made on parallel brass tubes 1 in., 1½ in., and 3½ in. in diameter at various spacings. These tests showed that the corona starting-points for very high voltages studied can be calculated from the laws established at lower voltages, and that observed and calculated values which are plotted in Fig. 3a agree very closely. The line spark-over curve shown in Fig. 3c is also continuous.

Electric Stresses.

It is interesting to observe that at low voltages the stresses on the line unit of a string of twenty-two insulators would be about 20 per cent. of the applied voltage. If this relation obtained for 1 000 000 V on a string of twenty-two units, the stress on the line

unit would be 200 kV. Since a single unit arcs over at about 75 kV the whole string would be expected to arc over as soon as the voltage became 375 kV. Such a string does not, however, arc over under 1 000 000 V, the reason being that it is automatically graded by the corona.

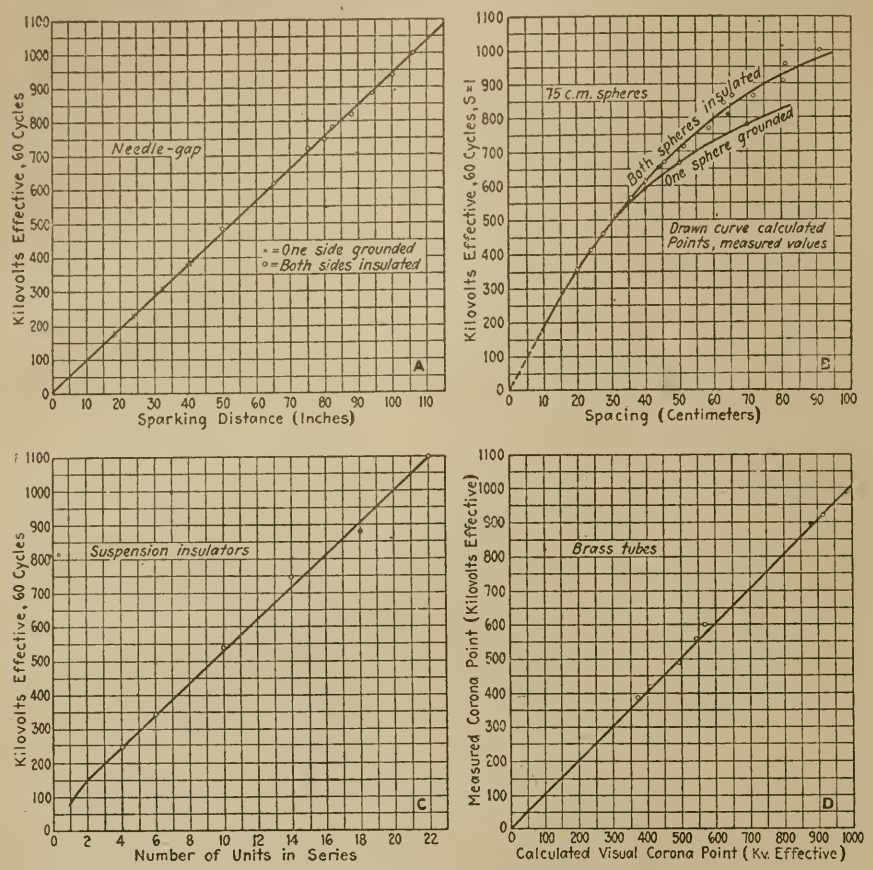

Fig. 3.—Observations of Sparkover and Corona Voltages at 1 000 000 V.
A. Needle-gap sparkover values; B. Sphere-gap sparkover values; C. Suspension arcover values; D. Relation between calculated and measured corona points, using brass tubes.

Some Engineering Questions.

While it is not at present important to speculate just when 1 000 000 V will be used in practice, it is important to know how to pre-determine the characteristics of high voltage lines so as to be ready when economic conditions demand these pressures. It is also pertinent to consider the characteristics of the parts of a transmission system affected by the higher voltages, and, in the article we have already mentioned, Mr. Peek deals with the transformer, transmission conductor, and the line insulator from these points of view. It is mentioned that the design of the high voltage transformer does not offer any great difficulty except at the bushing. On the other hand, the size of conductor necessary for such a line is interesting. At sea level and 20 ft. spacing on a three-phase system it is found that a conductor 5 in. in diameter is required for a critical voltage of 1 000 000 V, and while at this voltage the lines could be arranged so that the corona loss is zero if the voltage is increased 10 per cent. the loss becomes 325 kW per mile, *i.e.*, the corona loss increases very rapidly with a slight percentage increase of the voltage above the critical point. For this reason it may be desirable to operate with large margins between the critical and operating voltages with the higher voltage lines. The same applies when the critical voltage is lowered owing to rain, and to ensure only a small loss during the storm it might be necessary to increase the diameter of the tube to 6·5 in. Estimating the capacity current and the kVA per mile of a three-phase line with 6·5 in. conductors separated 20 ft. and energised at 1 000 000 V, 60-cycles, Mr. Peek points out that the current per mile of line is 4·43 A, the kVA per mile being 7 650. Line insulator design offers another difficult problem, but assuming that the insulator would be 15 to 20 ft. long, the 1 000 000 V line with 6½ in. conductors could be spaced 20 ft. apart, the minimum spacing being determined by mechanical considerations. With long lines in which one quarter, one half and full wave length of the operating frequency are approached, the line characteristics and the effect of capacity current differ greatly from the conditions on shorter lines.

Mechanical and Electrical Effects of Large Currents on High-Tension Switchgear.*

By Dr. C. C. GARRARD.

The tests described in these notes were carried out by the New York Edison Company and were recorded in a Paper † by Mr. Philip Torchio.

In a recent conversation with Mr. Torchio it was suggested that British engineers would appreciate the opportunity of seeing the films illustrating the experiments, and he has been good enough to send them for exhibition.

Oil Switch Tests.

The experiments with switches were made with currents of the order of 100 000 A, 25 cycles, but at low pressures (about 200 V). The object of the tests was not to determine the breaking capacity of the switches, but to find out in what way the apparatus withstood the very large mechanical stresses set up by these very large currents. In all the switch tests, the circuit-breakers were mechanically locked in the closed position. The arcing seen in the films is due to the opening of the main and of the arcing contacts caused by the mechanical force resulting from the high current. The justification for such a test lies in the fact that the short-circuit current in actual practice in a power station reaches its maximum value with great

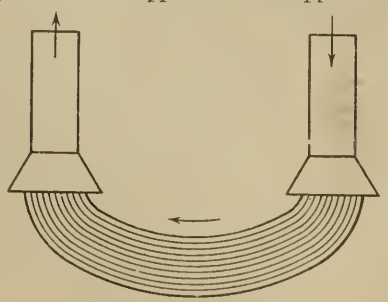

Fig. 1.—Brush which tends to out of contact under the influence of current.

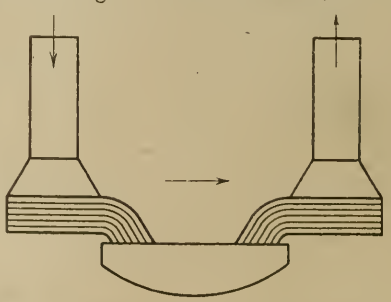

Fig. 2.—Improved inverted brushes which tend to press on tighter, due to magnetic forces set up by current

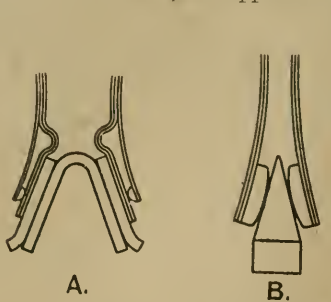

Fig. 3.—Finger contacts of oil circuit breakers arranged to attract and increase contact pressure.

* Introductory notes to a film illustrative of the mechanical and electrical effects of large currents on high-tension switchgear shown at the Institution of Electrical Engineers on Jan. 12.

† "Journal of the American Institute of Electrical Engineers," 1921, Vol. 40, p. 120.

rapidity and before the operating mechanism has had time to open. During the period before the automatic opening of an oil circuit-breaker, at which time it is, in effect, locked in the closed position, its mechanism must withstand the mechanical forces set up by the current, which may, moreover, be greater than that corresponding to its kVA breaking capacity. If, for example, the circuit-breaker be chosen under the assumption that the short-circuit current falls off to 6/10ths of its maximum value within ½ sec., the mechanical forces set up before the breaker operates will be those due to a current 66 per cent. greater than that corresponding to the kVA rating of the circuit-breaker.

It must not be assumed from the film that the switches which apparently fail were in all cases inadequate to withstand a test equal to their rating. The numerical figures of the tests must be studied in order to arrive at a conclusion in this respect, as in some cases the testing currents were increased above those corresponding to the breaking capacity rating in order to compare different types of construction.

Influence of the Shape of the Electric Circuit.

It was found that practically all the circuit-breakers tested had brush contacts arranged as in Fig. 1, so that when the current flowed the resultant mechanical force acted in a direction opposed to the brush pressure, thus tending to open the contacts and cause them to burn and weld together. This can be understood by reference to the principle that a closed electric circuit always tends to open out and enclose the maximum area.

As a result of the experiments an improved arrangement of the brushes was introduced and is illustrated in Fig. 2, from which it will be seen that the force set up by the current *increases* the brush pressure. The film clearly shows the improvement that is effected. Some of the best results, however, were obtained with finger contacts as in Fig. 3 (*a*), from which it will be seen that in such contacts the

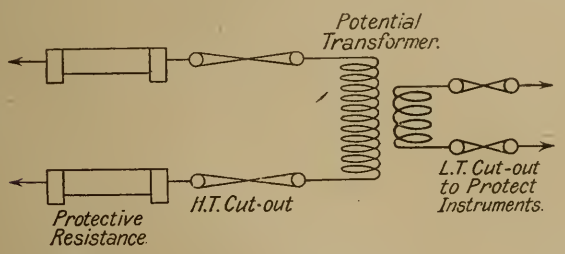

Fig. 4.—Potential Transformer with Protective Resistance. Suggested British Standard Arrangement for Heavy Systems.

current flows through each finger in the same direction. The fingers, therefore, attract each other under the influence of the current and thus the contact pressure is increased. Fig. 3 (*b*) has been introduced to illustrate a construction whereby this attracting force may be increased by bringing the fingers very near together.

Tests on Current Transformers.

The results clearly show the large forces to which current transformers are subjected on short-circuit. In one test the transformer was destroyed in ½ sec. at 92 000 A (R.M.S.).

Mr. Torchio's conclusion is that only the single-turn primary type is suitable for large systems. But it is not always possible to use this type in feeder circuits.

Tests on Potential Transformer Fuses.

Tests on potential transformer fuses were carried out at the full pressure of 6 600 and 13 000 V. The definite conclusion arrived at was that no type of potential fuse on the market can satisfactorily open the circuit without the addition of a resistance (see Fig. 4). As an example it may be mentioned that a fibre-tube fuse having a resistance of 79 Ω failed completely at 6 600 V, the current being 1 970 A (maximum). The addition of 50 Ω external resistance reduced the current to 25 A (maximum), when the fuse operated without visible disturbance in 0·02 of a cycle.

Tests on Disconnecting Switches.

The need of locking devices and the desirability of avoiding bends in the leads to the switches was demonstrated, but when these cannot be avoided the blade opening should be at right angles to the main lead.

Conclusion.

The original Paper shows the valuable information which can be obtained by collaboration between manufacturers and supply authorities. Such co-operation under the direction of the British Electrical and Allied Industries Research Association will doubtless yield similar results in this country.

Some Views on Power-Station Auxiliaries.

It is a little doubtful whether at an informal meeting greater emphasis on subject matter or on mere discussion is desirable, but there can be no doubt that, at the first informal meeting of the I.E.E. North-Western Centre, the subject-matter presented on the subject of Power-Station Auxiliaries would have done ample justice to a meeting of the more conventional type at which the heavy artillery drowns with its thunder the efforts of the smaller calibres. As a beginning the meeting was an astonishing success; later, doubtless, traces of stage management will be abandoned wholly in favour of spontaneity without the slightest risk of frost. Possibly even a little argument for its own sake will be permissible, and a speaker make an error in his arguments without feeling that he has ruined his professional reputation in the eyes of the specialist.

Methods of Driving Auxiliaries.

Mr. H. C. Lamb, in opening the discussion, was fortunate in being able to reveal some of the details of the new Barton Station at Manchester. He pointed out that increase in size of units had greatly increased the importance of auxiliary plant, which must at all costs be made safe. Failure of condenser pumps, and, with modern boilers, failure of the feed pumps soon caused difficulty. Three methods of driving auxiliaries were in common use: by steam, by electric drive from a separate and independently driven generator, and by electric drive through transformers from the high-tension system, all of which were used in Manchester. The direct steam drive was safe and simple, and independent of the other parts of the plant, but it was more costly to maintain than the electric drive and more skilled supervision was required. It was uneconomical to heat feed water with high pressure steam. The electric drive was not only more economical, but more convenient to lay out. The method of using transformers from the main bus-bars was the more efficient of the two electrical methods, but the plant had to start non-condensing unless power from outside was available. Also, if a short circuit occurred in or near the station it invariably happened that the a.c. motors would pull out and shut down, demanding attention at a time when the staff was most needed elsewhere.

The New Barton Station.*

The auxiliaries at Barton were all electrically driven, and, to ensure safety, separate and independent supplies were available both from the low tension turbo-alternators and from transformers. The main plant was divided into three sections, and for each section there was a house-service turbo-alternator generating at 420 V with the turbine exhausting into the boiler feed, and a house-service transformer giving 33 000/420 V. The alternators and transformers would not be paralleled. The works power switchboard was in three sections with duplicate bus-bars throughout, a selector switch enabling either supply to be used and the load distribution arranged to give any desired feed-water temperature. Each of the main condensing plants had duplicate sets of pumps, these being driven from the two sources of supply. The auxiliary motors were divided between the two supplies, so that failure of either source of supply would not seriously affect the main plant, and a failure of power from one source could quickly be made good from another.

Mr. Lamb showed a number of slides illustrating the auxiliary plant at Barton, and gave figures showing the relative economy of the all-transformer supply, the mixed transformer and low-tension alternator supply and the steam drive.

The Heat Balance of the Station.

Mr. J. Collinge referred to the new power station which Salford contemplated at Agecroft, and said that electrically Manchester and Salford were excellent friends. He thought the boiler feed and condensing auxiliaries needed especial care, the important features being simplicity of design and reliability of operation. They should also complete as far as possible the overall heat balance of the whole power-station. In design, amazing progress had been made in recent years. There was a tendency to organise a power station staff to specialise in the operation, maintenance and repair of the various parts of the plant. The choice of steam or electric drive should be governed by the consideration of heat balance. Theoretically, the electric drive from the main sets was most efficient. If with this was combined feed water heating by bleeding the steam from a stage at the exhaust end of the turbine, it was possible to obtain a very high efficiency in heat balance. Bleeding the turbine only slightly affected the steam consumption of the unit, but there was a gain in heat efficiency by recovering the latent heat of steam which would otherwise be largely dissipated in the circulating water.

* For some further details of the Barton Station, *see* p. 70 of this issue.

This ideal arrangement had one objection: the difficulty of starting up in the case of a complete shut-down.

Exclusive Types of Drive Undesirable.

Means should be available for pumping water into boilers in the case of a complete shut-down, to minimise the rise in pressure and to reduce the steam blown off. On the other hand, auxiliaries exclusively driven by steam would waste heat, as all the exhaust heat could not be absorbed in the boiler feed, and even if it could it would not be economical from the point of view of heat balance. There was, therefore, a mean position between the steam driven and electrically driven auxiliaries, desirable both from the point of view of heat balance and reliability. The engineer must then determine the economic heat balance of his system and arrange auxiliary plant in accordance with the particular installation.

Mr. W. Dundas said that the points to be considered in deciding the drive for auxiliary plant were economy, cost of maintenance, reliability and operation. The steam drive was undoubtedly the most reliable, but reliability was obtained at the expense of economy and cost of maintenance. With the tendency towards increased steam pressures the steam drive became more undesirable and difficult. The electrical drive interposed many links between the source of power and the point of application, each of which was a source of weakness.

A.C. Versus D.C.

Condenser auxiliaries should be in duplicate, each set capable of taking 75 per cent. load and the electrical supply taken from two independent sources, so that a.c. was preferable to d.c. The only advantage offered by the latter was speed control, and, though especially useful in stoker and fan drives, that, in view of its other disadvantages, did not justify its adoption. Electrically-driven feed-pumps were not favoured, and d.c. should be used for station lighting and for operating switchgear, where reliability of supply was of utmost importance and could be guaranteed by the use of batteries.

Mr. A. L. Lunn gave some details of the amount of power absorbed in auxiliaries at the Stuart Street Station. There were over 200 motors, varying in size from $\frac{1}{15}$th B.H.P. to 550 B.H.P. For continuity of supply the majority of power station engineers leaned towards steam auxiliaries as being the most reliable, although the only time he remembered the supply being affected by the failure of an auxiliary it happened to be a steam auxiliary that failed. Motor auxiliaries were certainly much more efficient than steam auxiliaries, and were quite reliable when proper attention was given them. A.c. was preferable to d.c. where machines had to run continuously for several weeks.

Switchgear for Auxiliaries.

Mr. W. A. Coates said that the arrangement referred to by Mr. Lunn should never be adopted except for quite small currents. The total capacity of house sets was now such that switchgear for them demanded as much consideration as power station switchgear a few years ago. The oil switches for station service transformers should be of the same breaking capacity as those for all other circuits supplied from the main bus-bars. Selective relays should be used to permit of smaller motor switches being employed. Where the auxiliary transformers were supplied from main generator leads a separate oil switch was not necessary, since biased balanced current protection could be employed so as to cause the generator oil switch to open in the event of trouble in the corresponding transformer. Two motors on the same shaft were sometimes used for the more important pumps. In this case one was commonly d.c., and since a battery was needed for switch operation this could well be employed for driving such auxiliary motors in addition.

Mr. J. S. Highfield referred particularly to feed pumps and lighting supply. Part of the latter should be on the battery. A shut down was less dangerous for circulating pumps than for feed pumps. Steam sets were most reliable, but the amount of steam to be dealt with in the all steam drive became too great. Feed pumps, however, should be steam-driven where possible. For circulating pumps the Barton method was best. He did not like stand-by plant that was not kept running.

Analysis of Conditions.

Mr. H. Midgley suggested that the problem should be set out systematically, considering types of auxiliaries and station conditions; alternative methods of supply; and the application of these methods to the particular station conditions and types of auxiliaries available. Auxiliaries were of two types—those whose momentary stoppage would cause a shut-down of the main sets, and those the shut-down of which would not cause serious inconvenience. The station conditions included starting the first set, and starting later sets; running under no load, full load and sudden peak load; and the shutting down of any section. The alternative arrangements had to be considered from point of view of capital and running costs, efficiency, staff required, simplicity, reliability and heat balance. Leakage in steam pipes necessitated more feed for make-up. In a station with electrical auxiliaries 3 per cent. was required, but 6 per cent. was necessary in a station using direct steam drive. The cumulative effect on the power supply of steam demands made by auxiliaries might be serious in an underboilered station.

Notes on the Barton Station, Manchester.

Mr. S. L. Pearce, chief engineer and manager of the Manchester Corporation Electricity Department, gave some interesting details at a recent meeting of the Junior Institution of Engineers at Manchester concerning the new power station which is being built by the Manchester Corporation at Barton. The Corporation Electricity Department now operates over an area of 48 acres and serves a population of about 900 000 people, in addition to supplying in bulk to several neighbouring authorities. The statutory powers to acquire the Barton site and build the station were acquired in 1914, but war exigencies caused all extensions to be made at the Stuart Street station, where some of the plant originally intended for Barton is installed.

The Barton site is 15 acres in extent, and is close to the Ship Canal. Coal may be brought by the Bridgewater Canal, while the West Lancashire coalfield is only four miles away. The railways in the neighbourhood of Trafford Park afford through communication to all parts of the country. The space available permits plant of 125 000 kW capacity to be put in, and at the present time operations are going forward for the installation of plant for 75 000 to 80 000 kW. The turbine room has an area of 240 ft. by 65 ft., the switch room 210 ft. by 41 ft. and the boiler house 312 ft by 85 ft.

Boiler Plant.

Boreholes showed that 1¾ million gallons of water can be obtained per day and the coal storage capacity is over six weeks' supply, 25 000 tons. The service bunkers hold 3 000 tons, sixty-two hours' supply. Ten boilers are provided for three turbine sets, each boiler having a heating surface of about three quarters of an acre. Air heaters are fitted, and two types of fuel, low grade slack and coke, could be burnt. Each unit evaporates 100 000 to 120 000 lb. per hour. The boilers are novel in design and are more efficient than ordinary types. The grate area is 512 sq. ft. The steam conditions at the boiler are 375 lb. per sq. in. pressure and 295°F. superheat. The feed temperature at the economisers is 200°F.

Turbo-Alternators.

There are three main units each of 27 500 kW maximum continuous rating, the economical load being 25 000 kW, and these units mark notable progress in steam turbine design. The vacuum allowed for is 29·1 in. The alternator and step up transformer form one unit the transformer ratio being 6 600/33 000 V, all switching being done on the h.t. side. The generator and transformer are protected as one unit by balanced current system. The condenser surface is 40 000 sq. ft., cooling water required being 2 280 000 gallons per hour. Two circulating pumps per condenser deal with 20 000 gallons per minute, the motor being 320 H.P.*

Distribution.

For each generator there are two three-phase transformers, each of 19 500 kVA capacity weighing 55·5 tons. These are on the ground floor, the next floor containing the busbars and the top floor the oil switches. Seven feeders will ultimately lead into the existing network, protected by the Merz-Beard system.

The estimated cost of the station in 1914 was £11 per kW, but the cost when installed is expected to be £29 per kW.

International Telegraphy and Commerce.

Mr. John Lee, Controller of the Central Telegraph Office, London, and formerly of Liverpool, was the guest of the Liverpool Rotary Club at luncheon at the Compton Hotel on Thursday, Jan. 12, and spoke on the subject of "International Telegraphy and Commerce." Mr. James Blackledge (president) presided. Confining himself to the portion of international telegraphic communication performed by Government enterprise, Mr. Lee mentioned that the Post Office had now direct wires from London to twenty-nine different cities on the Continent of Europe, and nearly a million messages passed from this country to the outside world each month. He referred to the line which was laid during the war from the North of Scotland to the Murman coast of Russia. Speaking of the machines employed, Mr. Lee said that Liverpool was the only provincial city which up to the present had shown sufficient direct, intimate commercial relationship with particularised Continental cities to justify a wire. Their engineers had recently been working at this problem, and they had now succeeded in "splitting" a wire with such ingenuity that they were able, by means of this one wire, to serve two cities in England (London and Liverpool) and two in France (Paris and Lyons). The machines operating this wire were worked, not by the Morse system, but by modern printing telegraph instruments.

* For details of Barton auxiliaries *see* the discussion on "Power Station Auxiliaries" on p. 69.

Annual Exhibition of the Physical Society of London and the Optical Society.

(*Continued from page* 45)

The Cambridge & Paul Instrument Company.

The CAMBRIDGE & PAUL INSTRUMENT COMPANY, as usual, provided a most interesting display of instruments. These embodied apparatus appealing both to the station engineer and the pure physicist. As an example of the former, we may mention a remote power indicator which has been patented by Mr. E. Fawsett, Chief of the Research Department of the Newcastle-on-Tyne Electric Supply Company. This gives a local indication of a.c. power at a distant station which may be several miles away.

For single-phase measurements the apparatus consists of a sensitive Cambridge unipivot indicator, a non-inductive resistance R (Fig. 9) of suitable value, two current transformers C, and two sets of thermo-junctions J fitted with separate heaters H. A potential transformer must be added in the case of high tension circuits. Connections are made so that the E.M.F.'s of the junctions are in opposition. The heaters are adjusted so that with equal currents through them equal opposing E.M.F.'s are generated by the junctions. The current transformers, which are of equal ratios and similar characteristics, are connected one to each heater. It will be noted that these transformers operate separately from each other. The heaters are joined in series and are also in series with the non-inductive resistance. This series circuit which is in shunt to the mains corresponds to the ordinary moving coil circuit of a wattmeter, the current transformer unit corresponding to the fixed coils. It will be noticed that if the load current is in phase with the pressure, the instantaneous superimposed currents in one heater are additive and in the other are in opposition, so that the former heater will be at a higher temperature than the other.

Now, if both heaters are at the same temperature, there will be no difference in E.M.F. between the thermo-couples and consequently no deflection on the indicator. If, therefore, the heaters are warmed by equal currents from the current transformers, or the same current through the non-inductive resistance, there will be no deflection in either case. If, however, the heaters are warmed by currents from the two sources simultaneously, there will (except at a power factor=0) be a difference in the temperature of the heaters. Therefore, the E.M.F. from one thermo-couple will be larger than that from the other, and a deflection will be obtained on the indicator.

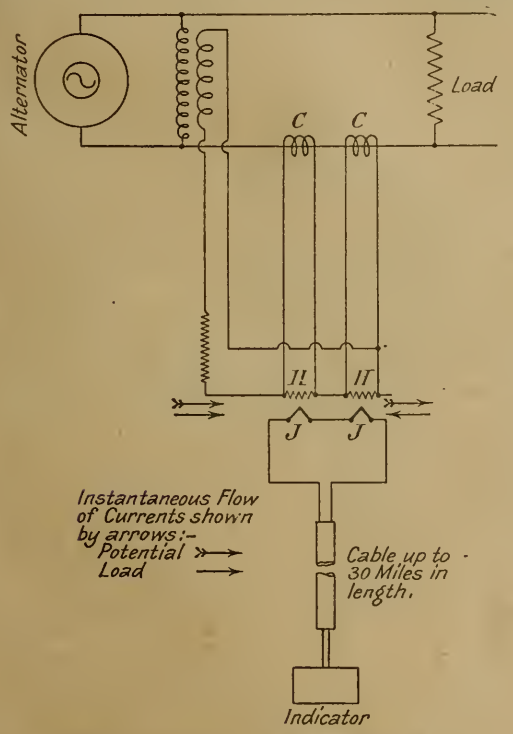

FIG. 9.—DIAGRAM OF FAWSETT'S REMOTE POWER INDICATOR.

It may be proved that the deflections of the indicator are strictly proportional to the watts in the circuit, *i.e.*, the instrument is a true wattmeter. By the provision of a condenser in the potential circuit instead of the non-inductive resistance, the apparatus is available as a wattless power indicator. The arrangements are also easily adaptable to polyphase circuits.

We understand that the apparatus has been in efficient use for some time in connection with two stations nine miles apart. It should have a wide application for the measurement of power at a distance.

Apthorpe's Temperature Regulator.

Apthorpe's temperature regulator, which was also shown, is of a novel type. It consists of a millivoltmeter calibrated in degrees. Near the end of the pointer is attached a light thermo-couple which is connected to a moving coil relay. A small platinum spiral, which is heated electrically, can be placed at any desired position on the scale in front of the galvanometer, but so that it does not interfere with the free movement of the pointer. To control the temperature of a furnace, a thermo-couple is placed in it and is connected to the millivoltmeter. The heated spiral is then set at the desired temperature. As the temperature rises the pointer deflects until it comes opposite the heated spiral. The thermo-couple on the pointer then generates current and operates the relay, which, in its turn, closes an electric circuit controlling the gas supply. The pointer is prevented from swinging past the heater by a stop. The device can be used to control temperatures from the lowest that can be measured by a resistance thermometer to the highest that would be measured by a radiation pyrometer. The instrument was shown controlling a small electrically-heated furnace at about 700°C. ± 5°C. Other uses, such as the operation of alarms, are obvious, and it appears to us that the device should find a wide application, not merely on account of its convenience but owing to its accuracy.

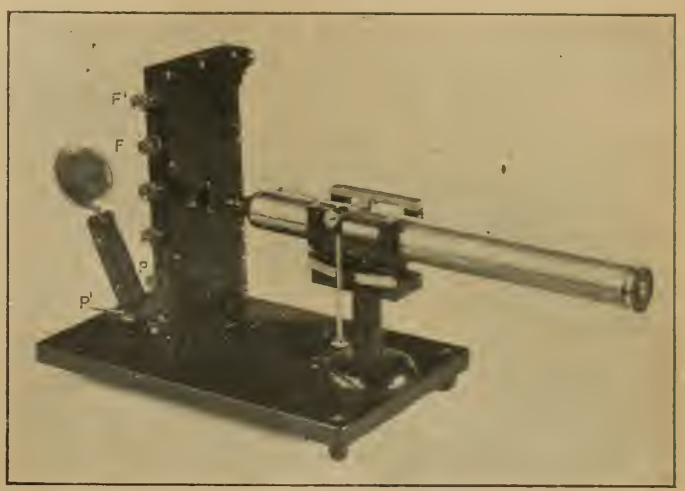

FIG. 10.—STRING ELECTROMETER.

String Electrometer.

As is well known, the string electrometer originally suggested by Prof. Einthoven is an instrument in which the moving system is a silvered quartz fibre tightly stretched between, and parallel to, two fixed metal plates. The special feature of the model shown is its compactness and the ease with which it can be assembled with any other apparatus. In particular, being flat, it may be used on a microscope stage without further fittings. The general character of the electrometer is seen in Fig. 10.

The instrument consists of a silvered quartz fibre, each end of which is carried by a flag, which is anchored to an amber block by means of a brass clip. One flag is held in a slot in each clip by a screw. This enables the interchange of fibres to be done very simply, as fibres can be supplied ready mounted on flags, and can be transferred by means of a fibre manipulator. The upper amber block is held in a fixed position, while the lower amber block is carried on a rocking arm controlled by a micrometer screw at the right side of the flat case. The ends of the fibre are mounted on an invar steel rod, so that variations of temperature have only a small effect on the tension of the quartz fibre. The position of the plates in relation to the fibre may be altered in a lateral direction to obtain electrical symmetry. Observation of the fibre is made through a microscope, with a finely adjustable forward and lateral movement.

The instrument is extremely rapid in action, the free period being small. If desired, it can be employed as an oscillograph electrometer. It is sensitive, with a very small capacity (a few

cm. only), and the sensitiveness can readily be varied. The sensitivity and period vary, of course, with the tension on the fibre and the potential difference on the plates, but it may be mentioned that in one typical instrument for standard optical work, 21 divisions for 1 V were obtained with 87 V on the plates, this corresponding to a movement of the fibre of about 0·16 mm. for 1 V. For this sensitiveness the period was about 0·1 sec. The motion for practically all workable tensions is aperiodic.

Salomonson String Galvanometer.

A simple and less costly form of Salomonson's string galvanometer with two copper fibres 12 μ in diameter, was shown. The resistance of either string is 11 O, and the magnification is about 40 at a working distance of 80 cms. A flux of 12 800 is obtained with a current of 5 A. Being a double string instrument it is capable of giving two simultaneous records on the same plate. The mechanism can be removed quite easily so as to give ready access to the fibres. It is a compact instrument, as will be seen from Fig. 11.

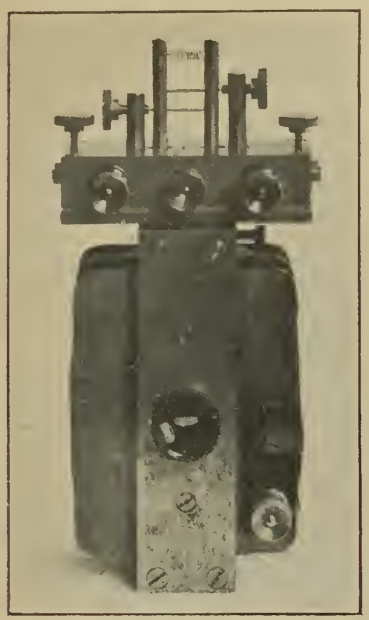

Fig. 11.—New Model of Salomonson String Galvanometer.

Disappearing Filament Pyrometer.

The disappearing filament pyrometer designed by Dr. Ezer Griffiths, of the National Physical Laboratory, is a self-contained instrument. It consists of an electric lamp which is in series with a small ammeter and a rheostat. The leads provided are connected to a 2V accumulator. The observer looks at the hot body through the eye-piece of the instrument and adjusts the current through the lamp by means of the rheostat until the tip of the filament is of the same brightness as the hot body. The temperature of the hot body is then read on the ammeter. The scale of the instrument is calibrated direct in degrees of temperature, the standard ranges being 700 to 1 400°C. for single and double scale instruments, and also 900 to 2 000°C. for double scale instruments. The eye-piece is provided with a rubber eye-guard to exclude extraneous light, and is made adjustable so that it can be focussed on to the lamp filament. The objective is also provided with an adjustment so as to bring the hot body into the correct focus. Immediately behind the eye-guard fixed to the eye-piece is a series of 3 stops, one being a plain hole which is most suitable for viewing the filament against the hot body at low temperatures. The second stop is provided with a monochromatic glass which is more useful when measuring temperatures at about 1000°C., the monochromatic glass reducing the amount of glare. The third stop is provided with an extra convex monochromatic lens suitable for still higher temperatures. The introduction of these glasses into the optical system does not affect the scale or accuracy of the instrument, but is simply a convenience when watching the colour of the two objects. The lamps in these pyrometers are never used at their maximum brilliancy under actual conditions. They are specially aged so that their brilliancy remains constant for very considerable periods. We are informed that persons without any previous experience can readily use this instrument and can obtain an accuracy within 1 per cent. without difficulty. The convenience of the instrument will be apparent from Fig. 12.

The Cambridge & Paul Company exhibited many other interesting instruments. Among these may be mentioned the beautiful apparatus evolved by Mr. T. Shimizu for showing continuously C. T. R. Wilson's experiment rendering evident the tracks of α, β and X-rays. A moving coil galvanometer was shown, designed by Dr. Moll, with an electromagnetic field—an idea which was tried years ago by Ayrton, but was then discarded. It is very quick in action and gives a deflection of 200 mm. at 1 metre for 1 microampere. It is particularly suitable for use with thermopiles. We noticed that the firm's CO_2 recorder, which has already been described in these columns, has been modified into a portable form

H. W. Sullivan.

Mr. H. W. Sullivan again exhibited an attractive collection of wireless and similar apparatus. Perhaps his hot wire microphone attracted the chief attention.

Hot Wire Resonator Microphone.

This microphone was originally designed for determining the position or origin of a sound produced by the discharge of a gun and was largely used in the war, forming the subject of a secret patent. It has since, however, been applied to a number of other purposes, particularly for the detection and measurements of sounds emanating from sources other than gun fire. The microphone consists of an electrically-heated Wollaston wire, or grid, which is mounted close to, and in front of, a small opening in a cylinder or container, the latter being closed at the other end, the volume of air in the container being variable by means of a plunger operated by a micrometer screw. The fine wire, which is supported in a suitable frame, is connected to terminals, and an electric current is passed through it for the purpose of raising its temperature above that of the surrounding air. In operation the temperature of the wire is reduced by the cooling effect of the movement of air caused by the sound to be determined or recorded, and if the ends of the wire are connected to a sensitive indicating galvanometer of the uni-pivot type, a deflection of as much as 90 deg. is easily observed. This deflection, of course, depends upon the intensity of the particular soundwave which is affecting the microphone.

The variation in the electrical resistance can be used in many ways. The greatest effect, however, is obtained by inserting the microphone in the arms of a Wheatstone bridge, which utilises to the best advantage any resistance variation in the microphone. In conjunction with an Einthoven galvanometer, or other suitable instrument, it can be used for recording the wave form of sounds of low frequency—*e.g.*, within the range of 25 to 1 000, or if connected through a transformer and used in conjunction with a valve magnifier, sounds can be rendered audible over great distances.

High Frequency Apparatus.

Among the wireless apparatus shown by Mr. Sullivan we noticed a bridge for the measurement of resistance, capacity and inductance at radio frequencies of 10 000 to 500 000 cycles per second. The buzzer hitherto used for determinations of this kind is replaced by a high frequency generator, and thus tests are carried out under actual working conditions, which is a great advantage. The higher of the two frequencies above mentioned is equivalent to a wave length of 600 metres. The operation is simple, and a calibration

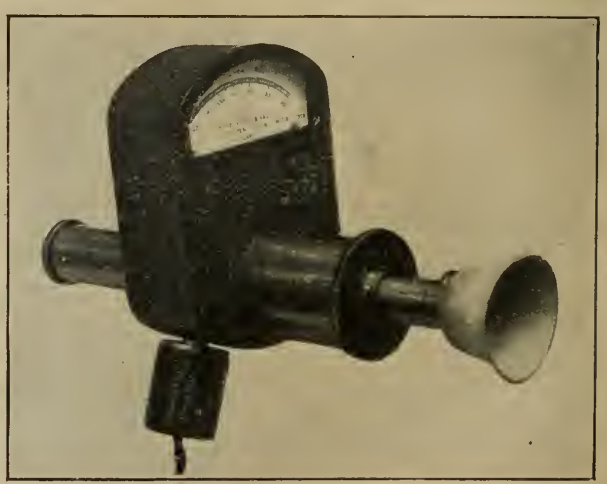

Fig. 12.—Disappearing Filament Pyrometer.

supplied with the oscillator enables inductance and capacity values to be determined by simple calculations.

A fixed air condenser of 0·001 mfd. was shown, which had been designed in conjunction with the National Physical Laboratory and made on the lines of standard condensers supplied to the Laboratory. The chief feature in the design is that quartz is used as the only insulating material, so that the condenser (which is otherwise all metal) is less liable to be affected by temperature than if materials such as ebonite are used. Quartz was selected as its dielectric losses are lower than those of any other material except amber. The latter was used in a large condenser supplied to the National Physical Laboratory, but owing to difficulty in obtaining this material it was superseded by quartz. By fitting metal caps over all the insulators, the metal cover is made to form a perfect earth, thus rendering the screening complete. We understand

that the Laboratory recently tested condensers of this kind made for a Government Department, and formed an exceptionally high opinion of their value.

The Thermionic Valve as A.C. Generator.

The convenience of the thermionic valve as a generator of alternating currents up to high frequencies is now well recognised, but apparatus for this purpose has not been readily available. Mr. Sullivan exhibited an instrument which appears to be very suitable for laboratory work. For frequencies from 3 up to 400 periods per second the instrument consists of coupled circuits with iron cores. The frequency is varied by means of a condenser, and a chart is supplied showing the capacity necessary for various frequencies. Two valves are used in parallel. The input is about

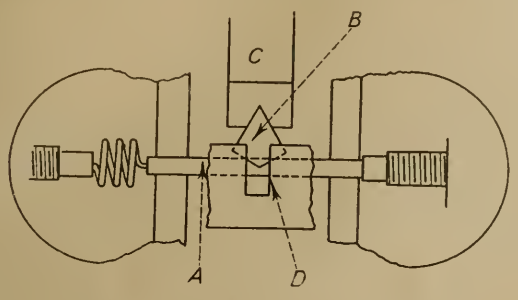

Fig. 13.—End View of Oscillograph.

12 watts and the output about 2 watts, which is quite sufficient for supplying the necessary current for general testing purposes. A further range of oscillators was shown for generating frequencies of from 400 to 10 000, and from 10 000 to 500 000.

A convenient heterodyne wave-meter was also shown, suitable for wave lengths from 150 to 20 000 metres.

The Cox-Cavendish Electrical Company, Ltd.

An interesting electrostatic oscillograph, due to Prof. Taylor Jones, was exhibited by the Cox-Cavendish Electrical Company. This oscillograph, which is very simple in construction, was used by Prof. Jones in his work on induction coils, some of which was published in our columns. Figs. 13 and 14, which are diagrammatic, show the construction that has been adopted. A strip A of phosphor bronze or steel, 1·75 cms. long, is stretched between substantial ebonite jaws, the tension being adjustable by means of a nut and sliding screw. A mirror B of elongated form is attached at one end to the centre of the strip, while the other end rests on an adjustable ebonite pillar C which forms a fulcrum so that the mirror rocks through a small angle in response to any movement of the strip. The movement is immersed in oil, the liquid serving for both insulating and damping purposes. Opposite to the centre of the strip when in position in the container is an attracting plate E embedded in an ebonite rod F which passes through the container wall, while on the side of the strip remote from this is a small plate of metal D in electrical connexion with the strip and therefore repelling it. The potential to be measured is put between E and

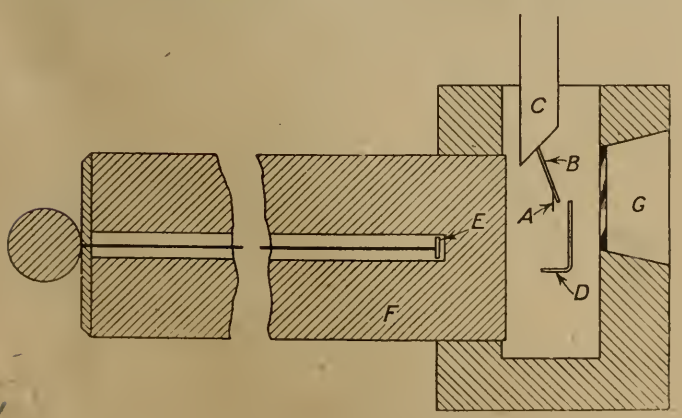

Fig. 14.—Side View of Oscillograph.

the filament. A window G in the container allows a beam of reflected light for observation or recording. For different ranges of potential, different containers fitted with attracting plates at different distances and shielded by different thicknesses of ebonite are used, the movement being the same in each case. The instrument as described can be used for frequencies up to 1 500; above this a special form, having a strip only 3 mm. long, is used. The deflections are, of course, proportional to the square of the potentials. It will be seen that this oscillograph differs from other types so far used in that the deflection does not reverse with a reversal of polarity, and consequently it cannot be used for tracing alternating potentials.

Gold Leaf Electroscope.

The design of the gold leaf electroscope shown is due to Dr. E. A. Owen, and the chief feature is the method adopted to prevent leakage. The gold leaf A (Fig. 15) is attached to a rod B screwed into an insulator D of ebonite ringed with sulphur. The charging rod F is capped with ebonite and is held up in its top position by a spiral spring. A loose flange E on its lower end, which is maintained in its position by a weak spring, makes contact when the rod is depressed with a flange C on the rod holding the gold leaf; thus the instrument cannot be injured by pressing down the charging-rod too hard. The most important point to arrange for in an electroscope is the insulation of the leaf system. Ebonite is a poor insulator as regards surface leakage and deteriorates rapidly with exposure to a damp atmosphere. The best material to employ as insulator would be sulphur or amber; the former is ruled out in this case on account of its weakness mechanically, whilst the latter is at present difficult to obtain and suffers from the same defect as sulphur, though not to the same degree, in that it is not mechanically strong. The insulating properties of ebonite can be greatly improved by the old method of letting sulphur rings into it. This method is used in the present case and is found satisfactory. The

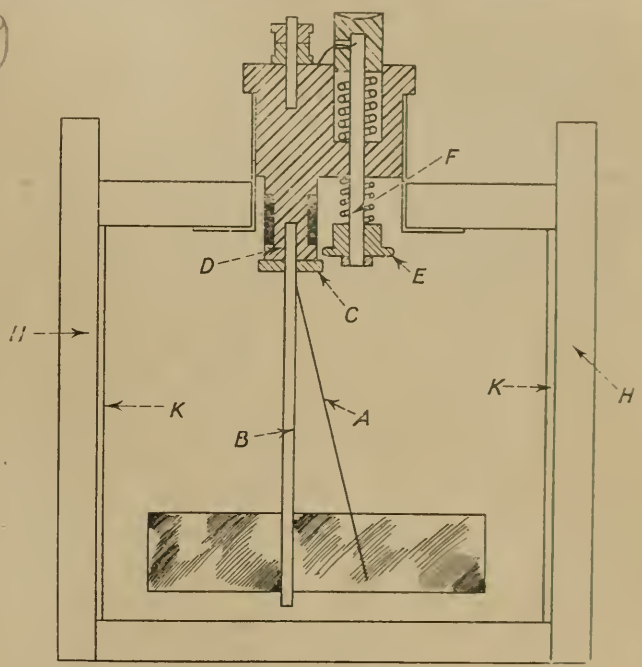

Fig. 15.—Gold Leaf Electroscope.

cylinder is immediately mounted, kept in the dark and guarded against the deposition of dust. The gold leaf is about 4·5 cms. long; the end of the leaf falls through about 0·11 mm. in one hour after the electroscope is charged at 280 V, while a change of potential of 1 V on the leaf moves it through 0·51 mm. The amount of soakage in the ebonite insulation is small, and reliable readings may be taken with the instrument in about five or ten minutes after the leaf is initially charged. The sensitivity of the instrument is constant over the whole scale of the microscope, so that readings may be taken indiscriminately over any part of the scale. For γ ray measurements the whole of the electroscope is covered with lead about 0·25 in. thick; for X-Ray measurements, the two lead-end faces H are removed and the rays pass into and out of the instrument through aluminium windows K of suitable thickness.

(To be concluded.)

German Reparations in Kind.

We are glad to see that the attack on the idea of the Germans paying for their Reparations in Electrical Machinery is not weakening. A very trenchantly-worded letter has been addressed to the Prime Minister by the British Engineers' Association on this subject, and a copy of the letter has been forwarded to the Federation of British Industries, with a protest at the failure of the Federation to take effective precautions to ensure that Press publicity should not be given to the personal views expounded by Sir Peter Rylands on a subject of grave importance to the engineering industry.

An Electrical Cinematograph Demonstration.

As already announced in THE ELECTRICIAN, the proceedings at the meeting of the INSTITUTION OF ELECTRICAL ENGINEERS on Thursday of last week were of an unusual kind. Temporarily, the lecture theatre was turned into a picture palace, and the influence of the new departure was to be seen in the display of exit notices of the type familiar in theatres over the doors and by the provision of a very inadequate emergency lighting, whose effect, if not whose function, was to make darkness visible. The hide-boundedness of bureaucracy, against which we all inveigh, could not have been better displayed than in this simple way.

As might have been expected, the fact that films were to be shown attracted a large audience, who, with rather more reason than usual, filled the back seats first, with such effect that before the President entered standing room only could be obtained in quite the best picture palace style. So much did the new atmosphere affect those present that we heard the suggestion ventured that a charge should have been made for admission and the proceeds applied towards the reduction of members' subscriptions.

A Ten-Thousand Membership.

The PRESIDENT, in opening the meeting, announced that the membership of the Institution exceeded 10 000. He also mentioned that the meeting on Feb. 2 would be followed by a dinner at the Engineers' Club, open to any members of the Institution who cared to attend. These functions, he added, were of an extremely useful kind, and he hoped that in future they would receive greater support than the one before Christmas had done.

Mr. HIGHFIELD then called upon Dr. Garrard to make some introductory remarks on the film illustrating "Investigations and Tests on High-Tension Switchgear." These introductory remarks are reproduced on another page of this issue.

When Dr. GARRARD had concluded the exhibition of the film was proceeded with and attracted a considerable amount of interest and not a little applause. Typical tests were the passing of a current of 108 000 A through a circuit-breaker rated at 1 200 A and 123 700 A through a breaker rated at 800 A. Similar tests of current transformers and fuses were also exhibited. A specially effective test was one conducted on a 4 000 A switch at a current of 102 000 A. The preliminary flares and flashes were followed by a regular Brock's benefit, and we were surprised to see anything left of the equipment when it was, as customary, exhibited after the test. As might be expected with an American film, the captions were terse and to the point, while the very wise method was adopted of showing each test twice, so that points missed during the first exhibition could be picked up during the "repeat."

Technology Popularised.

At the conclusion of this film, Mr. F. GILL was called upon to demonstrate two films entitled "The Audion" and "Telephone Inventors of To-day" respectively. Mr. Gill began by pointing out that the films, which were to be shown were not of the same high technical interest as those which Dr. Garrard had exhibited. In electrical manufacture now-a-days there were a large number of people engaged who had not much technical knowledge, but in whose interest it was necessary that a certain amount of information on the appliction of the apparatus they were turning out should be given. These films had been designed for this purpose, and we may add that that purpose was admirably fulfilled. As films they were very much better productions than that we have just described, and the one illustrating the Audion particularly showed an amount of imagination which reflects the highest credit on its authors or filmers. Even theoretical engineers are not used to seeing current flowing along a wire or electrons emitted from antennæ or passing from filament to grid. The film was received with a good deal of laughter, but at the same time its instructional properties even to a technical audience were quite evident.

Automatic Telephony Up-to-Date.

Our chief criticism of the film entitled "Telephone Inventors of To-day" is that it is most inaptly named. It deals not with personalities but with apparatus. Perhaps the most interesting feature of it was the wireless assembly of a subscriber's ordinary telephone set, in which the variety of washers, screws, and other parts employed leapt into place in a most uncanny way quite worthy of Maskelyne and Cooke. The phenomena of the receiver, which it is the lot of most of us to use every day, wiring itself, should we say electronically, must be seen to be believed.

Trade with Morocco.

Mr. C. R. B. Atkinson, H.M. Commercial Secretary for MOROCCO, is at present in London, at the Department of Overseas Trade, 35, Old Queen-street, S.W., 1, and will make appointments until Jan. 25 to interview firms who desire information regarding trade with Morocco. When writing, Reference No. 3 617 T.G. should be quoted. Mr. Atkinson will also be pleased to receive catalogues.

Correspondence.

THE EXPONENTIAL VALUES AND EXPANSIONS IN POWERS OF θ OF SIN θ AND COS θ.

To the Editor of THE ELECTRICIAN.

SIR,—With reference to Mr. Lucas's letter, giving a method of arriving at the exponential values and the expansions of sin θ and cos θ, it is perhaps worthy of note that the expansions can easily be obtained without the use of complex quantities.

It can be proved by elementary geometry that

$$\frac{d}{d\theta}(\sin\theta)=\cos\theta$$

$$\frac{d}{d\theta}(\cos\theta)=-\sin\theta$$

Assume $\sin\theta=A+B\theta+C\theta^2$ *etc.*
$\cos\theta=a+b\theta+c\theta^2$ *etc.*

Differentiating each side of each equation

$\cos\theta=B+2C\theta+3D\theta^2$ *etc.*
$\sin\theta=-b-2c\theta-3d\theta^2$ *etc.*

By equating co-efficients of similar powers of θ in corresponding expressions for sin θ and cos θ, and by putting $\theta=0$.

$A=-b=0$ and $a=B=1$
$B=-2c$ $b=2C$
$C=-3d$ *etc.* $c=3D$ *etc.*

From which are obtained by successive substitution

$$A=0,\ B=1,\ C=0,\ B=-\frac{1}{3!},\ E=0,\ \textit{etc.}$$

$$a=1,\ b=0,\ c=-\frac{1}{2!}d=0,\ e=\frac{1}{4!}$$

giving finally the usual expansions for sin θ and cos θ.

By putting $j\theta$ for θ in the expansion of sin θ, and adding the series for cos θ, the exponential value of cos $\theta+j$ sin θ is immediately obtained.—Yours, etc. G. W. STUBBINGS.

London, S.E.23. Jan. 16th.

"CHOKE CONTROL"—A QUESTION OF PRIORITY.

To the Editor of THE ELECTRICIAN.

SIR,—My attention has recently been directed to British Patent Specification No. 133 366 of June 28th, 1918, granted to the Western Electric Company, in which is described the well-known "choke control" method of modulation in radio-telephony. Various authors have wrongly attributed this system to Heising. As a proof thereof, suffice it to quote part of my French patent No. 21 855 of Nov. 30, 1916, in which this system is described in its most elaborate form and such as it was used by the British and American Signalling Corps during the war:

In certain wireless telephone diagrams the voltages obtained by the action of the voice on the microphone are amplified by means of thermionic tubes and then impressed on the high-frequency cathode tube generator which energises the antenna. These voltages may be impressed on either the grid or the plate circuit of the generator.

The object of the present invention is to realise an arrangement whereby a part or the whole of a single source of direct current may be

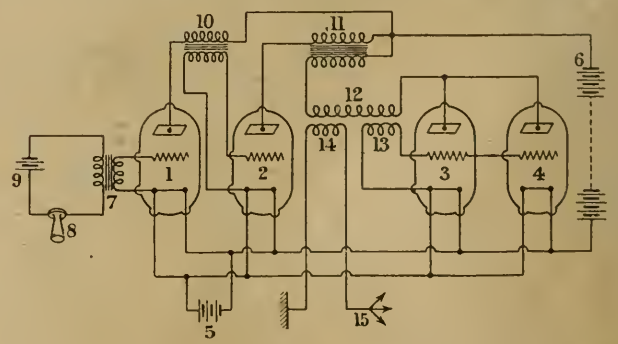

FIG. 1.

used to energise both the microphone current amplifying tubes a[illegible] generator tubes in accordance with the general idea of a common b[illegible] put forth in the main patent.

Fig. 1 shows four tubes, 1, 2, 3, 4, the filaments of which are br[illegible] to incandescence by battery 5, all the anodes being fed off a co[illegible] battery 6.

Tubes 1 and 2 are used to amplify the microphone current The microphone current originating in the circuit comprising the micro-

phone, 8, and the battery, 9, is communicated to the grid and negative pole of the filament of tube 1 through the transformer, 7. Transformer 10 permits of this current undergoing a second stage of amplification through tube 2. The resulting amplified microphone voltages are introduced in the plate circuit of the parallel-connected high-frequency generating tubes 3 and 4 through the transformer 11.

The high-frequency generator includes, in accordance with a known diagram which is only shown by way of example, a primary winding 12, and auxiliary winding 13 connected to the grids and filaments, and a secondary winding 14 which feeds the antenna 15.

Instead of the high-frequency generator output going directly to the antenna, the same may be used to energise the grid-filament circuit of a tube system working as a high-frequency amplifier the output of which is made to feed the antenna. It will be easily understood how the tubes of this high-frequency amplifier may derive their energy from the same source of current.

The secondary winding of the transformer 11 should preferably be shunted by a small capacity in order to create a by-path for the high-frequency current without appreciably impairing the low-frequency working.

If the speech-amplifying tube filaments are heated to the same degree as those of the generating tubes, the amplified microphone voltages obtained at transformer 11 may be of the order of that of the battery 6, and consequently it is easily seen that the arrangement described permits of the efficient working of the generating tubes 3 and 4, and this even with a relatively small voltage from battery 6.

Transformer 11 *may amount to an auto-transformer or a mere choke coil. In view of the fact that a relatively important steady current flows through its winding, it will be preferable to leave an air-gap in its magnetic circuit. This feature applies equally well to transformer* 7.

The elements of the battery 9 may economically be constituted by a portion of either the battery 5 or 6.

Trusting the above may serve to dissipate a prevalent error, I am, &c.,

MARIUS LATOUR.

Paris, Jan. 9.

Electricity Supply Districts.

The Electricity Commissioners (Sir John Snell, Sir Harry Haward, Mr. H. Booth and Mr. W. W. Lackie) opened their seventh public inquiry at Manchester on Tuesday. The inquiry related to the scheme submitted for the reorganisation of electricity supply in the SOUTH-EAST LANCASHIRE DISTRICT. It is proposed to set up an Advisory Board of forty-eight members, with a technical committee of engineers. The policy of the Board, which would have no borrowing powers, would apparently be little more than an extension of the principle of linking up the existing supply undertakings.

Mr. TYLDESLEY JONES, K.C., who appeared for the promoters, gave details of the scheme. He said the Yorkshire Electric Power Company, which was interested in Saddleworth and Springhead, and the Stalybridge, Hyde, Mossley and Dukinfield Joint Board opposed, but the Bredbury and Romiley Urban Council was the only authority which had passed a hostile resolution. Salford and Stretford had approved the establishment of the Advisory Board, but added some phrases pressing for the formation of a joint electricity authority, while Oldham had approved the standard resolution, adding that they thought it most unwise to embody such an authority. Counsel said there was enough opposition to the idea of a joint authority to make its introduction fatal to the success of the scheme, which would be the means of shutting down all uneconomic stations. That could, however, only be done with the goodwill and co-operation of the undertakings in the district.

Ald. W. T. DAGNALL, chairman of Manchester Electricity Committee, and Mr. S. L. PEARCE, city electrical engineer, of Manchester, gave evidence in support of the scheme, and the inquiry was adjourned.

West of Scotland District.

The map below shows the area of the West of Scotland Electricity District which was recently provisionally determined by the Electricity Commissioners.

WEST OF SCOTLAND ELECTRICITY DISTRICT.

Imported Lamp Bulbs.

Evidence concerning the manufacture of incandescent electric lamp bulbs in this country was given by Mr. C. Wilson, of the Osram Lamp Works, on the 11th inst. before the committee which has been appointed under Part II. of the SAFEGUARDING OF INDUSTRIES ACT to enquire into a complaint as to the detrimental effect upon the British industry of imported bulbs. The Committee has been asked to report as to whether, or not, a tax of 33⅓ per cent. should be imposed upon imported goods, and also to enquire whether the industry is being carried on efficiently. The complaint has been lodged by the British Flint Glass Manufacturers' Association and the British Flint Glass Makers' Society in respect of illuminating glassware as well as domestic and mounting glassware from Germany and Czecho-Slovakia.

Mr. Chas. Wilson's Evidence.

MR. WILSON said that he was a director of the General Electric Company, and managing director of the Osram-G.E.C. Lamp Works, the Lemington-on-Tyne Glass Works, and the Tyne Glass Works (Gateshead), all of which were owned by the General Electric Company. When working full time, the Company's bulb requirements amounted to approximately thirty millions per annum. Their requirements in pre-war times had been satisfied partly by the output of their own works at Lemington and partly by the purchase of foreign bulbs. Considerable quantities of bulbs were made in this country before the war, but during the war, when foreign imports were no longer possible, other English glass manufacturers took up the manufacture of bulbs, and large quantities were made, the output rising in the aggregate to about one million per week, the General Electric Company reaching over 600 000 per week. As was natural, at first the quality of the English bulbs was poor, but as the makers became more used to their new work the quality had been steadily improving, and the Lemington works now produced a bulb which compared well with any bulb in the world. The G.E.C. had invested over £300 000 in the glass business, and it had always been their policy to maintain the English industry in bulb-making in order to avoid complete dependence on foreign supplies, and in the interests of the country Mr. Wilson considered it was of vital importance that this policy should be encouraged. It had always been possible to purchase foreign bulbs more cheaply than English bulbs. Before the war the relative prices of similar bulbs were :—English bulbs, 53s. per 1 000; foreign bulbs delivered London, 44s. per 1 000, less breakage allowance and export rebate, making 36s. 6d. per 1 000. Since the war this discrepancy in price had increased. The present price of German bulb No. 0362 was :—At works, 46s. 6d., plus 9s. 10d. freight, or 56s. 4d. delivered, as against a British total cost of manufacture of approximately 135s., of which 63s. 11d. (or 48 per cent.) was represented by labour, and the balance by fuel, materials and overhead charges. Similar figures for bulb No. 564 were :—At works, 50s. 3d., plus 9s. 10d. freight, or 60s. 1d. delivered, against the British cost of approximately 140s., of which 65s. 7d. (48 per cent.) was represented by labour.

Depression in Trade Due to Imports from Germany.

MR. WILSON said the suggestion made by certain witnesses that no bulbs had been imported from Germany or Czecho-Slovakia since the war was absolutely untrue. He had been inundated with quotations of all kind, and he had himself purchased from Germany and Holland since June, 1921, upwards of two millions of bulbs. At present the electric lamp trade was undoubtedly quiet, but it was a matter of recent and temporary occurrence, and he could say without hesitation that the fundamental cause of unemployment in the bulb trade had been the very low price at which, owing to the depreciation of the mark, it had been possible for the Germans to put their bulbs on the English market. So far as bulbs were concerned, Belgium could not compete with Germany. The quotations which Mr. Wilson had obtained for Belgian bulbs showed that they were considerably more expensive. In his opinion, if relief were given under the terms of the Safeguarding of Industries Act, it would certainly tend to increase employment among English bulb blowers, and the benefit of the duty would be increasingly felt as foreign currencies recovered.

Statistics of British and Foreign Bulbs.

Replying to questions by members of the Committee, Mr. WILSON said that considerable quantities of bulbs were made in this country before the war outside his firm. His own firm made about 65 or 70 per cent. of its own requirements and imported the remainder, but at present, owing to the decreased demand, his own glass works were able to make all the bulbs which the Hammersmith lamp works required. He had no exact figures of the total production in this country. At the beginning of the war his glass works were making 250 000 bulbs per week, and in the busiest time they made 650 000 per week. The prices mentioned for the English bulbs were the usual prices here, the bulbs in his case being charged up to the lamp works at the market price.

The Chairman (SIR WM. ASHLEY) drew special attention to the statement made by witness that since the war the British price had increased 150 per cent. and the foreign bulb 50 per cent. Had witness any doubt as to affirming that?

MR. WILSON said his figures proved that. The increase was due to the greater cost of materials and labour. He held no brief for British labour as regards glassblowers. He had given orders abroad and could speak of actual prices in respect of them. He had placed an order in Germany for one million bulbs and a similar order in Holland during the last six months. One of the reasons for giving those orders was to bring home to the British workman the nature of the foreign competition we had to meet. Another reason was the coal strike, and a third was a desire to test the quality of the foreign lamps. At present his works were working alternate weeks, so that he was able to make all the lamps he required here. With regard to glassblowers' wages, the pre-war rate was 9¾d. an hour, but that was pushed up to 4s. an hour during the war. That was what was earned on piece work. Therefore, he held no brief for the workmen, but he must say that they were now in a much better frame of mind than they were a little while ago, because they saw the danger of foreign competition. He did not altogether blame the workman for the state of the industry here; the employers were also to blame.

Equipment of British and German Works.

Many of the British works were not as up-to-date as they should be, but that was due to the fact that those particular firms had not the money to instal modern plant. His own firm had been better situated in that respect than most of the others. He did not say that a 33⅓ tax would be a very great help to the trade at the moment to compete in price with the German bulbs, and it would be of no assistance to them if they did not help themselves by putting in modern furnaces and so on.

Answering SIR THOMAS ALLEN (a member of the Committee), Mr. Wilson said that before the war he had 240 employees, and now there were 517 working alternate weeks. Just after the armistice the number employed was 720. Whilst the number employed was larger than in 1914, the works could employ more workpeople than there actually were.

The Economics of Glass Works.

In reply to SIR JOHN BARRAN, witness said they had always lost money on their glass works, but as they were making for their own consumption, they were not troubled so much as they would otherwise have been. The policy had been to make this country less dependent upon foreign supplies and to increase the output. They were feeling German competition before the war, but they had enormously increased their output as between 1914 and now. That was due to an increase of plant and an increase in the number of up-to-date furnaces. A man he had sent round the country to secure orders for bulbs had come back with the report that everywhere he was met with German competition at prices which they could not touch. The reason the Germans were able to turn out bulbs cheaper than ourselves was due in a large measure to the greater technical knowledge of the German industry, and the German workpeople were also better trained. He had his manager in Germany at present studying the conditions there. The equipment of German factories was in most cases better than the average British works. Even so, if the exchange were normal he believed we could compete.

The attention of Mr. Wilson was called to the fact that in a letter from the German Embassy it was stated that the German Government had made a regulation that all quotations for goods for export were to be on the basis of the mark at 280 to the £.

MR. WILSON replied that he had a quotation received a few days ago, but there was no reference to such a regulation. It would be a step in the right direction, however, to assist the British glassmaker. The German price was 53s. 8d. per thousand and the Dutch quotation 115s. 1½d. per thousand for an inferior article. The Dutch could not compete with the Germans.

Illuminating Glassware.

Mr. F. WATKINSON, managing director of J. and W. B. Smith, Ltd., Farringdon-road, said Australia and New Zealand placed large orders for foreign glassware with English firms, and if a duty were imposed those countries would buy direct and the goods would be shipped from Antwerp or Hamburg.

Mr. D. LOEBL, chairman of Schindler & Company, said the majority of the kind of goods his firm sold were not made in England before the war, the small proportion made here being produced at exorbitant prices. There was nothing to prevent an export house here from buying mounts only in England and adding glass sent direct from the factories abroad, thus evading the duty altogether. That would increase neither the glass trade here nor employment in the glass factories, whereas shipping firms here would lose trade in consequence.

When the evidence was concluded, Sir ARTHUR COLEFAX, K.C., summed up, and said in regard to illuminating glassware, the committee must be satisfied that the prices at which these articles were being sold here to-day were the prices occasioned by the fall in the currency of the country from which the goods came. The ratio of increase over pre-war prices of imported articles was substantially higher than the ratio of increase in the case of pre-war British goods. That was not due to the question of currency. The British trade was essentially a special trade in a high class of articles, and it was not touched by the present importation.

A somewhat cryptic advertisement appears on page xxi. of this week's issue. It consists not of a hidden number, but of a number whose meaning is hidden. One of the objects of all advertisements is the stimulation of interest, and we have no doubt that our readers will be interested enough to watch these pages from week to week, notice the changes that occur therein and speculate on their probable meaning.

British Trade with India.

In the general review of the conditions and prospects of British trade in India for the two years ended March, 1921, Mr. Thos. M. Ainscough, H.M. Senior Trade Commissioner in India and Ceylon, states that the period was one of transition, and that it will be some time before a position of equilibrium will be reached. Though the year 1919-20 was one of phenomenal trade activity, there was an almost complete cessation of Indian exports in the following year, owing to the financial chaos in Central Europe and the trade depression in America, and as this drop in exports coincided with a flood of imports, a collapse of the exchange and a severe financial crisis ensued, from which the country is slowly recovering. Mr. Ainscough thinks that direct trade with responsible Indian firms is reasonably safe, particularly in cases where the home shipper has a resident representative to safeguard his interests.

British Imports and Exports.

Of the total trade of India, the share of the Empire is now 56 per cent., compared with 52 per cent. in the year before the war, while the share of the United Kingdom is 44 per cent., against 41 in 1913-14, but her share of India's imports (61 per cent.) is still 3 per cent. below the pre-war standard. The American and Japanese competitors, who gained a footing during the war, are likely to remain, and there are signs of growing German and Belgian competition.

Before the war, Great Britain supplied 89 per cent. of the total imports of machinery; in 1918-19 her share had fallen to 64 per cent., but in the past year the percentage had advanced to 78 per cent. The value of the electrical machinery imported in 1920-1921 was £2 188 587, against £1 240 680 in 1919-20; instruments and apparatus for Government purposes were valued at £602 794 (against £41 912), and telegraph materials £343 468 (£578 977). The total value of the electrical supplies imported, including wires and cables, electric fans and parts, lamps, batteries, meters, lighting accessories, &c., was £4 183 864 (against £1 549 589 in 1919-20), and Great Britain's share of this was £2 888 257 (against £800 132). The United States came second with £950 283 (£562 875), and Japan third, £126 582 (£81 253). During the war the large trade in fans was shared by the United States and Italy, but the British imports are now nearly equal to those of the United States, who also supply large quantities of electric wires and cables. Holland appears to be the chief competitor in electric lamps, and Japan sends electric cables and wires, lighting accessories, electrical porcelain, &c.

Foreign Competition.

The principal American exports during the past five years have been motor-cars (£6 486 000), iron and steel (£5 199 000), machinery (£4 026 000), hardware (£2 255 000), and instruments and apparatus (£1 335 000). It is stated that American machinery of all kinds has now gained a reputation, and is being assiduously pushed with method and enterprise. Japanese competition is mainly in textiles, matches, and hardware, and though she supplied electrical instruments, cables, &c., during the war, the shipments of these have fallen off.

The statistics for 1920-21 record the re-entry of Germany into the Indian markets with shipments of the value of £4 748 000, the principal items being dyestuffs (£1 203 000), metals (£864 000), hardware (£291 000), glass and glassware (£203 000). German exports are increasing steadily, being favoured by the depreciated mark exchange. Recently many orders for machinery for rice mills, sugar plants, &c., have gone to Germany, owing to quotations being 50 per cent. below British prices. Last year's Belgian exports were of the value of £5 326 000, or about double the pre-war shipments. Belgium is underselling British steel makers in constructional steel.

Dealing with political events, Mr. Ainscough points out that the watchwords among Indian politicians, industrialsts, and business men is protection for Indian industries, and this movement will affect British exporters more than others. During the year the general import tariff was increased from 7½ to 11 per cent. It is again urged that British houses should be represented by an active and competent organisation in the country itself, and engineers should open branches, with competent engineers and erecting staffs.

Production of Minerals.

The output of manganese ore amounted to 538 000 tons, and of this amount 370 000 tons, valued at £697 732, were exported, mainly to the United Kingdom. The quantity of mica produced was 47 783 cwts. (valued at £219 842), a decrease of about 9 000 cwts. compared with 1918-19. There were decreases in the outputs of monazite, copper, and tungsten, but there were increases in the tin and lead production. Important deposits of bauxite have been discovered near Chakar, in the province of Jammu.

Hydro-Electric Development.

A brief sketch of the progress made in the development of water power as well as the position of the hydro-electric survey is included in the Survey, but particulars of this work have already appeared in The Electrician. There are about 1·75 million e.h.p. in sight, but the actual available water power is much greater, and about half the power is produced in Bombay. Steady progress is being made with the provincial hydro-electric surveys, and it is anticipated that the initial part of the work will be completed in about three years. Abstracts of the report of the Chemical Services Committee, and of the work of the Indian Institute of Science (Bangalore), as well as accounts of the progress of various industrial companies, are also included. In 1919-20 there were 905 new companies formed, with a total capital of £275 534 700, and in the following year 965 companies, with a capital of £145 766 700.

Branch Works in India.

In regard to the factors which should influence British manufacturers in deciding whether or not to erect works in India, Mr Ainscough thinks that, in cases where the principal raw materials are available in India, and where the country affords a steady market for the finished product, the prospects for local manufacture should be promising; where there are established industries in India requiring large and constant supplies of machinery, and where there is a steady demand for standardised and simple types of heavy plant for Government, railway, or municipal requirements, local manufacture would be successful. The competition of Indian industries with British works has not yet been severely felt, but the local engineering shops are competing more and more in structural steelwork and small steam engines. The agents, representatives, and travellers of British firms engaged in the manufacture of industrial plant, machinery and stores, are recommended to establish friendly relations with the Directors of Industry in the provinces, a list of whom are set out.

Igranic Tubular Heater.

An interesting development in electrical heaters for all kinds of purposes has been made by the Igranic Electric Company. We understand this is not a variation of any existing apparatus, but is of such fundamentally different construction that it gives characteristics unlike those of any other heater. By its means, it is claimed, many requirements can be met which could not be satisfactorily met by any previous form of heater.

This heater, which is of the tubular type, consists essentially of four elements. The resistance of round wire is wound in a helix, disposed centrally along the axis of a metal tube which is completely filled with insulating material, embedding the resistance and terminals and insulating them from the tube. The resistance material is usually nickel chromium, the enclosing tube being of steel or copper, according to the use to which the heater will be put. Steel is used for general purposes and copper for water immersion heaters. The insulation employed is a specially developed highly refractory material, capable of operating at high temperatures without deterioration.

No mica is used except at the terminals to insulate them from the tube. The terminals are of brass or steel, the latter being employed for high temperatures, where brass would not be suitable, while brass is used where steel would be liable to rust; generally a copper

Immersion Water Heater.

tube heater has brass terminals and steel tube heaters steel terminals. The lead wire connecting the terminals to the resistance is of nickel chromium of much greater section than the resistance, and provides a portion of tube of inactive length, so that all the heating effect is produced within the required portion of the tube.

Application of Tubular Heaters.

There are four general types of tubular heaters

The immersion heater, which is immersed directly in the liquid to be heated. This is shaped as required, the terminals being brought out to a suitable location over the edge of the container and passed through glands in the bottom or side. The tube can be bent to conform to the shape of the vessel, and to avoid obstructions, and thus provides a maximum of adaptability in installation.

Cast-in heaters. The tubular heater is peculiarly adaptable for certain work, as it can be shaped to any desired form, and will stand the temperatures at which aluminium, copper, brass, or even iron are cast. It is strong enough to be self-supporting in the mould, so that it does not present a difficult moulding problem.

Conduction heaters are usually clamped to the part to be heated, and it is desirable to provide grooves, into which the heater will fit fairly closely, so as to secure the maximum conduction of the heat generated. This is a simpler and cheaper method of applying the tubular heater to a casting than that of casting it in, and in many cases is just as satisfactory.

Air and radiant heaters may be constructed by simply suspending the element in the air and mounting it on any suitable support. If

operated at a sufficiently high rating it will colour, and can be used as a radiant heater.

Igranic tubular heaters are standardised in four diameters :— 9/32 in., 29/64 in., 9/16 in., and 21/32 in., and made in any length up to a maximum of 60 in. The permissible watt rating is determined by the service the heater has to meet, varying from 60 W per in. of actual length of the smaller diameter when used for water immersion, down to 12 W for air heaters.

The insulation is so highly compressed by the method of manufacture that it is practically an artificial stone which fills the space between turns of the resistance helix and between the helix and the tube. The helix is kept central in the tube, and is not, we are informed, displaced by bending. The tubing, being thoroughly annealed, can be bent cold, but if required to be re-bent should be again annealed by heating to red heat and allowing to cool down again.

The advantages claimed for this heater may be summarised as follows :—Insulation unaffected by high temperature; freedom from expansion troubles; no soldered or other joints to open up; adaptability by reason of ease of bending, casting in, &c.; elimination of mica, permitting higher temperatures; small diameter permits application in restricted positions; high insulation value; great regularity in duplication owing to standardised manufacturing methods; and high thermal efficiency.

More About Electrical Showroom Service.

As already noted in The Electrician, the Metropolitan-Vickers Electrical Company have recently opened new extensive London showrooms at 232, High Holborn, W.C. 1. We are not surprised to learn that a large number of trade visitors have already availed themselves of the opportunity of inspecting these splendidly equipped premises, which are very centrally situated, being adjacent to Kingsway (Holborn end) and practically adjoining the Holborn Tube Station.

The new showrooms consist of a ground floor and basement, and cover a total floor area of about 4 000 sq. ft. The basement contains a complete display of electrical fittings, accessories, heating and cooking appliances and lamps, while a trade counter provides facilities for dealing promptly and efficiently with contractors' orders.

The accompanying photograph (Fig. 1) gives a general view of the ground floor, and indicates the care which has been taken in the grouping of the various fittings. In order to display electric fittings as far as possible in their appropriate surroundings, the showrooms have been divided up into sections, representing respectively the Adam style and the Jacobean and Georgian periods.

Another department has been decorated and furnished throughout in the William and Mary style, and has been specially designed for the effective display of the highest grade of electric fittings, designed and manufactured at the company's Birmingham works, Harcourts, Ltd.

No surprise will be felt at the announcement that the showrooms contain a kitchen. This is shown in Fig. 2. Here daily demonstrations of cooking by electricity and in the use of electric household utensils are given by an expert lady assistant. The kitchen, it is needless to add, is designed on the most hygienic and up-to-date lines, and no housewife could witness a demonstration without longing to have the control of appliances of like utility and cleanliness.

The policy of the company is to protect the interests of electrical contractors and retailers, all of whom are invited to regard the particular showroom in their vicinity as an extension of their own premises. To this end books of specially designed introduction cards are supplied free to the trade. These cards can be handed to prospective purchasers, introducing them to the nearest showroom for the purpose of witnessing a demonstration of any electric household appliance or fitting in which they may be interested, sales resulting from such introduction being credited to the retailer concerned. These showrooms were wired, furnished, and decorated by Harrods, Ltd.

A Galaxy of Electric Hot Cupboards.

The illustration shows a consignment of electric hot cupboards manufactured by the Jackson Electric Stove Company, just before despatch to a canteen in Ireland. The cupboards are 10, 12, and 13ft. long, all 2ft. 9in. high by 2ft. back to front, fitted with sliding doors on one long side. The bodies are of sheet steel double

Jackson Electric Hot Cupboards Ready for Delivery.

cased and lagged, and the tops of cast-iron ground and polished bright. The cupboard and top are each separately controlled and independently heated, each section being split into two circuits and each arranged for three-heat regulation.

The connections are of the well-known "Jackson" type, solid rod mounted on porcelain insulators. The elements are of the firm's standard fireclay pattern. No mica, asbestos, covered wires, loose leads, beaded wires or pigtails of any description are employed. The whole is built up of a solid nature and in such a manner that it is impossible for an earth or short to develop.

The 10ft. cupboards are fitted with three sliding doors and the 12ft. and 13ft. cupboards with four sliding doors.

Metropolitan-Vickers New Showrooms. Fig. 1—General View of the Ground Floor Fig. 2—View in the Kitchen.

Legal Intelligence.

Action Against Electrical Company Settled.

On Monday Mr. Justice Avory had in his list the case of the Britannia Rubber Company and Kamptulicon Company, Ltd., v. the International Electric Company, Ltd., but when the case was called on Mr. Disturnal, K.C. (for plaintiffs) asked the court to allow time for a consultation with a view to settlement. Later counsel stated that defendants (for whom Mr. Schiller, K.C. appeared) had agreed to pay £1 438 16s. 6d., with taxed costs on the claim and counter-claim.

The record was withdrawn and judgment entered accordingly.

B.T.-H. Company, Ltd. v. Corona Lamp Works, Ltd.

On the 11th inst. Sir D. Kerly, K.C., applied to Mr. Justice Astbury to postpone the hearing of this action. Counsel said he appeared for the defendants, and the plaintiffs were represented by Sir Arthur Colefax, K.C., and Mr. J. H. Grey, K.C. His position was that he had not got the brief and his clients were not able to deliver it because they had not got expert's report. He asked to be allowed to mention the case on Thursday. He said there was another case between the same parties which had just come to an end in the House of Lords.

His Lordship said counsel could mention the case again on Thursday, and observed that as it had waited six years another term would make no difference.

On the following day His Lordship fixed Feb. 6 for the hearing of the action, subject to any part-heard case.

Damages for Jacket Torn in Tramcar.

In the Glasgow Small Debt Court on the 11th inst. Sheriff Macdiarmid heard an action which raised an interesting point as to the liability of the Corporation Tramways Department for injury to a passenger's clothing. The pursuer complained that, while a passenger in an Uddingston car on July 20 last, she had had the jacket of her costume torn in consequence of a button having caught in a gap between the spars of the seating. The defence was that the seating had been examined and found in perfect order, and therefore the department repudiated liability.

The evidence was to the effect that the gap was due to the fact that the seat, which also forms the lid of a box used for storage of car requisites, had not been pushed into its place, thus leaving a space between the spars of the lid and those of the back.

The Sheriff held that it was the duty of a conductor, on taking over a car, to inspect it with a view to the safety of the passengers, and that that duty had not been fulfilled in the present case. He therefore decided in pursuer's favour, and assessed the damages at £10.

Suit by Unregistered Firm.

In the City of London Court last week Messrs. Phipps sued Mr. E. A. Galloway for £5 1s. for some electrical bowls supplied. Defendant pleaded that he placed his order with Mr. Mollett, one of the partners, with whom he had a *contra* account. He always paid Mr. Mollett and had had no transactions with plaintiffs. He declined to pay plaintiffs until he was sure of the authority to collect the account.

The Registrar pointed out that, under Sec. 8 of the Registration of Business Names Act, plaintiffs could not sue unless at the time of taking out the summons their names were properly registered as partners carrying on business under a trade name. They were not so registered, and if defendant desired he was in a position to ask that the case should be struck out. He suggested that the reasonable thing to do was for plaintiffs to allow defendant the amount of his counter-claim, and for defendant to pay the claim, less the counter-claim, plaintiffs dropping the costs of the summons. He non-suited the plaintiffs, so that they would be able to bring a fresh action if the present proceedings were not disposed of in the way suggested.

Dispute Over Electric Light Fittings.

Mr. Justice Acton gave judgment last week in the case of Halford v. McCandlish and Hasler, in which the plaintiff claimed damages against both defendants (the secretary and head porter of the United Services Club) for removing electric light fittings from 13, Stratford-place. His Lordship said that during the occupation of the premises by the club certain electric fittings and mirrors were put in. Plaintiff became owner, and part of the tenancy agreement was that the tenant's fixtures should become the landlord's property. When the club was preparing to vacate the premises, plaintiff (through his agents) was proposing to take over the fittings at a valuation. At an interview it was agreed to leave the fixtures on the premises with a view to selling them with the property. Plaintiff denied this, and alleged that defendants vacated the premises, leaving the articles on the premises, subject to the plaintiff's legal rights. The burden was on defendants to show that they had a right to take the articles away, and that his Lordship reluctantly came to the conclusion they had not done. The articles were removed, and a technical trespass was committed, and very slight damage resulted. Plaintiff was, however, technically right, but he (his Lordship) was surprised that an outrageous claim of £500 was put forward. There would be judgment for the plaintiff for £22 10s., and no costs were allowed.

Electricity Supply.

The accounts of Glasgow Electricity Department for the six months ended Nov. 30 last show a loss of £54 000.

Mr. Russell F. Ferguson, Hastings Borough Electrical Engineer, read a Paper, on Monday, before the Ratepayers' Association on "The Electricity Developments in the Town."

Stepney Borough Council have agreed to pay Babcock & Wilcox, Ltd., the sum of £4 000 in settlement of their claim of £5 400 for increases in the cost of materials and rates of wages beyond those which obtained when they tendered for the work in connection with Limehouse Generating Station.

At a meeting of Exeter Town Council last week, the Electricity Committee reported the purchase of new machinery in consequence of increased demand for electricity, and it was stated that so many lights of bigger power had been installed in business and private houses without warning that some of the sub-stations were unequal to the demand, and had been overloaded. The Committee had instructed the engineer to consider what sites were available for additional sub-stations in the centre of the city.

Dundee Electricity Department has decided to withdraw from the National Joint Industrial Council. At a meeting called to consider the question last week, the engineer explained that the Industrial Council's new scheme fixed the wages of a fitter at £3 11s. 6d., and left the pay of a labourer at £3 8s. 11d. The pay in his department was above the rates laid down in the new scheme of the N.J.I.C., and the scheme could serve no useful purpose. The conditions in Dundee also were better for the men than under the scheme, and left freedom to select and pay men according to ability.

In reference to the acquisition of the Bootle electricity undertaking by Liverpool Corporation, it is stated that the latter will pay the Bootle electrical engineer (Mr. T. D. Clothier) £8 000 compensation and the other members of the Bootle staff will be retained. The net debt on the Bootle undertaking is £160 129. Among other changes to be made in supply methods in Bootle will be the introduction of meter rents (1s. 6d. to 2s. 6d. per quarter) and a reduction of a farthing per unit for electric current for lighting. Existing agreements between the Bootle Corporation and its consumers will remain in force, and Bootle will have representation on the Liverpool Electricity Committee. It is estimated that it would cost Bootle about £120 000 to install the extra plant needed to meet the present and prospective demands for electricity in the borough.

New Schemes and Mains Extensions.

Ely City Council have decided to apply for powers to generate and supply electricity in Ely and the district.

Portsmouth Town Council has received sanction to loans of £30 000 for supply mains, £6 272 for services, and £6 000 for transformers and sub-station equipment.

Whitehaven Town Council has applied for a loan of £3 500 for the extension of electrical services at Arrowthwaite, Thwaiteville, and in connection with the Braunsty Housing Scheme.

Middlesbrough Electricity Committee is making application to the Electricity Commissioners for sanction to borrow £6 000 for the purpose of erecting a further sub-station to supply electricity to the Linthorpe district.

Westgate-on-Sea Parish Council has asked the Gas Company whether they are prepared to supply electricity to the town. If not, the Isle of Thanet Electric Tramway and Lighting Company are to be asked if they will extend their cables to Westgate.

A public meeting of the ratepayers of Neath on Tuesday unanimously approved of the Bill being promoted in Parliament by the Town Council for the extension of boundaries and additional powers in regard to the water, gas and electricity undertakings.

At a meeting of Willesborough Parish Council last week it was decided to ask the Whitstable Electric Company if they would entertain applications for lighting the parish if terms could be arranged.

The Amble Electricity Special Order, which authorises Amble Urban Council to supply electricity within the urban district, has been submitted to the Minister of Transport for confirmation. Any objections must be sent to the Ministry of Transport by Feb. 6.

Application for a Special Electricity Order for Crieff has been made to the Electricity Commissioners and an Electricity Committee of the Town Council has been elected as follows:—Provost Mungall (convener), Messrs. Lauder, Watts, and Reid, and Mrs. Wilkie Brown.

Southwick Urban Council has decided, subject to the charges for electricity not being in excess of those at Hove, to support the application of the Shoreham and District Electric Lighting and Power Company for a Special Order for the supply of electricity to the town.

The proposal to introduce electricity in the burgh of Inverurie was again discussed last week, and it was decided to ascertain what the cost of installing plant would be, and also to write to the Aberdeen Town Council to ask if they would consider the extension of their supply mains to Inverurie.

The Preston Corporation Electricity Special Order, 1921, authorising the Corporation to supply electricity in the Borough and Rural District of Preston, has been submitted to the Minister

of Transport for confirmation. Any objection must be sent to the Ministry of Transport by Jan. 28.

At a meeting held on Thursday, Jan. 12, the Glasgow Corporation Sub-Committee on the Grampian Electricity Order instructed the Town Clerk to lodge a petition against the Order, with the view of protecting the interests of the Corporation Water and Electricity Departments, both of which are affected by the provisions of the Order.

Cannock Electricity Committee have obtained sanction to a loan of £36 763 for carrying out the scheme of the authority for the supply of electricity in the district. Application is to be made to the Commissioners for authority to supply electricity to the Brereton and Cannock Chase Collieries in the area of the Lichfield Rural Council.

A Special Order made by the Electricity Commissioners for the supply of electricity by the Wareham Electric Supply Company, Ltd., within the Borough of Wareham and parts of the Wareham and Purbeck Rural District, has been submitted to the Minister of Transport for confirmation. Any objections must be sent to the Ministry of Transport by Feb. 4.

The Liverpool Electric Power and Lighting Committee has received the sanction of the Electricity Commissioners for the borrowing of the sum of £21 782 for the provision of mains, services, and sub-station building and equipment in connection with the supply of electricity to the housing scheme at the Springwood Estate, Garston, and £100 000 for the provision of mains.

Dundee Electricity Committee have appointed the chairman of the committee and the general manager to interview the Hydro-Electric Development Company with regard to the price of bulk supply to the Dundee district, and to report as to whether the Grampian Provisional Order should be opposed or not. Approval has also been given to the acceptance of contracts for £40 000 for sub-station equipment.

The Sussex Electricity Supply Company has applied to the Electricity Commissioners for powers to supply the whole of the Littlehampton urban district, including Wick, and for the installation of the necessary plant. The Urban District Council decided last week to support the company's application. The current is to be supplied by means of overhead wires, and an immediate commencement is to be made on the work.

Lewes and District Electric Supply Company, Ltd., are applying to the Electricity Commissioners for a Special Order to amend the provisions of the Lewes Corporation Electric Lighting Order, 1898, by increasing the maximum price of electricity to 1s. 2d. per unit, with a minimum charge of 11s. 8d. in respect of the July-September quarter and 17s. 6d. in respect of each of the remaining quarters.

The application by the Mersey Power Company for permission to carry overhead electric wires in the Appleton district of Widnes caused much discussion at the Widnes Council meeting last week. The application had been previously discussed in committee, and was turned down by a majority of one. Alderman Neil moved an amendment that the permission sought be granted. On the vote being taken, permission was refused by one vote.

Now that the Electricity Commissioners have given their decision in regard to the question of wayleaves over estates between the North Wales Power and Traction Company at Dolgarrog and the boundary of Colwyn Bay Urban Council, it is understood that the transmission line will be proceeded with as quickly as possible. The Colwyn Bay Council has completed their distribution station and the underground lines from the company's sub-station at Bronynant.

At a meeting of Sidmouth Urban Council last week the chairman brought up the question of the proposed electric lighting installation for the town, and reported on an interview with a representative of Gilbert Gilkes & Company, showing that the scheme for the installation would cost approximately £10 000. This was a saving of £15 000 on the scheme presented two years ago. It was decided that the Council should meet Messrs. Gilkes' engineer and consider the question with him.

The General Purposes Committee of Barrow Corporation recommend the Town Council to object to inclusion in the reorganisation scheme for the North Lancashire and South Cumberland Electricity District until some more satisfactory provision is made by the Government towards the capital cost. At the forthcoming public inquiry the Urban Councils of Millom, Bootle and Dalton will oppose the scheme, and Millom will submit counter-proposals for generating electricity from the surplus heat of the local ironworks.

The report of the London engineers on a county hydro-electric installation for Buckie was considered by the Town Council last week. The engineers divide the district as follows:—Banffshire districts of Aberchirder, Aberlour, Banff, Buckie, Craigellachie, Cullen, Dufftown, Findochty, Keith, Macduff, Portknockie, Portsoy, Whitehills, about 2 500 H.P.; Aberdeenshire districts of Huntly and Turriff, about 1 600 H.P.; Morayshire districts of Burghead, Elgin, Fochabers, Forres, Lossiemouth, Rothes, about 1 300 H.P. They are of opinion that the water-power scheme should be looked for to develop 5 000 to 10 000 H.P. They outline two possible River Spey schemes, one of which they consider too expensive. The other, by a tunnel line from Blacksboat to Carron, will develop 5 000 to 10 000 H.P. from 42 000 cubic feet water per minute, through two and a half miles tunnel. The estimated cost is £300 000. Another £100 000 for storage works would give the generating cost at the power station of 1·4d. per unit. For h.t. main from the power house at Carron to Keith, thence a ring main to Buckie along the coast to Banff, Macduff, Turriff, Huntly, and back to Keith, they estimate £160 000. The average selling price to consumers would be below 4d. per unit. The engineers recommended further investigations to reduce the Spey scheme cost, also that Aberdeenshire be asked if they would join Banffshire for a bulk supply.

Alteration of Charges.

The Urban Electric Company, Ltd., have secured an Order authorising them to charge 1s. per unit for electricity in Caterham as from Jan. 1.

The Minister of Transport has refused sanction to Lytham Council to increase the maximum price for electricity under the Lytham Electric Lighting Order, 1913.

An Order has been made on the application of the Ascot and District Gas and Electricity Company, fixing the charge for electricity at East Hampstead at a maximum of 1s. 1d. per unit Before the war the charge was 3½d.

Yarmouth Electricity Committee are to consider the question of a sliding scale of charges, to come into operation after March 31. A proposal to increase the Electrical Engineer's salary from £710 to £760 in accordance with the number of units sold has been referred to the Salaries and Wages Committee. The General Purposes Committtee recommend the Council to withdraw from the Incorporated Municipal Electrical Association, and also from the Joint Industrial Council.

Electric Traction.

Three of the newly-delivered single-decked tramcars are now running at Burnley.

By the substitution of mechanically propelled vehicles for horse traction Holborn Borough Council have saved £2 000 in a year.

Finchley Ratepayers' Defence League have approached the Metropolitan Electric Tramways Company with regard to the possibility of securing a reduction in fares.

So few people have taken advantage of the special late trains put on the tubes by the Underground Company that they have been withdrawn. Four additional six-car trains have been put into service on the Piccadilly line during the "rush" hours. These carry 2 400 passengers.

On Sunday, Jan. 22, Chelsea and Southwark Bridge will be brought into direct tram connection by a new route which will be started via Clapham, Stockwell, Brixton, and Camberwell Green. The total length is nine miles. There will be a three minutes' service during the rush hours, and a four minutes' service at other times of the day.

Taunton Town Council have instructed a committee to reopen negotiations with the Taunton Electric Traction Company for the transfer of the tramway undertaking to the Council. It was stated in discussion that during the twenty years the trams were running they were worked at a loss—except in one year, when a dividend of 1 per cent. was paid.

At a meeting of the Swansea Tramways Committee last week, the Borough Engineer asked for a definition of the Committee's future policy in regard to extending the tramways or doubling the tracks, in order that the Highways Committee could be guided in its policy of road improvements. The adoption of the trackless system was suggested, and a report is to be prepared on the subject.

Halifax Tramways Committee, on Monday, recommended the Tramways Sub-Committee to consider the advisability of purchasing another motor 'bus, with a view of starting a service for Wheatley Valley. The Committee also decided to recommend the Town Council to approve the extension of a single line from the present Skircoat Green terminus to the top of Copley Hill.

During the New Year holidays in Glasgow, nearly 33 000 passengers were carried by the all-night trams, and a revenue of nearly £500 was added to the ordinary receipts, which now total well over £40 000 each week. It was less than a year ago that the all-night service was started, for the convenience chiefly of newspaper workers. After the ordinary service is withdrawn at midnight, special cars are put on fifteen separate routes.

At Farnworth Council last week it was reported that the Farnworth and Kearsley Councils had waited on Salford Corporation regarding the linking up of the tramlines between Bolton and Manchester by providing a short length at Clifton. There was not much hope entertained of this link being supplied for the present. The Salford lease of the Swinton line would expire in four years, and the short length of tramway, costing £5 000, would then have to be handed over to the Swinton Council.

As the result of the opposition of the Commercial Motors Union and the Road Transport Association, which led to clauses in Blackburn's new Parliamentary Bill being heavily defeated at the statutory ratepayers' meeting, a special meeting of the Town Council was called on Saturday to discuss the situation. Alderman Forrest, as leader, moved that a poll of the whole town be taken, the cost of which would be between £500 and £1 000. This was seconded by Councillor Hamer. Opposition was offered on the ground of expense and because the prevailing services were ample for

the town. Eventually the resolution to have a poll was carried by thirty-one votes to three. The cost of the services proposed, with extension of tramways, will exceed £268 000. It is believed that the Bill will be opposed in London.

Considerable difficulty was experienced in working the open-air ELECTRIC RAILWAYS round London during the snowstorm which occurred on Sunday evening last. On the section of the Bakerloo between Queen's Park, Willesden Junction, Harrow, and Watford the electric service was suspended and steam trains substituted until the live rail had been cleared of snow. On the Metropolitan and District Railways snow ploughs were used to clear the live rails, while on the Central London and London and South-Western Railway late running was the rule.

In the Bill which the directors of the LONDON, BRIGHTON AND SOUTH COAST RAILWAY COMPANY are promoting power is sought to raise capital for the electrification of the line. It is estimated that the necessary works will require over £1 000 000, but this expenditure will for a considerable period be unremunerative or unproductive of an adequate return. In 1911 the company was empowered to raise £1 500 000 and to borrow by the issue of debenture stock a further £500 000. None of these powers has, however, been exercised. It is now proposed to empower the company to borrow the £500 000 authorised in 1911, and also to borrow a further £1 000 000, which "may be raised without reference to the issue of any additional capital." It is also proposed that the company may, during any period not exceeding five years, pay out of the moneys borrowed the whole or any part of the interest on any mortgages or debenture stock issued for electrifying the railway.

At the adjourned meeting of HULL CITY Council, on Monday, the Tramways Committee presented five separate schemes for improving the Hessle-road tram service to the City-square. They were, briefly (1) the widening of Midland-street at a cost of £80 000 (which was rejected by the Local Government Board some years ago); (2) taking the cars along Waterhouse-lane from the City-square to Osborne-street, at a cost of £45 000, this involving the purchase of the Punch Hotel; (3) continuing the line from Brook-street to Osborne-street, at a cost of £40 000; (4) placing the terminus at the east end of Osborne-street (with a double line), at a cost of £12 000; and (5) taking the cars from Carr-lane into Osborne-street by way of Anne-street, at a cost of £6 000. The Committee recommended the fifth scheme, for which no Provisional Order would be necessary. By laying a single track along Osborne-street, the dangerous corner of Midland-street would be relieved. After considerable discussion it was decided by 24 votes to 20 to adopt the fourth scheme, and lay a double line down Osborne-street, with a cross-over at the east end of that street.

Telegraph and Telephone Notes.

An overland telegraphic service has been established between MOMBASA (Kenya Colony) AND CAPE TOWN *via* Tanganyika Territory, Nyasaland, and Rhodesia. The rates are said to be cheaper than by the submarine cables.

Sir William Noble, Engineer-in-chief to the British Post Office, on Monday opened at the head offices of the "Liverpool Courier" and "Express" a new RELAY AUTOMATIC TELEPHONE EXCHANGE linked up with the public service, which has been laid down for the use of these journals. The Post Office, he said, was not to blame for the fact that telephony in Great Britain had not developed so rapidly as in the United States, whose mail, postal, and telegraph systems were much behind ours. When the telegraph was invented private automatic exchanges were due to private individuals, and were not controlled by the Post Office. The Post Office had installed automatic exchanges in fourteen self-contained areas, and was considering the question of automatic telephones for large multi-office areas like Liverpool and London. Sir William defended the new telephone rates, stating that otherwise part of the cost would have had to come out of taxation. Had the Government increased its charges, like everyone else, in the early stages of the war, the telephone rates would now have been on the down grade.

Wireless Notes.

At the annual meeting of the LIVERPOOL WIRELESS ASSOCIATION last week all the officers were re-elected, with the exception of Mr. J. Coulton, whose resignation was accepted with great regret. Mr. James K. Wilkie was elected to succeed Mr. Coulton as hon. secretary.

The SNOWSTORM over the week-end caused a considerable amount of damage to telephone and telegraph wires all over the country. Communication with Paris was much interrupted, Mid-Wales suffered badly, Welshpool was cut off from Shrewsbury, Oswestry and Llanfair, and only one telephone wire was left intact with Newtown. At Preston, in Lancashire, the tramway service was seriously interfered with.

The first prize in the Transatlantic amateur wireless tests has been won by the MANCHESTER WIRELESS SOCIETY. The receiving set used in the test was erected at the residence of Mr. W. R. Burne, who was responsible for the manipulation of the various instruments loaned to him by members of the Society. These instruments, together with the special panel built for the occasion by Mr. Burne himself, enabled the tests to be carried through successfully. The receiving set will be exhibited on February 25 at the Society's headquarters, the Albion Hotel, Piccadilly.

Personal and Appointments.

Prof E. W. MARCHANT has consented to act as president of the Liverpool Wireless Society.

On the 2nd inst., at St. Pancras Church, Chichester, Mr. J. S. CHILD, late joint sales manager to the Edison Swan Electric Company, was married to Miss E. L. CRUNDEN.

SIR EDWARD BUSK has formally announced his intention of retiring in May from the chairmanship of the Convocation of London University. Sir Edward is in his 78th year.

At the annual meeting of the BRITISH INDUSTRIAL "SAFETY FIRST" ASSOCIATION, Lord Leverhulme was re-elected president; Sir R. Vassar-Smith and Mr. J. H. Thomas were appointed joint hon. treasurers, and Mr. H. E. Blain was reappointed hon. secretary.

Mr. T. W. BLOXAM has resigned the position of City Electrical Engineer to Belfast Corporation Electricity Works on a retiring allowance of 23/60ths of his present salary, which, with bonus, amounts to £1 240. Mr. Bloxam was appointed assistant chief of the station in 1899, and became chief in 1907.

Service Notes.—Lieut.-Commander G. McL. Cameron, R.N. has been appointed to "Comus II." for charge of the Wireless Station at Aden. Captain C. R. H. Thorn, T.D., has relinquished his commission in the London Electrical Engineers after nearly twenty years' service. On retiring from the Southern Signal Companies Major A. Handley has been given the rank of lieut.-colonel.

Business Items, &c.

The telephone numbers of the BRITISH THOMSON-HOUSTON Company's Liverpool office (33, James-street) are Bank 4 374 and 4 375.

Mr. THOMAS TWIST, late of St. Helens Corporation Electricity Works, has started business in the town as an electrical engineer under the style of Twist & Son, at Britannia Chambers, George-street.

The business carried on hitherto by the British, Irish, and Colonial Department of the Ateliers de Construction Oerlikon has been transferred to OERLIKON, LTD., Oswaldcstre House, Norfolk-street, Strand.

The ELECTRIC LOCOMOTION & FOUNDRY COMPANY, of Glasshouse-lane, Gateshead, have obtained a contract for an electric storage-battery locomotive for the Glasgow Corporation. The order amounts to some thousands of pounds.

The offices of the BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION and of Mr. J. W. Beauchamp (director and secretary) have been removed to 15, Savoy-street, Strand (Institution of Electrical Engineers' building), London, W.C. 2. Telegraphic address: "Electreda Rand, London"; Telephone number: "Regent 4570."

Vickers-Petter, Ltd., of Ipswich, have recently put a new range of SEMI-DIESSEL CRUDE OIL ENGINES on the market which are claimed to be adaptable to almost every purpose for which cheap and efficient power is required. In producing this new series the ratings and speeds have been designed with a view to meeting the demands for marine sets and for driving air compressors, pumps, and electrical equipment, both d.c. and a.c. generators.

BOVING & COMPANY inform us that they have recently been awarded a large contract by the Government of New Zealand for water turbines in connection with the Mangahao hydro-electric power scheme. The order includes five main Pelton wheels, three with a maximum output of over 8 000 B.H.P., and two of over 4 000 B.H.P.; also two smaller exciter Peltons, each 325 B.H.P.; making a total capacity of nearly 33 000 B.H.P. These water wheels will work under an average head of water of 825 ft.

LORIVAL MANUFACTURING COMPANY (1921), LTD., now established in their new works at Southall, are placing on the market a new grade of insulating material. We understand that this possesses all the properties of their ordinary material to an intensified degree, and enables the firm to quote for all classes of mouldings, large and small. The firm employ two distinct processes, producing two different classes of material. The first is a "casting" operation, particularly suitable for the manufacture of large articles; the second is the usual "pressing" process, for the manufacture of a "filled" material. It is the latter which is now being placed on the market.

Mr. Lionel Robinson, B.A., has taken into partnership Mr. W. E. WARRILOW as and from Jan. 1, and under the name of LIONEL ROBINSON & COMPANY will continue and further develop the sole agency for resistance materials and wires of Henry Wiggin & Company, Ltd., Birmingham, which Mr. Lionel Robinson has held for the past fifteen years. Mr. Lionel Robinson is the originator with Henry Wiggin & Company of their now famous "Ferry" resistance wire, so largely used in all the best makes of motor starters, controllers, regulators, rheostats, cinema projectors, and also in sliding resistances and many scientific instruments. Mr. Warrilow brings to the business fifteen years' experience of commercial work, chiefly in encouraging, through the Press, the sales of electrical and allied products of every description. Makers of electric fires and cooking apparatus will be interested to know that the company are now introducing for Henry Wiggin two grades of iron free nickel chrome alloys in wire and ribbon form, which they claim are equal to any American or other imported materials on the market. They will also develop other agencies for any class of material required by manufacturers using electrical resistance alloys. Announcements will be made regarding these from time to time. Enquiries should be addressed to the company's offices, 3, Staple-inn, London, W.C. 1.

Institution Notes.

The annual dinner of the WESTERN CENTRE OF THE INSTITUTION OF ELECTRICAL ENGINEERS will be held in Cardiff on Monday, Feb. 6.

The ANNUAL DINNER AND REUNION of the INSTITUTION OF ELECTRICAL ENGINEERS will be held at the Hotel Cecil, Strand, London, W.C., on Tuesday, Feb. 21, under the presidency of Mr. J. S. Highfield, supported by the council. It is particularly requested that early application be made for tickets, the charge for which is 13s. 6d., exclusive of wine.

Arrangements have been made for the members of the Institution to dine at the Engineers' Club, Coventry-street, W., after the ordinary meeting of the Institution, to be held on Feb. 2. The charge will be 5s. 6d. each. Members wishing to be present at the dinner are requested to send their names to the secretary in advance.

THE INSTITUTION OF CIVIL ENGINEERS have made the following awards for STUDENTS' PAPERS read in London or at local associations during the Sessions 1919-20 and 1920-21 :—The James Forrest Medal and a Miller Prize to R. D. Gauld (Manchester); the James Prescott Joule Medal and a Miller Prize to J. E. Dumbleton (Birmingham); Miller Prizes to Henry Fowler (Manchester), G. H. Humphreys (Manchester), C. M. Brain (London), J. T. Chalk (London), K. T. Spencer (London), and E. A. Phillipson (London).

A Paper on electric arc welding in steel structures, illustrated by lantern slides, was read by Major James Caldwell, of London, last week at the first meeting, held at Swansea, of the recently formed SOUTH WALES BRANCH of the INSTITUTION OF MECHANICAL ENGINEERS. The chairman of the branch is Sir John Roper Wright, vice-chairman Mr. David E. Roberts, and the joint hon. secretaries Mr. W. H. Reynolds, Cardiff, and Prof. F. Bacon, of the Swansea University College. Half the meetings are to be held at Swansea and half at Cardiff.

FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION have elected the following officers for the year beginning Jan. 1, 1922 :—*President:* W. G. Head. *Vice-Presidents:* Prof. G. T. Morgan, A. J. Chapman, F. H. Masters, W. J. Tennant. *Members of Council:* J. H. Coste, Harley F. Knight, W. W. Bradfield, E. W. Moss, E. S. Conradi, E. G. Walker. *Hon. Auditors:* L. M. Clark, F. R. C. Rouse, *Hon. Treasurer:* W. Bernard Thompson, "Elleray," Regent-road, Altrincham, Cheshire. *Hon. Secretary:* H. P. Guy, 74, Silver-street, Edmonton, N. 18.

At the last INFORMAL MEETING of the Institution of Electrical Engineers in London, Mr. J. W. Beauchamp opened a discussion on Co-operative Advertising. Besides outlining the activities of the British Electrical Development Association he showed and criticised a number of lantern slides of various advertisements and discussed the value of different advertising methods in the technical and lay Press. In the discussion which followed Mr. A. G. Whyte appealed for well-trained and well-paid commercial engineers in the sales departments of supply authorities. He thought that very many station engineers did not understand and even disliked publicity.

The annual dinner of the LIVERPOOL ENGINEERING SOCIETY will be held at the Exchange Station Hotel, Liverpool, at 7 p.m. for 7.30 on Thursday, Feb. 2. Tickets (exclusive of wines and cigars) will be 20s. each, and may be obtained on application to any of the following :—Mr. J. B. Wilkie, Mersey Engine Works, Sefton-street, Liverpool; Mr. J. R. Davidson, Water Engineer's Office, Dale-street, Liverpool; Prof. T. B. Abell, The University, Liverpool; Mr. R. E. Gibson, Gas Offices, Duke-street, Liverpool; Mr J. Reney Smith, H. and C. Grayson, Ltd., Royal Liver Building, Liverpool; Prof. E. W. Marchant, Electro-Technical Laboratories, The University, Liverpool; Assoc.-Prof. T. R. Wilton, 1, Crosshall-street, Liverpool.

At the last meeting of the DIESEL ENGINE USERS ASSOCIATION Mr. C. O. Milton, electrical engineer to the Borough of Maidenhead, was re-elected President for a second year, and Mr. Percy Still was re-elected hon. secretary. Messrs. H. S. Whiteley and W. E. Brandreth were elected members of the General Committee in place of the two members retiring at the end of their term of office. The members forming the Standard Committee on Insurance Against Breakdown were re-elected for a further term of office.

The hon. secretary made his annual statement, which reported a further substantial increase in the membership of the association during the year. By the courtesy of the Institution of Electrical Engineers the meetings of the association are now again being held in that building.

The BIRMINGHAM AND DISTRICT ELECTRIC CLUB held the first meeting of the new session at the Grand Hotel on Saturday, Jan. 14, when the new president, Mr. Norman Deykin, delivered his inaugural address. Dealing with the immediate prospects of the electrical industry, Mr. Deykin said that there were no prospects of a boom, but there should be a steady expansion, to assist which the primary need was reduction in price; but even this could not secure business in foreign markets against the extraordinary low prices of our Continental competitors, largely by reason of the unbalanced exchanges. In the home market it was essential there should be more effective protection for the English manufacturer, but reduction in prices and increased production were necessary steps in the direction of increased trade. It was also important for manufacturers to give greater support to their selling organisation and the needs of their customers. The cost of electrical energy was too high. It might be wise to increase the price of current for lighting purposes, making a corresponding decrease in the price for power, cheap electricity for manufacturers being vital in the struggle for trade.

Exhibition Notes.

The dates for the UTRECHT Industries Fair this year are Feb. 21 to March 3, not Feb. 27 to March 10, as previously announced.

A BUSINESS EFFICIENCY EXHIBITION organised by the Association of Office Appliance and Equipment Manufacturers and Traders will be opened by Mr. Gordon Selfridge in the Central Hall, Westminster, on Feb. 8. It will remain open for ten days, and efficiency experts will explain various ideas in the way of short cuts to accountancy, methods of keeping stock, plans of sales promotion, and how to organise efficiently an office of any description.

The OFFICE CENTRAL DE CHAUFFE RATIONNELLE, PARIS, is organising an exhibition of apparatus and material for the conservation of heat, to take place in April, in Paris. The exhibition will include every type of apparatus or material used in the conservation and recuperation of heat, and will be divided into the following sections : (1) Conservation of heat—refractory materials, insulators, instruments for testing calorific value, &c. (2) Recuperation of heat—recuperators and regenerators, economisers, air superheaters, and pre-heaters.

An INDUSTRIAL EXHIBITION which is causing much interest is now proceeding at the premises in Oxford-street of Selfridge & Co. The object of the exhibition is to bring to public notice the intricate machinery and complicated processes through which many of the things that are handled in everyday life have to pass. Among the exhibits is a new type pump made of a series of helical springs linked together to form an endless chain that will lift water to any height by regulating the speed at which it is run. The Waygood-Otis automatic lift is demonstrated; wireless concerts are given hourly; an automatic camera electrically operated takes photos and delivers the finished article in 3½ minutes; and the electric lamp is blown and very fine tungsten filaments drawn through a diamond die.

The SMALL POWER ENGINEERING AND SCIENTIFIC EXHIBITION, better known as the "Model Engineer" Exhibition, which opened on Jan. 7th at the Royal Horticultural Hall, Westminster, closed last Saturday. It was the fifth of its series since 1907, the last being held in 1913. A model tractor engine attracted much interest. It was exact in detail and measured only 1¾ in. in length. Electrically propelled locomotives and boats were also in prominence. Many interesting exhibits were to be seen at the stand of the G. E. C., Stuart Turner, and Bower Company, the Kendrick inspection lamp and Meta electric fire being demonstrated by the last-named firm. Demonstrations of wireless telephony and telegraphy were given periodically. Among the exhibitors of lathes and tools were Messrs. Drummond, H. Milnes, Buck & Ryan, Colchester Lathe Company.

On Dec. 28 the foundation stone was laid of the pavilion which is being built for the accommodation of British exhibits at the forthcoming BRAZILIAN CENTENARY EXHIBITION. Though, owing to the present state of Brazilian exchange, there is little hope of immediate business on a large scale, it is also true that the Brazilian market possesses many special attractions for British traders, and should not be ignored. Brazilian people are strongly predisposed in favour of British firms and British goods, the reputation of both standing even higher than before the war by reason of the contrast with the quality of the goods and the methods of other nations who took advantage of the war to exploit the Brazilian market. A committee, of which Mr. Lionel de Rothschild is chairman, was formed to co-operate with the Department of Overseas Trade, and has collected funds which will defray nearly half of the cost of this country's participation. Full particulars regarding rates for space, &c., can be obtained from the Department of Overseas Trade.

Obituary.

Mr. H. L. TAYLOR, of Littleborough, who died last week at the age of thirty-three years, was the managing director of E. Taylor & Company, electrical engineers, Littleborough. He had been in failing health for some months.

The death has occurred at his home at Leeds of the Hon. E. C. KITSON, third son of the late Lord Airedale, formerly Sir James Kitson, and brother of the present peer. Mr. Kitson, who was in his forty-eighth year, was chairman of Kitson & Company, mechanical engineers, of which firm his father was the founder.

The death is announced, at the age of fifty-eight, of Major-General Sir REGINALD SALMOND CURTIS, K.C.M.G., C.B., D.S.O. General Curtis saw service with the Egyptian Army in the Sudan campaign of 1891, and during the Ashanti expedition of 1895-6 acted as director of telegraphs, receiving mention in despatches and brevet majority. At the outbreak of the war in 1914 he held the post of A.A.G. at the War Office, and in 1917 was given the command of the Cromarty defences. He subsequently had charge of administration, Aldershot Command, and retired in 1920.

It is announced that the thirteenth KELVIN LECTURE will be delivered at the Institution of Electrical Engineers on May 11 by Sir Ernest Rutherford. The subject will be "Electricity and Matter."

The "CYC-ARC" PROCESS OF AUTOMATIC ELECTRIC WELDING was described and demonstrated by Mr. L. J. Steele, chief electrical engineer at Portsmouth Dockyard, its inventor, to the Birmingham Branch of the Institution of Electrical Engineers at the Birmingham University last week, Prof. Cramp presiding.

Tenders Invited and Accepted.

UNITED KINGDOM.

Worthing Corporation. Jan. 23.—One Diesel engine and c.c. dynamo; and vulcanised bitumen-sheathed paper-insulated concentric and triple concentric cable. Specifications, &c., from the Borough Electrical Engineer.

Lewisham Board of Guardians. Jan. 23.—Repairing of electrical installation at the Children's Home, Goat House Bridge, Norwood Junction. Particulars from the Clerk, Mr. W. R. Owen, 394, High-street.

Hammersmith (London) Borough Council. Jan. 25.—Supply, and drawing in existing ducts, of 11 000 V 3-phase linking-up main between Hammersmith and Fulham. Specifications, &c., from the Engineer, Electricity Works, 85, Fulham Palace-road, W. 6.

Salford Guardians. Jan. 31.—Small alterations and additions to electric wiring and fittings in Pavilion B of the Infirmary at Pendleton. Particulars from the Clerk, Poor Law Offices, Eccles New-road, Salford.

Warrington Corporation. Feb. 6.—Main e.h.t. switchboard extension. Specification, &c., from the Borough Electrical and Tramways Engineer.

Islington (London) Borough Council. Feb. 16.—One year's supply of stores, including cables, electricity meters, fuse boxes, compounds, lamps, wires, electrical sundries, transformers, carbons, arc lamp globes, insulators, &c. Specification, &c., can be obtained at the Town Hall.

Hampstead (London) Borough Council. March 15.—Supply of various stores for six or twelve months, including electrical engineers' stores and oils for the electricity station. Form of tender, &c., from the Town Clerk.

Metropolitan-Vickers Electrical Company, Cardiff.—Wiring for the electric lighting and heating of their new premises in Custom House-street.

Aylesbury Corporation.—300 kW converter, with e.h.t. and l.t. switchgear. Specifications, &c., from the Borough Electrical Engineer.

AUSTRALIA.

City Electric Light Company, Ltd., Brisbane.—Feb. 10, 1922. —*Supply and delivery of six miles of three-core 0·15 by 0·15 paper insulated cable, suitable for 5 500 V, with a non-earthed system. Tenders, accompanied by a preliminary deposit of £100, to the Engineer and Manager, Boundary-street, Brisbane.

Australian Commonwealth Government, Feb. 15 :—30 tons approximate Wheatstone tape paper white (Schedule 544). Particulars from the Supply Officer, Australia House, Strand, London, W.C. 2.

Victorian Government Railways.—Feb. 15.—*Supply and delivery of : (1) Fifty track relays, four front and two back contacts, fifty track relays, eight front and two back contacts, fifty line relays, six front and two back contacts (Contract No. 34 739); (2) 100 three-position line relays (Contract No. 34 740); (3) 100 electric signal mechanisms (Contract No. 34 738); (4) electro-mechanical interlocking apparatus (Contract No. 34 822); (5) fifty miles insulated copper wire (Contract No. 34 823). Local representation is essential.

Victorian Railway Commissioners. Feb. 15.—*Hydraulic pig iron breaker, including tools, gears, accessories and spares, for Bendigo workshops. (Contract No. 34 191.)

Deputy Postmaster-General, Brisbane. Feb. 15.—*Telephone apparatus and parts, including bells, buzzers, chambers for transmitters, induction coils, condensers, cords. (Stores schedule No. 544.)

New South Wales Government Railways and Tramways Department (Electrical Engineer's Branch).—Feb. 22, 1922.—*Supply, delivery, erection and maintenance of one 5 000 kW 50 cycle turbo-alternator with condenser and accessories, at Zarra-street power house, Newcastle. (Contract No. 556.) Tenders, on proper forms and accompanied by a preliminary cash deposit, to the Secretary for Railways, Phillip-street, Sydney, N.S.W. Local representation is essential.

Commonwealth of Australia. March 8.—Switchboard apparatus and parts (schedule 545). Particulars from the Supply Officer, Room 101, Australia House, Strand, London, W.C. 2.

Victorian Railway Commissioners. March 8.—*Thirty-five cabin transformers for power signalling. (Contract No. 34 863.)

Deputy Postmaster-General, Brisbane. March 15.—*Protective apparatus, including arresters, carbon blocks, fibre fuses, protectors and terminals. (Stores schedule No. 546.)

Commonwealth of Australia. March 15.—Protective apparatus. Particulars from the Supply Officer, Room 101, Australia House, Strand, London, W.C. 2.

Municipal Council of Sydney (Electricity Department). April 24.—*Supply, delivery, and erection of two 2 000 kW rotary converters; one 10 000 to 12 000 kW turbo-alternator.

NEW ZEALAND.

Borough Council of Palmerston North. Original closing date Sept. 24. Extended date not yet decided.—*Service meters : (*a* Single-phase, 230 V, 400 5 A, 150 10 A, 50 15 A; three-phase, balanced load, 400 V, 100 10 A, 30 25 A, 15 50 A, 10 75 A, 5 100 A. (b) 19 50 kVA single-phase transformers, with oil, complete; 1 complete winding h. and l. tension, for one leg; spare parts and accessories.

* *Particulars from the Department of Overseas Trade.*

Public Works Department, Wellington. Feb. 28.—*Supply and delivery, ex ship's slings Lyttelton, of a bank of three 11 000 V reactances, complete, for the Lake Coleridge electric power scheme.

Public Works Tenders Board, Waikato Power Scheme. March 6.—*(Section 45) two 2 500 kWa alternators, three-phase, 50 cycle, 5 000 V, at 166⅔rds rev. per min., with a power factor of ·8. Excitation at 220 V. (Section 46) two 3 100 h.p. water turbines of the double-runner Francis type to operate the generators mentioned in Section 45. (Section 47) two exciter sets, each consisting of one 200 kW d.c. generator, and one 350 h.p. asynchronous motor, together with a Tirrill regulator. The generator shall have an output of 220 V, with a full-load current of 7 000 A. The motor shall be of 350 h.p., with a power supply of 400 V, three-phase, 60 cycle. The synchronous speed of the sets shall be 750. (Section 48) four Stoney sluice gates for the pits, appertaining to the turbines mentioned in Section 46. Tenders to the Secretary, Public Works Tenders Board, Government Buildings, Wellington.

Dunedin City Council. March 31.—*Supply and delivery of one 150 h.p. three-phase induction motor and reduction gear for the Mornington Cable Service.

Auckland Harbour Board. April 25.—Four double-barrel electric winches for the Central Wharf, Auckland. Specifications from W. & A. McArthur, 18-19, Silk-street, Cripplegate, London, E.C. 2.

ITALY.

Director-General of the Italian State Railways. April 30.—Electrification of the Bologna-Venice-Monfalcone line. Particulars from the Direzione-Generale, Ferrovie dello Stato, Rome.

SOUTH AMERICA.

Chilean State Railways, Feb. 4, 1922* :—1 electric compressor; 1 air storage drum and 1 continuous current electric motor (70 h.p.); 1 300 electric filament lamps for locomotives; 38 wall telephones.

Argentine Ministry of Public Works. Feb. 21, 1922.—*Nine electric motors, 36 tip waggons, 1 centrifugal pump with electric motor. Specification expected at the Department of Overseas Trade by Dec. 28.

BULGARIA.

Bulgarian Department of Posts, Telegraphs, and Telephones. January 30.—*Supply of the following parts for telephone exchanges : 2 200 subscribers' line indicators, 600 indicators (end of conversion), 2 500 jacks, 1 500 plugs, 2 000 connecting pieces, 20 000 switchboard connecting pieces.

Bulgarian Department of Posts, Telegraphs and Telephones. Feb. 8. *Supply of the following telegraphic accessories :—Twenty terminal boxes for 40-pair cable, 1 000 combined lightning arresters and 1 A fuses, 500 combined lightning arresters in fuses (different type), 300 transformers, 700 condensers (2 micro-farad), twenty junction-boxes with protective devices for 40-pair cable.

Bulgarian Department of Posts. March 8.—*Porcelain insulating tubes for telephones (10 000), insulating tubing (impregnated paper) for telephones (2 200 metres), ebonite caps (1 700), and insulated copper wire (1 000 metres).

Bolton Corporation have accepted the tender of Hadfields, Ltd., for special tram rails, points and crossings.

Stepney Borough Council have accepted the tender of the Tipton Tub and Tube Company for two dust catchers for Limehouse generating station at £215 each.

Portsmouth Corporation have accepted the tender of J. Cochrane (Barrhead), Ltd., for additional pumps and electrical machinery for the drainage scheme at £9 182.

London County Council have accepted the tender of Steel, Peech & Tozer for tramcar trailing wheel tyres at £1 16s. each, and English Electric & Siemens Supplies, Ltd., for electric lamps.

Burton-on-Trent Corporation have accepted the tenders of G. and J. Weir for auxiliary pumps, £1 230; and the Metropolitan-Vickers Electrical Company for two 500 kW transformers, £1 603.

Peterborough.—The Board of Guardians have accepted the tender (the lowest received) of Mr. W. H. Borrows, of Werrington, for installing electric light at the Workhouse at £240. Six tenders were received, the highest being £295

Blackpool Electricity Committee have accepted, subject to the sanction of the Electricity Commissioners, the tender of Fraser & Chalmers (G.E.C.) for the supply of a new 5 000 kK turbo-alternator, and that of Hick, Hargreaves & Company for condenser and auxiliaries.

Bradford Corporation have accepted the following tenders :—T. Smith & Son (Rodley), Ltd., two 7-ton electric motor cranes, £4 194; English Electric Company, one 250 kVA transformer and two electric lifts; C. Bell, one passenger lift; and Reliance Lift and Engineering Company, one goods lift.

Glasgow Corporation have accepted the following tenders for tramway materials :—T. Bolton & Sons, trolly wire; Whipp & Bourne, switchgear; Metropolitan-Vickers Electrical Company, relays; Fleming, Birkby & Goodall, stud bolts; and Brush Electrical Engineering Company, truck frame forgings.

Hampstead Borough Council have acceptd the following tenders :—British Thomson-Houston Company, h.t. switchgears, at £1 825; Pirelli General Cable Works, laying of 2 300 yards of cable between Boundary-road and the electricity station, at £2 454 11s. 4d.; British Electric Transformer Company, distribution transformers, at £11,854 2s., less £1 694 for the transformers replaced.

Electrical Imports and Exports.

IMPORTS.—The following are official values of electrical machinery, apparatus and material imported into this country (*a*) during December, 1921, and (*b*) the aggregate figures from Jan. 1 to Dec. 31, with increase or decrease compared with corresponding periods of 1920 :—

Electrical machinery, (*a*) £49 795 (decrease £97 027), (*b*) £728 181 (decrease £603 606); telegraph and telephone cables, submarine, (*a*) nil, (*b*) nil (decrease £50); other than submarine, (*a*) £1 346 (decrease £4 973), (*b*) £76 701 (increase £49 853); telegraph and telephone apparatus, (*a*) £11 810 (decrease £40 227), (*b*) £308 723 (increase £64 415); other electrical wires and cables, rubber insulated, (*a*) £2 745 (decrease £1 392), (*b*) £43 142 (increase £10 088); with other insulations, (*a*) £1 909 (decrease £8 305), (*b*) £105 209 (decrease £128 328); carbons, (*a*) £4 519 (decrease £13 785), (*b*) £94 828 (decrease £58 578); glow lamps, (*a*) £40 966 (increase £28 730), (*b*) £280 152 (increase £204 672); arc lamps and electric searchlights, (*a*) nil (decrease £8 956), (*b*) £6 653 (increase £10 070); parts of arc lamps and searchlights (other than carbons), (*a*) £497 (increase £346), (*b*) £15 119 (increase £2 012); batteries, (*a*) £4 736 (decrease £8 426), (*b*) £119 487 (decrease £10 438); meters and measuring instruments, (*a*) £3 171 (decrease £12 297), (*b*) £135 884 (increase £37 945); switchboards, (*a*) £6 116 (decrease £2 552), (*b*) £29 344 (increase £17 924); electrical goods and apparatus unenumerated, (*a*) £46 480 (decrease £86 144), (*b*) £716 120 (decrease £174 260). Total of electrical machinery, apparatus and material (other than uninsulated wire), (*a*) £174 090 (decrease £255 008), (*b*) £2 659 543 (decrease £498 421).

EXPORTS.—The exports of electrical machinery, apparatus and material (*a*) during December, 1921, and (*b*) from Jan. 1 to Dec. 31, with increase or decrease compared with corresponding periods of 1920, were as follows :—

Electrical machinery, (*a*) £1 196 (decrease £137), (*b*) £18 267 (increase £6 367); including railway and tramway motors, (*a*) £3 (decrease £60), (*b*) £650 (increase £412); other generators and motors, (*a*) £546 (decrease £272), (*b*) £10 274 (increase £3 411); and electrical machinery unenumerated, (*a*) £647 (increase £195), (*b*) £7 343 (increase £2 544); telegraph and telephone cables, submarine, (*a*) £83 339 (decrease £242 956), (*b*) £147 250 (increase £370 310); other than submarine, (*a*) £85 128 (decrease £39 959), (*b*) £1 621 837 (increase £582 072); telegraph and telephone apparatus, (*a*) £194 330 (increase £43 485), (*b*) £2 056 532 (increase £831 675); other electrical wires and cables, rubber insulated (*a*) £61 611 (decrease £104 461), (*b*) £1 236 362 (decrease £517 087); with other insulations, (*a*) £107 067 (decrease £40 211), (*b*) £2 072 427 (increase £31 852); carbons, (*a*) £4 252 (decrease £25 036), (*b*) £70 243 (decrease £78 646); glow lamps, (*a*) £25 439 (decrease £1 022), (*b*) £443 850 (increase £123 996); arc lamps and searchlights, (*a*) £200 (decrease £3 067), (*b*) £12 941 (decrease £7 947); parts of arc lamps and searchlights (other than carbons), (*a*) £341 (decrease £1 134), (*b*) £6 265 (decrease £9 232); batteries, (*a*) £36 156 (decrease £39 776), (*b*) £675 476 (increase £47 202); meters and measuring instruments, (*a*) £35 264 (increase £5 376), (*b*) £492 002 (increase £94 822); switchboards, (*a*) £18 810 (increase £4 950), (*b*) £240 819 (increase £123 610); electrical goods and apparatus unenumerated, (*a*) £98 814 (decrease £145 729), (*b*) £1 989 411 (decrease £128 362). Total of electrical machinery, material and apparatus, other than uninsulated wire, (*a*) £1 063 154 (decrease £605 528), (*b*) £17 809 468 (increase £3 536 989).

Social Notes.

The staff engaged at the WREXHAM Electricity Works, together with members of the Town Council and a large number of consumers, were entertained to dinner last week by Alderman E. Hughes, chairman of the Electricity Committee.

The LONDON STUDENTS' SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS are arranging a theatre party for the Coliseum on Jan. 27 at 7.45 p.m. Tickets, price 3s. 6d. each, may be obtained from Mr. A. Butler, "The Cottage," Callendar's Cable and Construction Company, Belvedere.

The LONDON ELECTRICAL ENGINEERS' OLD COMRADES ASSOCIATION have arranged to hold a Bohemian concert at Bridge House Hotel, London Bridge, on Friday, Feb. 17, at 7 p.m. Admission by membership card.

The annual dinner of the London Electrical Engineers (24/26 L.A.S.S. Company), will be held at Bridge House Hotel on Thursday, Feb. 23. Tickets, 7s. each, may be obtained from Mr. E. A. Wilson, 3, Lombard-street, E.C. 3.

The annual dinner of the London Electrical Engineers (No. 4 (Newhaven) Company) will be held at Anderton's Hotel, Fleet-street, on Saturday, March 18, at 6.30 p.m. Tickets, price 6s. each, may be obtained from Mr. G. H. Cannon, 313, Fore-street, Edmonton, N. 9.

The annual New Year's Invitation Social of the ATHLETIC AND RECREATION CLUB of J. H. TUCKER & COMPANY, LTD., Birmingham, held on the 5th inst., proved a great success. The committee had arranged whist, a concert and dancing, and there were no speeches beyond the usual vote of thanks to the committee. The chair was occupied by Mr. T. R. Martin, and prizes were distributed to the winners of the whist drive.

Miscellaneous.

The contributions received and promised up to Nov. 30 in connection with the 1921 annual festival dinner of the ELECTRICAL TRADES' BENEVOLENT INSTITUTION amounted to £1 443 18s. 9d.

On a charge of embezzling £292, the money of the FIXED PRICE LIGHT COMPANY's branch at Wimbledon, W. Taylor, the firm's chief clerk, was at Wimbledon Police Court last week committed for trial to the Central Criminal Court. He denied having had the money, and refused to be dealt with summarily.

In addition to the awards in the MORLEY ARBITRATION (set out on p. 46 of our last issue), the following sums have also been awarded for loss of employment :—L. Dale, engineman, £198; E. Williams, engineman, £101; H. R. Turner, shift engineer or switchman, £66; C. Stinton, shift engineman or switchman, £66.

With certain exceptions, the salaries of MIDDLESBURGH Corporation officials receiving £500 a year and over are to be reduced by 7½ per cent., and those of officials receiving less than £500 are to be reduced by 5 per cent., the reductions to operate as from Jan. 1. The exceptions are officials who have been recently appointed, the Town Clerk, and the Director of Education.

About 2 000 UNEMPLOYED, representing various branches of the unemployed workers' movement in London, PROTESTED outside the Amalgamated Engineering Union headquarters in Peckham-road on Monday afternoon against the ballot now being taken, and the recommendation of the Executive Council that the men should accept overtime at the discretion of the employers. The interview lasted about an hour, and at the end the men were told their case would be placed before the Executive Council when it met.

An arrangement has been made between a number of the leading fuel research chemists of this country and the "Colliery Guardian" to publish a monthly record of British and foreign research regarding the PREPARATION AND USE OF FUEL, which will be available to all interested in the subject. The publication will take the form of a supplement to the "Colliery Guardian," and will appear on the fourth Friday of every month, being circulated free with that issue of the journal. The supplement will be entitled "Fuel in Science and Practice," and will be edited jointly by Dr R. V. Wheeler, Professor of Fuel Technology of Sheffield University, and Dr. J. V. Elsden, joint editor of the "Colliery Guardian."

The LONDON COUNTY COUNCIL have made new by-laws as to lamps used for marking road obstructions. (1) Where any work is being carried out, or any road material or erection (whether movable or not) is placed, in or on any part of a street or highway which makes the use of such part dangerous for traffic, that part of the street or highway shall, during the period between one hour after sunset and one hour before sunrise, be kept continuously lighted by one or more lamps showing a red light, placed in such manner and positions as to indicate sufficiently to foot passengers and drivers of vehicles the extent and position of such work, road material or erection. (2) No lamp exhibiting a light other than a red light shall be used for the purpose. For breaches of the by-laws there is a penalty not exceeding £5.

A committee of the Federation of British Industries has been investigating the REGULATIONS GOVERNING REGISTRATION OF BUSINESS NAMES, and a letter has been sent to the Controller of the Companies Department of the Board of Trade on the matter. It is pointed out that the necessity of furnishing full particulars to the Registrar at Somerset House as to all the occupations of the directors of a company is found to be extremely inconvenient and troublesome. The Federation feels that, although it might have been desirable that full information should have been disclosed during the war, the necessity for this has ceased. It urges that nothing further should now be required than that a director should supply the particulars required by the Companies Consolidation Act, 1908, giving his usual occupation. The obligation to place the names of directors on the letter paper, &c., of the company is regarded as unnecessary. As regards the Act of 1916 requiring these particulars in relation to private firms, the Federation feel this to be an advantage to the business community generally, which might well be retained, but the Companies (Particulars of Directors) Act, 1917, might be repealed.

Companies' Meetings, Reports, &c.

The EASTERN EXTENSION AUSTRALASIA & CHINA TELEGRAPH COMPANY notify that the interest on the 4 per cent. mortgage debenture stock for the half-year ending Jan. 31 will be paid by warrant on Feb. 1.

The FIFE TRAMWAY, LIGHT AND POWER COMPANY on Tuesday offered for public subscription £250 000 7 per cent. debenture stock at £93. The issue was largely over-subscribed, and the lists were closed at 11 a.m.

An extraordinary meeting of the METROPOLITAN DISTRICT RAILWAY COMPANY, last week, accepted and confirmed the revised scheme (THE ELECTRICIAN, Dec. 16, p. 770) for the common fund agreement between the above company, the London Electric Railway Company, the City and South London Railway Company, the Central London Railway Company, and the London General Omnibus Company. Similar meetings of all the companies concerned followed, and at each the same scheme was dopted.

The report of the CHATHAM AND DISTRICT LIGHT RAILWAYS COMPANY for the year ended Dec. 31, 1921, shows the revenue to be

£87 267 15s. and expenses £67 945 15s., leaving a gross profit of £19 324. From this sum had to be deducted £3 743 12s. for rent of Rochester Corporation lines, £2 470 for interest account, and £4 000 for reserve and depreciation, making a total of £10 213 14s., and leaving a net profit of £9 110 6s., which with £1 608 11s., the balance brought forward from 1920, left a balance of £10 718 17s. Of this amount £2 940 has been paid for the 5 per cent. interim dividend for the half-year ending June 30, 1921, on the preference share capital; £2 120 for the 4 per cent. interim dividend for the same period on the ordinary share capital, and the directors recommend that the balance be disposed of as follows :—£2 940 to a 5 per cent. dividend for the half-year ending Dec. 31, 1921, on the preference share capital; £2 120 to a 4 per cent. dividend for the same period on the ordinary share capital; and £598 17s to a revenue new account. There is a decrease of £3 446 in the revenue and £1 228 in the expenses as compared with the revenue and expenses for the year 1920. The decrease in net revenue is due to the coal stoppage and trade depression. During the past year an efficient service of trams on the various routes has been maintained. The generating plant has worked satisfactorily, and the whole of the company's machinery, engines, rolling stock, permanent way, cables, and other works have been maintained in good working order and repair.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, 116-118, Chancery-lane, London, W.C. 2.

Brasco-Lath, Ltd. (178 940). Registered Jan. 10. Manufacturers, dealers and contractors of electric fittings and building appliances, 165, Queen Victoria-street, E.C. Nominal capital, £1 000 in 1 000 shares of £1 each. Directors : D. McPherson Armstead, J. E. Woodruff, and J. B. Wilson. Qualification of directors, one share.

British Motor Improvements, Ltd. (178 916). Registered Jan. 9. Mechanical and electrical engineers, &c. Nominal capital, £100 in 100 shares of £1 each. Qualification of directors, one share. Directors to be appointed by subscribers. Subscribers : Alice E. Egerton, 37, Essex-street W.C. solicitor's clerk; and H. G. Springall.

Culkin & Parkinson, Ltd. (178 921), 111, Woodhouse-lane, Leeds. Registered Jan. 9. Electricians, mechanical engineers, &c. Nominal capital, £2 000 in 1 000 preference shares of £1 each and 1 000 ordinary shares of £1 each. Directors : J. Culkin and J. Parkinson. Qualification of directors, £10. Remuneration of directors, £50 each.

Electrical Insulating Composition Company, Ltd. (178 923), Proval Works, Davyhulme-road, Davyhulme. Registered Jan. 9. Electrical engineers and manufacturers, and dealers in electrical insulation composition. Nominal capital, £1,500 in 1,500 shares of £1 each. Directors : A. Rigby and H. D. Shancross. Qualification of directors, £200. Remuneration of directors, £15 per annum each Managing director, £50 per annum.

Greenodd Motor and Cycle Company, Ltd. (178 902). The Garage, Greenodd, near Ulverston, Lancashire. Registered Jan. 7. General mechanical and electrical and motor engineers. Nominal capital, £1 500 in 1 500 shares of £1 each. Directors : A. E. Gazey, G. C. Farrer, and T. Tyson. Qualification of directors, £50.

Multi-Way Earthing Clip, Ltd. (179 011), 44, Weston-street, London Bridge, S.E. 1. Registered Jan. 12. To acquire the business hitherto carried on by A. E. Ryeland and C. A. Greenslade at 44, Weston-street, London Bridge, S.E. 1, for the purpose of testing and developing an invention for improvements in or relating to means for bonding metallic tubing in electrical wiring installations, and to carry on the same. Nominal capital, £5 000 in 5 000 shares of £1 each. Directors : A. E. Ryeland, C. A. Greenslade, and H. Hibbard. Qualification of directors, one share.

Shenton & Company, Ltd. (178 993), 68-69, Shoe-lane, E.C. Registered Jan. 11. Electrical, telephone, mechanical, general engineers, &c. Nominal capital, £4 000 in 1 000 preference shares, and 3 000 ordinary shares of £1 each. Directors : A. Handley and C. J. Margerison. Qualification of directors, £250. Permanent directors,, £1 000.

Timeproof Ferro-Concrete Railway Sleeper Company, Ltd. (178 965), 2, Dean's-yard, The Sanctuary, Westminster, S.W. Registered Jan. 10. To acquire from Robert Baker the benefit of an invention for improvements in railway and tramway sleepers, and turn same to account. Nominal capital, £900 in 750 ordinary shares of £1 each and 3 000 founders' shares of 1s. each. Directors : R. Baker, D. Macdonald, W. Daniel, and E. A. Kite. Qualification of directors, one share. Remuneration of directors, £50 each. Chairman, £75.

Joseph Watson & Son (Nelson), Ltd. (178 889), Walverden Foundry, Nelson, Lancashire. Electrical and mechanical engineers. Nominal capital, £15 000 in 5 000 15 per cent. cumulative preference shares and 10 000 ordinary shares of £1 each. Managing director : I. Walton. Qualification of directors, 250 shares. Remuneration of directors, £7 per week managing director and such sum to be voted by company in general meeting.

Vio-Ray Electric Company, Ltd. (178 937). Registered Jan. 9. To manufacture, purchase, sell and deal in any kind of goods, electrical or otherwise. Nominal capital, £1 000 in 1 000 shares of £1 each. Directors to be appointed by subscribers. Qualificatiton of directors, one share. Subscribers : J. H. O. Emery, 50, Brightside-road, Hither Green, S.E. 13, and A. A. Henley, Oak House, The Mount, Sydenham Hill-road, S.E., incorporated accountant.

Arrangements for the Week.

FRIDAY, Jan. 20th (to-day).

Institution of Mechanical Engineers.

6 p.m. At Storey's Gate, London, S.W. Paper on "Some Observations on a Producer-Gas Power Plant," by Mr. H. S. Denny, C.B.E., and Mr. N. V. S. Knibbs, B.Sc.

Institution of Electrical Engineers.
(London Students' Section.)

7 p.m. At Savoy-place, London, W.C. Paper on "Some Applications of the Thermionic Valve to Telephony," by Mr. L. T. Hinton.

British Electrical Development Association.

8 p.m. At the Chartered Institute of Patent Agents, Staple Inn buildings, London, W.C. Salesmanship Conference on "Salesmanship in Relation to Electric Heating and Cooking." Speaker, Mr. W. A. Gillott.

MONDAY, Jan. 23rd.

Institution of Electrical Engineers.
(Informal Meeting.)

7 p.m. At Savoy-place, London, W.C. Discussion on "Electric Vehicles, Present and Future," to be opened by Mr. R. J. Mitchell.

Institution of Electrical Engineers.
(North-Eastern Centre.)

7.15 p.m. At Armstrong College, Newcastle-on-Tyne. Paper on "The Interconnection of A.C. Power Stations," by Messrs. L. J. Romero and J. B. Palmer.

TUESDAY, Jan. 24th.

Institution of Civil Engineers.

6 p.m. At Gt. George-street, London, S.W. Papers to be further discussed, "Control of Trains, in Relation to Increased Weight and Speed Combined with Reduced Headway," by Mr. A. W. Rendell, and "Trials in Connection with the Application of the Vacuum Brake for Long Freight Trains," by Sir Henry Fowler and Mr. H. N. Gresley, C.B.E.

Institution of Electrical Engineers.
(East Midland Sub-Centre.)

6.45 p.m. At The College, Loughborough. Paper on "Loughborough Electricity Undertaking and Extensions in Hand," by Mr. R. B. Leach.

Institution of Electrical Engineers.
(North-Western Centre.)

7 p.m. At the Engineers' Club, Manchester. Paper on "Cyc-Arc Process of Automatic Electric Welding," by Messrs. L. J. Steele and H. Martin.

Junior Institution of Engineers.
(North-Eastern Section.)

7 p.m. At Armstrong College, Newcastle-on-Tyne. Paper on "Pyrometry," by Mr. R. L. Granville Johnston.

WEDNESDAY, Jan. 25th.

Institution of Civil Engineers.
(Students' Meeting.)

6 p.m. At Great George-street, London, S.W. Lecture on "The Economic Aspects of Various Methods of Power Transmission," by Mr. E. W. Monkhouse, M.A. (Lecture II.)

THURSDAY, Jan. 26th.

Institution of Electrical Engineers.
(Tees-Side Sub-Centre.)

7 p.m. At the Cleveland Technical Institute, Middlesbrough. Paper on "Methods of Conversion of A.C. to D.C. for Traction Purposes," by Mr. C. H. Davidson.

Institution of Mechanical Engineers.

7.30 p.m. At the University, Birmingham. Paper on "High Tension Spark Ignition in Internal Combustion Engines," by Mr. J. D. Morgan.

FRIDAY, Jan. 27th.

Institution of Electrical Engineers.
(Scottish Centre, Students' Section.)

7.30 p.m. At the Royal Technical College, Glasgow. Paper on "The Economical Production of Electrical Power," by Mr. R. G. Kendall.

North-East Coast Institution of Engineers and Shipbuilders.

7.30 p.m. At the Literary and Philosophical Society, Newcastle-on-Tyne. Paper on "The Use of Compressed Air in Diesel-Engined Ships," by Mr. W. Reavell.

Institution of Electrical Engineers.
(Irish Centre.)

8 p.m. At the Royal College of Science, Dublin. Lecture on "The Development of Electricity Supply in Switzerland," by Mr. E. M. Johnson.

Junior Institution of Engineers.

8 p.m. At Caxton Hall, London, S.W. Lecturette on "Fuels and the Boiler House," by Mr. L. M. Jookel.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Partnerships Dissolved.

COLLINS, Sidney, and SLATER, William Owen, agents for electrical appliances, 17A, Sweeting-street, Liverpool, under the style of Collins & Slater, by mutual consent as from Nov. 1, 1921. Debts received and paid by S. Collins.

SUKIASSIAN, Sarkis Balthazar, and TAYLOR, James Harry, electrical accessory dealers, 29, Minshull-street, Manchester, under the style of the Princess Electrical Company, by mutual consent as from Dec. 31, 1921. Debts received and paid by S. B. Sukiassian, who will continue the business.

WINKLEY, William Leonard, and WINKLEY, Bernard Percival, electro platers and stampers, 6, Hockley-street, Brimingham, under the style of the Electro Plate & Stamping Company, by mutual consent as and from Dec. 31, 1921. Debts received and paid by B. P. Winkley, who will continue the business.

Bankruptcy Information.

FAWCETT, Ernest, 20, St. Anne-street, Liverpool, electrical and heating engineer. Receiving order, Jan. 13. Debtor's petition.

HURWORTH, Walter, 1, Back James-street, Harrogate, late 41, Town-street, Horsforth, Leeds, electrical engineer. Receiving order, Jan. 11. Creditor's petition.

LANGSFORD, Edwin Growdon, 24, Bar-street, Burnley, Lancaster, electrician. First meeting, Jan. 25, 11 a.m., Official Receiver's Offices, 13, Winckley-street, Preston. Public examination, Jan. 26, 11 a.m., County Court House, Bankhouse-street, Burnley.

ROTHWELL, Peter, trading (with Peter Ashworth Rothwell, a minor) as P. A. Rothwell & Company, at 64, Higher Bridge-street, Bolton, electrical engineer. Receiving order, Jan. 12. Debtor's petition.

Notice of Intended Dividend.

DRYSDALE, William, 24, Paxton-street, Barrow-in-Furness, Lancaster, electrician. Last day for receiving proofs, Feb. 4. Trustee, H. Mossop, 4, Ramsden-square, Barrow-in-Furness.

Company Winding-up Voluntarily.

HOOTON & ELLESMERE PORT DISTRICT ELECTRIC SUPPLY COMPANY, LTD. S. S. Dawson, 51, North John-street, Liverpool, appointed liquidator.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

BOULT, M. A., & COMPANY, 26, Slater-street, Liverpool, electrical engineers. £18 2s. 8d. Nov. 10.

BRITISH BELL TELEPHONE COMPANY, LTD., registered office, King's-walk, Nottingham, electrical engineers. £13 12s. 2d. Nov. 10.

CALDWELL & SONS, 26, Victoria-road, Hale, electrical engineers. £10 17s. 3d. Nov. 10.

HALL, Mr. H. W., 29, Emerald-street, Dingle, Liverpool, electrical engineer. £31 6s. 8d. Nov. 3.

MATTHEWS, Mr. F., 13, Herbert-street, Newport, electrical engineer. £12 16s. 6d. Nov. 4.

SEACOMBE, Mr. J., 98, Trevor-street, North Shields, electrical engineer. £19 18s. 8d. Nov. 9.

SLATER BROTHERS, Dickinson-street, Manchester, electrical engineers. £42 8s. 1d. Nov. 1.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

EVANS (ELECTRICAL) LTD., London, E.C. Registered Jan. 3. £1 100 debentures, to A. E. Pater, 1, Arcade-house, Hendon, builder and contractor; general charge.

FELIX MACAULEY, LTD., London, E.C., turners in ebonite. Registered Dec. 30. £3 000 debentures, present issue £1 600; general charge.

Receivership.

PULLAN ENGINEERING COMPANY, LTD. T. Paton, of 3, Piccadilly, Bradford, ceased to act as receiver or manager on Jan. 9, 1922.

Bankruptcy Proceedings.

BARNETT, Bernard, electrical engineer, 104, Whitechapel-road, E. At the adjourned meeting of creditors, held on Tuesday, a draft statement of affairs was submitted, showing liabilities £800 and assets valued at £1 102, of which £781 represented the debtor's interest in his partnership business. The debtor's late partners, who were present at the meeting, claimed to be creditors, and stated that instead of there being any interest for the debtor in the business, it was insolvent at the date of the appointment of a receiver. The debtor strenuously denied this contention. After a somewhat heated discussion, the Official Receiver expressed a doubt whether any assets would accrue to the estate from the partnership. He said that he should apply for an order for the summary administration of the estate in bankruptcy. Meeting was closed, the case remaining in the hands of the Official Receiver.

PUGH, Herbert John, formerly trading as H. J. Pugh & Company, electrical engineer, 38, Broadway-parade, Crouch End, Hornsey. The first meeting of creditors was held last week at the London Bankruptcy Court. Debtor began business in May, 1914, at Hornsey Rise with very little free capital, and a few months later removed to larger premises. He was exempted from military service on medical grounds, and between 1914 and 1920 he did an increasing business, though he could not state the amount of his profits. In 1920 his business suffered from the general trade depression, and creditors began to press. In April last one of them obtained judgment, and levied execution, the effects being sold by the Sheriff to the debtor's mother, who had since continued the business under debtor's management. Debtor estimated his liabilities at £400 and disclosed no assets, the failure being attributed to trade depression and to stoppage of his business for the execution of necessary repairs to the premises. Case left in the hands of the Official Receiver for administration in bankruptcy.

Prices of Metals, Chemicals, &c.

TUESDAY, JAN. 17.

		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£69 0 0	10s.	—
Electro Wirebars ..	„	£74 0 0	—	10s.
H.C. wire, basis	per lb.	0s. 11¾d.	—	$\frac{1}{16}$d.
Sheet	„	0s. 10½d.	—	—
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze wire, basis.....	„	1s. 3⅛d.	—	$\frac{1}{16}$d.
Brass 60/40—				
Rod, basis	„	0s. 7½d.	—	—
Sheet, basis.....	„	0s. 10½d.	—	—
Wire, basis	„	0s. 10⅜d.	—	—
Pig Iron—				
Cleveland Warrants	per ton	£4 15 0	—	10s
Galvanised steel wire, basis 8 SWG	„	£22 0 0	—	—
Lead Pig—				
English	„	£25 10 0	—	10s.
Foreign or Colonial ..	„	£23 17 6	—	10s.
Tin—				
Ingot	„	£165 5 0	—	£1 15 0
Wire, basis	per lb.	2s. 2⅞d.	—	¼d.
Aluminium Ingots		£120 0 0	—	—

Salummoniac.—Per cwt. 65s.-60s.
Sulphur (Flowers).—Ton £12 10s.
„ (Roll-Brimstone).—Per ton £12 10s.
Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.
Copper Sulphate.—Per ton £28 10s.
Boric Acid (Crystals) —Per ton £65.
Sodium Bichromate.—Per lb. 6½d.
Sodium Chlorate.—Per lb. 3½d.
Rubber.—Para fine, 1s. 1½d.; plantation 1st latex. 10⅝d. to 10¾d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd

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CONTENTS.

Notes of the Week.

Causes of Rail Corrugation.

The history of the investigations into corrugation of tramway rails, which has been conducted over a number of years, and has resulted in great differences of opinion on the causation, has received an addition in the Final Report of the Rail Corrugation Sub-Committee of the Municipal Tramways Association. This Committee, which was under the Chairmanship of Mr. W. W. Beaumont, was appointed some time before the war to investigate the corrugation of tramway rails, with particular reference to the vibration of the rails and of the foundations as being a probable cause. Experiments with this end in view were, therefore conducted in the London County Council's subway below Kingsway, where a length of straight, level track, protected from the weather and from the effects of other traffic, formed a suitable experimental ground. The cars running through this subway are of the single-deck type, seating thirty-six passengers and weighing 14½ tons empty. They are mounted on bogie trucks and are fitted with two 42 h.p motors. The trucks have steel tyres, the diameters of which are 31¾ in. and 21¾ in. on the driving and bogie wheels respectively, while the maximum speed attained is twenty miles per hour.

Experiments and Observations.

It was found that the corrugations were set up at intervals of about 2½ in. and of depths ranging from 0·004 and 0·008 in. As is well known, opinion on the Continent inclined to the theory that these corrugations were due to excessive rigidity in the foundations of the rails, or to inherent variations in the rail surface set up by the rolling action of the mills. Special care was therefore taken in these experiments to reduce vibration by the use of angle-irons or iron blocks bolted to each side of the rail web. The wooden sleepers on which the rails rested were replaced by short lengths of old rails laid crossways at intervals, the whole being concreted up to the level of the top working face of the track. As a result of six years' observation, the conclusion was arrived at that vibration has little or nothing to do with the appearance of corrugations. The origin is considered to be found in the action which occurs when the heavily loaded wheels roll along the surface of the rail. This action gives rise to superficial stresses in the rail material which are in excess of the elastic limit of the steel.

Joint Researches.

The total load on each wheel averages about two tons, but from experiments made by Mr. Beaumont on the area of contact between the wheel and the rail, it is concluded that this load gives rise to stress in the centre of the area of probably as much as fifty tons per sq. in. when the car is stationary, of some ninety tons when it is running at ordinary speeds on the straight, and of as much as 120 tons when it is rounding a curve at speed. We regret to notice that the Committee's report is stated to be final, as although it lays down with some definiteness the causes of rail corrugation, and thus makes a step forward in our knowledge of this important subject, it says little or nothing as to how these corrugations should be overcome. Continental investigations have rather proceeded in the other direction by starting with tracks where corrugations have been noticed and trying to find in their construction the method by which this expensive source of wear may be avoided. It would be as well if these two researches could be joined up and experiments undertaken that will lead to a removal of the damage.

Electrolytic Production of Magnesium.

Electrical engineers would do well to keep a close watch on the possibilities of magnesium as an industrial material. From the manufacturing point of view, it is already receiving a wide application in aeroplane construction, seeing that it is 40 per cent. lighter than aluminium and is no more susceptible to corrosion. Mechanically its properties are sufficiently attractive to make its use for transmission lines a possibility, as it can be easily worked and is handled

with facility. To the electricity supply engineer it makes another appeal. For the most economical means of producing it is by electrolytic methods, and considering that, like other such processes, it provides both a good load and a good load factor, the development of this process in areas where, for one reason or another, electrical furnaces have not yet been much employed, opens up possibilities of which the enterprising will not be slow to take advantage.

Details of the Process.

In the article which we publish on another page of this issue Mr. S. T. Allen gives some details of the electrolytic process employed by the Magnesium Co. in Wolverhampton for the manufacture of this metal. In this process magnesium chloride forms the starting point, as it occurs in nature as one of the constituents of the German salt deposits and forms a bye-product after the separation of the potassium chloride. This chloride is first rendered anhydrous by exposure to hot, dry air and dry hydrochloric acid gas. This results in the water being driven off and the magnesium oxide being converted into chloride; finally a salt with a content of over 99 per cent. magnesium chloride is obtained. The hydrochloric acid gas used for this purpose is produced by the electrolytic treatment of brine.

The Electrolytic Cell.

The anhydrous chloride is then mixed with either sodium or potassium chloride to reduce its melting point, and the mixture is treated in a gas-tight, cast-iron electrolytic cell fitted with carbon anodes. The cathode consists of a few inches of molten lead on which the electrolyte floats, the whole being kept in circulation. The electrical capacity of the cell is about 5 000 A at 5 V, and it is self-heating. It produces about 100 lb. of magnesium-lead alloy every twenty-four hours. In the second stage the magnesium-lead alloy forms the anode of a similar cell with steel rod cathodes. This is really a refining processs in which the molten lead is freed from its magnesium and returned to the first cell to be enriched. The second cell is worked in series with the primary and takes 5 000 A at 2 V. Thus about 100 lb. of magnesium is obtained every twenty-four hours for a consumption of 8·5 kWh per lb. In essence the process consists of the indirect separation of magnesium and oxygen, the chlorine produced being used for the production of more magnesium-chloride for the magnesite. The further development of the process will be watched with interest by both electricity supply engineers and electro-chemists.

The South-East Lancashire District.

The scheme put forward at the local inquiry last week for the reorganisation of electricity supply in the South-east Lancashire District possesses, in addition to the merit of simplicity, some special features which deserve more than passing notice. Next to the London area, this is probably the most important district in the United Kingdom, as it includes Manchester, Salford, Bolton, Oldham, Rochdale, Wigan, Stockport, Stalybridge, and other important towns and industrial centres. With the exception of those of the Lancashire Electric Power Company, all the large generating stations are owned by local authorities, who have with unpraiseworthy unanimity objected to the transfer of their undertakings to a Joint Electricity Authority. It has, therefore, become necessary to devise some substitute which would satisfy the individualistic views of Lancashire and at the same time co-ordinate the generation and supply of electricity in the area. After some delay and a good deal of discussion it was decided to form an Advisory Board of forty-eight members whose duty it will be to survey the sources of supply, to make recommendations for the closing of generating stations and the laying of transmission lines and to supervise in a general way the supply of electricity for power and lighting.

Weakness of Scheme.

Though the Advisory Board is said to be the only way of commanding the support of the whole of the twenty-eight supply authorities, it has two inherent sources of weakness. In the first place, it is too big to be an efficient instrument of administration, and we should prefer to see a Board of twenty or twenty-four members. However, as most of the real work will be performed by the technical committee of ten engineers, who will make recommendations to the Board, this objection may not be so serious as the absence of all compulsory or coercive powers. For the Board will have no authority to raise capital, its only reason for existence being to initiate or put forward plans of development that may be suggested by the engineering committee. It will thus have to rely upon its moral and persuasive powers to make the constituent authorities adopt its proposals. Already the majority of the undertakings in the district are linked up, and we are afraid that the new Board may not be able to do much more—perhaps even less—than the old linking-up committee, especially as each undertaking can appeal to the Electricity Commissioners against any of its decisions. It is therefore to be hoped that even at the last minute a way may be found to form a Joint Authority.

Technical Points in the Scheme.

From the technical point of view the scheme leaves little room for criticism, and it will at least effect real economies in generation and distribution. A capital expenditure of £13 000 000 would be necessary during the next ten years to meet the requirements of the individual undertakings, but by the suggested co-operation about £1 800 000 of this sum will be saved, and the average annual saving on coal and in capital charges is estimated at £103 423. The inquiry was one of the shortest yet held, and as it disclosed an agreeable spirit of goodwill and co-operation among the various local authorities, it may be that the proposed Advisory Board, if approved by the Commissioners, will be able to perform useful work for some years and so pave the way for the formation of a Joint Electricity Authority, when education and the experience of other such bodies will have rendered that course probable.

Telephones and Archæology.

An article by Mr. A. O. Gibbon, which appears in the current issue of the "Post Office Electrical Engineers' Journal," should be of interest both to electrical engineers and to archæologists. For, as already mentioned in connection with our description of the London Toll Exchange, the development of the telephone system in the metropolis has recently made the laying of additional cable ducts necessary. Work of this kind is always difficult in London, and, in this case, presented some more than usually stiff problems, especially between St. Paul's Cathedral and Fleet Street, where virgin soil was discovered within 10 ft. of the surface. Archæologists will note that foundations of old houses, which formerly stood on the site of the present roadway, were cut through and that some interesting Roman remains were also discovered and have been carefully preserved.

Overcoming Obstructions.

From the engineering point of view the obstructions that had to be overcome or circumvented in laying the ducts formed the most difficult problem. These included the main outfall sewer and the power supply mains of the Post Office, both of which had to be crossed at right angles. In general, such obstacles were avoided by gradually increasing the depths of the ducts until, at Ludgate Circus, a maximum depth of 19 ft. was reached. Here the Fleet River, which is now enclosed in a culvert, had to be crossed, and as the crown of the culvert is only 3 ft. below the surface of the roadway and the culvert itself is 24 ft. deep, it was decided to carry the cables at this point through steel pipes and to alter the formation of the ducts by spreading them out horizontally so as to make the most of the small vertical space available. At the point where the sewer empties into the Fleet River at Ludgate Circus, a specially-designed manhole with a strengthened roof was constructed, over which the sewer was carried. This manhole is the first to be built in London with the American method of splayed corners. The whole design and lay-out of the work and its conduct to a successful conclusion are matters upon which the Post Office Engineering Department and the contractors may be whole-heartedly congratulated, especially, as even their critics will admit, it has been undertaken to improve London's telephone service.

Selling Heating and Cooking Apparatus.

The third of the series of conferences which have been organised by the British Electrical Development Association to assist salesmen to market their wares was a little disappointing in its immediate appeal. The subject under discussion was "Salesmanship in Relation to Electric Heating and Cooking," and no subject should be of more importance to electrical engineers of all classes at the present time. For, as we have pointed out before, not only is the domestic field wide and mainly untilled, but the future of the electrical industry must depend increasingly on the success with which (to mix metaphors) this particular market is exploited. Yet the discussion tended to range not over the difficulties of salesmen and salesmanship and how these may be overcome, but over the disadvantages and shortcomings of electrical apparatus as reflected by each particular speaker's inner consciousness. This was not the opener's (Mr. W. A. Gillott) fault, for he summarised concisely and clearly the points which every salesman should keep ever in view. Especially he emphasised the need for psychology and tact of the special brands that are called into play when dealing with the non-technical and feminine public. We like particularly the idea that mistresses should be dealt with *via* the cook and masters *via* the mistress. Mr. Downe, an he would, could tell us a good deal about the success of this policy.

A Curious Lack of Enthusiasm.

One speaker, in the course of the discussion, pointed out that the real obstacle to the increased sale of domestic electrical apparatus was the lack of enthusiasm of its potentialities that persisted in electrical circles. This, in our view, exposes the sore which is infecting the whole body. The fact is that many electrical engineers have reached a stage in their domestic electrical education when discouragement has set in. Golfers know this stage well. It follows a beginning when every stroke is easy and the Amateur Championship appears within grasp. It is followed by the stage when balls vanish into hazards and broken clubs are consumed on a funeral pyre. But that stage passes too, and we hope it will soon pass with electrical engineers. Much of the old domestic apparatus was bad and many mistakes were made in its use. Apparatus is a good deal better at present, and it will be better still; and we are learning a great deal about how it should be used. Electricity supply engineers, too, must take courage and reduce their charges, as is already being done, notably by the Westminster Electricity Supply Corporation and by some of the large provincial supply authorities. Hiring schemes must be initiated and popularised. Then enthusiasm and cheapness will be most useful aids to good salesmanship.

Electrical v. Mechanical Engineers.

In our correspondence columns to-day we publish a letter to which we draw attention mainly in order that the views its writer expresses shall not obscure an important issue. A fortnight ago we said that to place the chief electrical engineer of an important railway under the chief mechanical engineer was a retrograde step. Our correspondent claims that it is equally retrograde to place the management of an electricity supply undertaking under a mechanical engineer. The two cases, however, are not on all fours. In an electricity supply undertaking the mechanical side is as important as the electrical side; indeed, in a large undertaking at the present time it may easily be more important. Again, the principal duty of the chief of a supply undertaking is to sell electricity as cheaply and efficiently as possible, and as long as he does that it does not matter whether his own bias or that of his staff is electrical or mechanical. For, unless he is a fool, he will do nothing that will check development along the most modern lines. In fact, his chief concern must be with questions of policy and management rather than with engineering details.

A Question for the Institution.

On a railway matters are far different. There are two warring factions. One led by the mechanical engineer, who hopes, though there are exceptions, that it may still by hard work and enterprise be possible to postpone the evil day when electric traction will be introduced. The other, led by the electrical engineer, who knows the advantages of electric traction and only asks to be allowed to prove them. It is obvious, it is against human nature, that the electrical engineer will not have that free hand if he is placed under the mechanical engineer. We reiterate that this is not a matter of personality, but of policy. Further, so important do we consider it in its bearings on the future of electric traction, that we feel it is a matter which the Institution of Electrical Engineers should take up without delay. They could not better signalise the grant of the Royal Charter.

Electric Lighting Developments.

It is common knowledge that during the war invention and discovery in the lighting field, as in many others, were checked or diverted into other channels. During this period, and indeed for some time after the Armistice, manufacturers were obliged to concentrate their efforts on meeting demands for standard articles. But they have now succeeded in making up arrears, and it seems likely that once again invention and discovery will come into their own. At least this should be the case if experience after the Napoleonic War is anything to go by, while the much more highly developed facilities for research at the present day suggest that, once the movement gets into its stride, progress will be rapid.

Small Discharge Lamps.

Perhaps the most striking development during 1921 was the introduction of the small "discharge" lamps, whose operation is based on the luminescence of neon gas in an ordinary lamp bulb. These lamps are capable of being inserted direct into a holder on a 200 to 240 V supply, and although their low efficiency at present prevents their having any important influence on lighting as a whole, they will doubtless be useful for such special purposes as pilot lamps, indicators, night-lights and luminous signs, while the method is probably capable of considerable development. Interesting speculations on this point are aroused by a recent Paper read in the United States by Mr. D. MacFarlane Moore, who has used the discharge through neon to start an arc between tungsten electrodes, within a sealed glass envelope, thus obtaining a relatively efficient source. Various other experiments with lamps using rare gases have been made on the Continent with more or less success, and it is possible that out of these investigations something useful may be evolved. Among other developments perhaps the most noteworthy is the increased attention paid to methods of producing "artificial daylight." The problem of imitating daylight is now much better understood, and such sources appear to have a future in connection with processes where the correct appearance of colours is vital.

Illuminated Signs.

There have also been interesting developments in connection with illuminated signs, especially those of the pictorial variety, and the range of reflectors and other appliances for the distribution of light has been considerably extended. In this connection it is probable that flood-lighting methods, i.e., the use of projectors equipped with gasfilled lamps to illuminate the surfaces of buildings and other large areas will make progress in this country as soon as the improvement in the industrial position encourages the use of spectacular lighting. The recent application of flood lighting to Selfridge's premises in London is interesting, but these methods are, of course, familiar in the United States.

The Judicious Use of Light.

The most hopeful feature in the lighting world during recent years has undoubtedly been the steady progress, aided by the propaganda of the Illuminating Engineering Society, towards more judicious methods of using light. While it is still true that many instances of glare arising from the use of unscreened gasfilled lamps in show windows exist, it is noticeable that the leading stores of London have almost invariably adopted concealed methods. In many cases their windows are now lighted in a creditable and artistic manner. London, however, is in advance of the provinces in this respect, and there is much room for further educational effort. Speaking generally, it may be said that facility in the production of light has as yet somewhat outrun knowledge as to the best way of using it, but it is encouraging to see how much better the principles of good illumination are appreciated among technical men. Various aspects of lighting have been dealt with in official reports recently, notably the second interim report of the Departmental Committee on Lighting in Factories and Workshops. It is to be hoped that the views expressed in such reports will in course of time penetrate to the lowest strata of technical knowledge.

Taxation and Trade Revival.

Opinion on the subject of taxation, in both engineering and more purely electrical circles, is hardening. We, as an industry, should soon be in a position to impose our views, through the proper channels, on those whose business it is to regulate these matters and to indicate in the most definite way the fact, learnt by hard experience, that nothing is impeding the long-looked-for trade revival more than the burden of taxation. There will be those who argue that unemployment and economy are both more important. But unemployment (and trade unions leaders and employers who meet their work people over the council table would do well to emphasise this) can only be relieved by more trade, and more trade depends, to a large extent, on the wider facilities that lower taxation would give. Economy, in the true sense, follows as a matter of course. For to spend, not recklessly but wisely, and to save, not like a miser but in order to be able to develop industry, are two ways of reviving trade which are impossible of application under present conditions.

Waste Heat Utilisation.

The policy recently adopted by the Institution of Electrical Engineers, of arranging joint meetings with other technical bodies at which "fringe" subjects are discussed, is worthy of commendation. Such meetings have already taken place with the Institution of Gas Engineers and with the Electro-Therapeutic Section of the Royal Society of Medicine and the Rontgen Society. These gatherings were most successful, and though the success that attended the joint meeting with the Institution of Heating and Ventilating Engineers last week was not quite so great, yet there is, we hope, every prospect of there being a "next time," when our congratulations on the proceedings will be whole-hearted. It is not hard to justify this optimism. For such meetings enable the views of those working in other fields to be laid before the Institution, and, similarly, enable the views of electrical engineers to be published in technical circles which are as yet unelectrified.

The Need of Universal Effort.

The subject discussed at the meeting to which we have referred was "The Utilisation of Waste Heat from Electrical Generating Stations." It was opened on behalf of the heating engineers by Mr. C. Ingham Haden, and on behalf of the electrical engineers by Mr. F. H. Whysall. Their arguments will be found summarised on another page of this issue. This matter is one on which the close union of all bodies concerned is necessary. We agree with Mr. Barker that the efforts of all sections of engineers should be directed towards improving our methods of using coal. The need for this, if not already obvious, was well brought out at the meeting last week. For some of the views expressed by the heating engineers on electrical matters were, to put it mildly, out of date. The idea, for instance, seems to be still prevalent that our generating stations are mainly concerned with a lighting load.

The Necessity for an Open Mind.

Unlike certain matters which have been raised at other joint meetings, this question of the utilisation of waste heat is one upon which electrical engineers have, and would do well to keep, an open mind. We, all of us, with Mr. Whysall, "deplore the fact that so much of the heat value of fuel is rejected to the condenser, where steam is the source of energy for the prime mover" in generating stations, and for many reasons we have recently not been inactive in a search for methods which shall allow this waste heat to be utilised in some way or other. Alternatively, efforts are being made to discover means for employing the heat content of the fuel more efficiently, so that a greater proportion may be used in the prime movers

themselves. The results of these efforts are one of the things about which Mr. Haden, for instance, does not seem to have heard. We have no reason to suppose that a great deal of good will not come from researches along both these lines, and that, in the limit, economies in the power house, with obvious added advantages in the spheres of distribution and finance, will result.

A Note of Warning.

But in this connection a note of warning must be uttered. The generation of electricity, inefficient as it is in some critics' view, might easily be made more inefficient by the adoption of methods which, though theoretically attractive, leave both the financial and heat balance-sheets little, if any, better off than they were before. Such a distinction without a difference would, we cannot help feeling, be the result of the adoption of Mr. Haden's scheme for improvement. Briefly, Mr. Haden would convert some of the existing generating stations, which would otherwise be shut down under the "super-station" scheme, into heat distribution stations, generating electricity as a bye-product and linking up such stations with the super-stations, to supply any surplus electrical load. The result would obviously be a decrease in efficiency on the generating side, but this decrease, in Mr. Haden's opinion, would be more than counterbalanced, both thermally and financially, by the advantages obtained from the distribution of heat in the form of steam to neighbouring houses, offices, flats and factories.

Which is the Bye-Product?

It will be seen that this scheme differs essentially from those that have been put forward at various times, notably by Mr. W. M. Selvey and Mr. Julius Frith, and from that which is in successful operation in Manchester and in certain cities in the United States. In Manchester electricity is the main, and heat the bye, product, and in the United States the heat stations are generally separate from those generating electricity. In Mr. Haden's scheme heat is the main, and electricity the bye, product. Mr. Haden supports his views with a wealth of ingenious argument, but, nevertheless, fails to cover up its essential fallaciousness. In a station which, as it is to be discarded, is already generating electricity uneconomically, arrangements are to be made to render the generation still more uneconomical (this must be done to supply the principal heat load), while the capital station is only to be used for supplying such electrical requirements as cannot be dealt with locally. Mr. Haden has, in fact, taken the usual argument in favour of the large station supplying a wide area—the better load and diversity factors possible, and the savings made by using large units under the best conditions—badly shaken it, and then stood it on its head. Whether it looks better after having been heated and ventilated in this way we are rather inclined to doubt. He also seems to have forgotten that, though in domestic areas heat is more in demand than power, in industrial areas the reverse is the case. In fact, we very much prefer Mr. Whysall's method of attacking the problem.

Heat as the Bye-Product.

Mr. Whysall starts from the electrical end. Given a station that under present conditions is as efficient as possible, how can that efficiency be improved? By discovering the conditions under which, without unduly decreasing the efficiency of the electrical plant (some decrease is inevitable), waste heat may be supplied to factories and other buildings within one and a half miles of the station, with mutual benefit to each. Owing to the large amount of steam provided by, say, a 750 kW set, to work on these lines requires that the plant employed shall run at 100 per cent. electrical load factor. Even under these conditions the financial results are probably no better than with energy supplied from a large central station, while the fact that the provision of a load factor of 100 per cent. on the plant supplying exhaust steam for heating purposes is effected at the expense of the load factor at the main power station must be taken into consideration when comparing results.

The Great Distribution Problem.

Economical and practical difficulties do not, however, cease with generation. There remains, especially for the heat engineer, the great problem of distribution. Mr. Haden proposes to distribute heat energy in the form of steam at the pressure of 60 lbs. per sq. in., and also in the form of hot water. It is not clear to what limiting radius from the station he thinks it would be possible to do this, and there is, indeed, a good deal of difference of opinion on this point. Mr. Selvey, in his scheme for hot-water distribution, put the maximum distance as four miles. Mr. Whysall talks about one and a half miles. In Detroit, according to Mr. Patchell, it is horizontally less than two and a half miles, though it could probably be more.

The Cost of Steam Transmission.

With steam the distance might be greater, but, in any event a suitably lagged main of a size unspecified by the author would be required, and the cost of laying this would be, according to Mr. Haden, £17 800 per mile. Both he and Mr. Whysall are a little fearful of the disturbance to the streets which would be caused by these, and Mr. Patchell's accounts of the space required for such a service in Detroit is not likely to allay their anxiety. Mr. Haden suggested that mains should be taken through the basements of the premises to be supplied, as has, in fact, been done at Manchester, where a successful scheme has been working for some time in the area adjacent to Dickenson-street station. But in any event the cost and inconvenience of the inevitable disturbance might well more than counteract the financial advantages of the steam main compared with the electric cable, even when we take into account that the energy supplied through the latter can be employed for all purposes, while the use of the steam is limited.

Too Great Ambition.

In our view, Mr. Haden's ideas on this subject are too ambitious. There are cases where the waste heat from generating stations can be, and is being, successfully utilised in the way he has described. But each such case must be judged on its merits by, as he rightly says, heating engineers and electrical engineers in combination. There can, we feel, be no general solution on the lines he suggests. Attempts to find such a solution might easily bring more disadvantages than advantages in their train, and, unless a careful balance between heat and electricity supply can always be assured, lead to a modern variant of Lamb's famous parable about burning houses and roast pigs.

If the discussion, which was unfortunately both nebulous and wandering, does nothing else, it will, we hope, indicate that present methods of generating electricity are not so economical as they might and should be, and that other people besides electrical engineers are quite aware of the fact. It follows that it is the duty of all electricity supply engineers to employ all methods which will lead to more efficient working, and especially to concentrate their efforts on the boiler-house end of the problem.

The Production of Metallic Magnesium.

The Electrolytic Process of the Magnesium Company.

By S. T. ALLEN,
(Chief Engineer and General Manager, Wolverhampton Electricity Department).

Magnesium is becoming of increasing importance as a constructional material. Its manufacture by electrolytic methods is of interest to the electricity supply engineer, as this provides a good load at a good load factor. Mr. Allen describes in detail the process devised by the Magnesium Company for the production of this metal on a commercial scale.

The importance of magnesium metal has greatly increased during the last few years, because of its present value and future possibilities in connection with the alloying of other non-ferrous metals, where extreme lightness and high strength are required, such as in the building of airships and aeroplanes, and also because of its properties as a deoxidiser of other metals.

Magnesium is 40 per cent. lighter than aluminium, and, when pure, is no more susceptible to atmospheric corrosion than is aluminium. Thus, given production as cheap as aluminium, which the Magnesium Company state is a possibility, and provided that there is a corresponding demand, the uses in the future of this beautiful metal will certainly multiply. Its production will therefore be watched with considerable interest.

A High Load Factor Supply.

The intention of this article is more especially to describe the new electrolytic process developed in Wolverhampton by the Magnesium Company, which is already creating a considerable amount of interest throughout the world. It is of special interest to the electricity supply engineer, as it is a continuous process, making for a very high load factor supply.

The only two compounds of magnesium which occur abundantly in nature are the carbonate and chloride; the choice of the raw material for the production of the metal is accordingly limited to one or other of these compounds. Magnesite, the carbonate, is found in varying states of purity in all parts of the world. There are no deposits of pure magnesite in the United Kingdom, but large quantities occur as dolomite, the double carbonate of magnesium and calcium, from which pure carbonate of magnesium can be separated by simple processes. Magnesium chloride occurs in nature as one of the constituents of the German salt deposits. The separation of potassium chloride from these deposits involves the production of huge quantities of magnesium chloride. Magnesium chloride also occurs in sea water, and is a product of its evaporation for the production of salt. Either of these two compounds can be used as raw material, the choice being influenced by the cost of freight and the means available to the manufacturer for the disposal of his by-products.

Suggested Processes.

The processes which have been proposed or used for the production of magnesium may be placed under three headings:—(1) Thermal processes; (2) substitution processes; and (3) direct electrolytic processes. In the first the oxide of magnesium is reduced by carbon at a temperature well within the range of the electric furnace. The metal is produced as vapour, which may be condensed. This process has been tried on a considerable scale, but great difficulties were encountered in attempts to produce coherent metal from the finely divided material which resulted from the condensation. In the second process magnesium has been produced experimentally by the reduction of magnesium oxide with aluminium. Unlike the well-known "Thermit" reactions, the reaction between magnesium oxide and aluminium is endothermic, and heat must be supplied. In the third process magnesium chloride is also readily reduced by metallic sodium, and at first sight this might appear to be an economic method of manufacture. To obtain satisfactory yields the magnesium chloride must be anhydrous, and as anhydrous magnesium chloride can be electrolysed for the direct production of magnesium, reduction with sodium can only be economical if the sodium electrolytic cell shows a higher efficiency than the magnesium electrolytic cell.

The Choice of Electrolyte.

The choice of the electrolyte for the production of the metal by direct electrolysis is for practical purposes limited to the chloride and the fluoride, although claims have been made for the electrolysis of magnesium oxide in a bath of fused magnesium fluoride following the lines of the ordinary aluminium process. Electrolysis of the fused sulphide has also been proposed, but it is safe to say that all the magnesium for the market is produced by electrolysis of the chloride in a state of fusion with or without the admixture of potassium and sodium chlorides.

Preparation of Anhydrous Magnesium Chloride.

The Magnesium Company are interested in two processes for the production of anhydrous magnesium chloride, in one of which the chloride is produced by the action of chlorine on magnesium oxide, and in the other water is removed from magnesium chloride crystals.

In the presence of carbon chlorine reacts with magnesium oxide, producing magnesium chloride and carbon monoxide. With pure materials the temperature at which this reaction is complete is uncommercially high. Compounds of iron act as chlorine carriers or catalysts of this reaction, and enable it to proceed to completion at a reasonable temperature. During the war large quantities of anhydrous magnesium chloride were made by this process, and subsequently reduced to the metal. The complete dehydration of magnesium chloride crystals is not a simple matter, and has been made the subject of a large number of patents.

Details of the Process.

The following is a brief description of the process employed by the Magnesium Company:—

The crystals of magnesium chloride, after passing through a hydro extractor to remove adhering water, are exposed for several hours to a current of dry air at a temperature of about 150°C. Half the combined water is thus removed with a small decomposition of the magnesium chloride, the product having the composition:—$MgCl_2$, 73·0 per cent.; MgO, 4·0 per cent.; and H_2O, 23·0 per cent.

The partially dried material is now exposed to a current of dry hydrochloric acid gas at a temperature of about 300°C. The remainder of the water is removed, the magnesium oxide is converted into magnesium chloride, and a product showing over 99 per cent. of magnesium chloride results. As the temperature of fusion is never reached during the drying process, the crystals retain their original form, and in consequence the product is very easy to handle. The hydrochloric acid gas used in the drying process is produced by direct combination of hydrogen and chlorine, resulting from the electrolysis of brine.

Electrolytic Arrangements.

As the melting point of anhydrous magnesium chloride, 750°C., is above the economical temperature for electrolysis, sodium or potassium chloride, or both, are added to the anhydrous magnesium chloride to produce the electrolyte. Molten magnesium floats on the surface of this electrolyte, and consequently a simple cell of the form used in the manufacture of aluminium cannot be employed. Such a cell would have to be fitted with permeable diaphragms in order to keep the chlorine out of contact with the magnesium. These diaphragms are a constant source of trouble

and expense, and, further, they tend to reduce the energy efficiency of the cell. This difficulty has been got over by the Magnesium Company, by conducting the electrolysis in two stages.

Stage 1.—The cell, which is of cast steel lined with fire-brick, is fitted with a gas-tight cast-iron cover which carries the graphite anodes. These have suitable openings for the discharge of the chlorine gas and the removal of the electrolyte. The cell is charged to the depth of a few inches with molten lead, which forms the cathode. On the surface of the lead cathode floats a 1 in. layer of the electrolyte, into which dip the ends of the graphite anodes. The gap between anodes and cathode surface is about $\frac{3}{4}$ in.

Circulation of Electrolyte.

Means are provided for the circulation both of the electrolyte and the liquid lead cathode. The cell has a capacity of 5 000 A, at a cathode current density of about 1 500 A per sq. foot, and a terminal voltage drop of about 5 V. Under these conditions the cell is self-heating, and produces about 100 lb. of Mg. per twenty-four hours in the form of an alloy with lead, with an ampere efficiency of approximately 85 per cent.

Stage 2.—The cell used in this stage is similar to that used in Stage 1, except that the magnesium lead alloy produced in Stage 1 forms the molten anode, while the cathode consists of a large number of small diameter steel rods immersed to a small depth in the electrolyte, which has the same composition as that used in Stage 1. Suitable means are provided for the removal of the molten magnesium as it is produced.

It will be realised that this part of the process really consists in the electrolytic refining of impure magnesium. Means are provided to circulate the magnesium lead alloy, which, as it becomes depleted of magnesium, is returned to Stage 1 to be enriched. The secondary cell, which is worked in series with the primary, operates on 5 000 A at 2 V. It will be seen that the total energy consumption for 100 lb. of magnesium per twenty-four hours amounts to 8·5 kWh per lb. of metal produced, giving an energy efficiency approaching 40 per cent. Given pure magnesium chloride, such as is produced by the processes already described, the cells operate with remarkable smoothness, and require little attention, save for the changing of the electrolyte and the removal of the metal.

Chlorine Disposal.

The disposal of the chlorine from processes of this type, especially when worked on a comparatively small scale, is always a matter of some trouble. The process adopted by the Magnesium Company overcomes this difficulty in a neat and economical manner. The chlorine is aspirated from the cells, and is brought into contact in a series of scrubbing towers with milk of magnesium, produced by suspending the ordinary calcined magnesia of commerce in water. The chlorine is absorbed by the magnesia, and a solution is produced containing magnesium chloride and magnesium chlorate in the proportion of five molecules to one.

This solution is concentrated to such a strength that, on cooling, half the contents of magnesium chloride separate as crystals. Potassium chloride is added to the mother liquors in quantity equivalent to the magnesium chlorate present. Potassium chlorate crystallises out practically quantitatively; it is washed and recrystallised, and is then ready for the market. The mother liquors from the potassium chlorate crystallisation are returned to the system, and are concentrated so as eventually to yield all their magnesium chloride as crystals. The potassium chlorate forms a valuable by-product; but, if for any reason it is undesirable to produce it, advantage may be taken of the well-known reaction whereby, when chlorine is passed into milk of magnesia in the presence of a catalyst, such, for example, as nickel oxide, magnesium chloride only is produced and oxygen liberated.

A Cyclic Operation.

It will be realised from the above description that the process forms a complete cycle, and really consists in the indirect separation of magnesium and oxygen, in that, apart from the production of the by-product, potassium chloride, the only raw material is magnesite. The chlorine is being continually separated from the magnesium in the electrolysis, and the same chlorine continually used for the production of more magnesium chloride from magnesite.

The magnesium produced is, as would be expected, of remarkable purity (over 99·5 per cent), and it is interesting in this connection to note that metal of this purity may be melted in open vessels without risk of its firing.

Properties of Magnesium.

To repeat what has been previously stated, there is no doubt that magnesium, either alone or in alloys, has big possibilities. It is 40 per cent. lighter than aluminium, and, when pure, is no more susceptible to atmospheric corrosion than is aluminium. It can be rolled and extruded. As a deoxidiser of other metals it is unrivalled, and its use in this direction is continually extending. It is a minor constituent of many valuable alloys. Alloys in which magnesium is the major constituent are already in use in cases where combined lightness and strength are desirable. Given a corresponding demand, there is nothing to prevent magnesium being put upon the market at the same price as aluminium.

The writer is indebted to the Magnesium Company for the details describing their process and the many interesting interactions connected therewith.

Armature Winding and Motor Repair.*

Of late years, there has been a tendency to reduce to order and to codify the manifold methods used in electrical repair shops—a tendency which is the logical sequence of the development and growing importance of electrical machinery. The present volume is a noteworthy attempt to provide electricians and repairers with such knowledge as will enable them to locate quickly and surely and to remedy effectively faults in motors and generators. The author is the joint editor of the "Electrical World," and, in addition to drawing on his own experience, he makes ample use of information relating to the experience of others.

At the outset, the different types of armature windings used in continuous- and alternating-current machines are described, and the importance of making parallel circuits symmetrical is emphasised. Then follows a long section on repair-shop methods for rewinding continuous-current armatures, instructions being given for the various cases that arise. The chapter on testing continuous-current armatures for faults is well written. The various kinds of insulating materials and varnishes and their uses are discussed at length, and much valuable information of a practical nature is given. Repair-shop methods for rewinding alternating-current machines, and for testing induction motors for faults, are followed by chapters on the adaptation of continuous- and alternating-current motors to changed conditions.

Criticism, but Not Disagreement.

Very important matters are also dealt with in the latter portion of the book, e.g., commutator repairs, adjusting brushes and correcting brush troubles, inspecting, costing, overhauling, diagnosis of motor and generator troubles; while numerous methods that have been devised to solve special troubles are collected. Finally, there is a chapter on the equipment needed in a repair-shop, and an appendix, containing data and reference tables. Here and there are points which might well have been criticised, but there is very little with which we should seriously disagree. The book is well written, well illustrated, and well arranged. There is ample scope for it, and it can be heartily recommended to all who have to do with the repair and upkeep of electrical machines.

* Armature Winding and Motor Repair. By D. H. Braymer. (London: Hill Publishing Company). Pp. xxi. + 515. 18s. net.

THE UTILISATION OF WASTE HEAT IN GENERATING STATIONS*

We give below an account of two Papers which were read before a Joint Meeting of the Institution of Electrical Engineers and the Institution of Heating and Ventilating Engineers on Thursday, January 19th. The first, by Mr. C. Ingham Haden, suggests the combination of heat distribution in the form of steam or hot water with electrical generation so as to utilise our fuel resources to better advantage than at present. This would be effected by converting generating stations, which would otherwise be discarded, into heat stations. The second, by Mr. F. H. Whysall deals with the practical and economic difficulties of any such scheme.

The Utilisation of Exhaust Steam from Electrical Generating Stations and Coal Economy.

By C. INGHAM HADEN.

If we express the calorific value of coal as 100 per cent. the average thermal efficiency obtained from it when used for domestic purposes is 50 per cent. The number of British thermal units in coal converted into electrical energy is approximately 5 per cent., though it is hoped with the new large stations to improve this figure to 8 per cent. With the most up-to-date boiler plant it is claimed that an efficiency of 80 per cent. is obtained from the coal so that, assuming the calorific value of the coal to be 14 000 B.Th.U.,

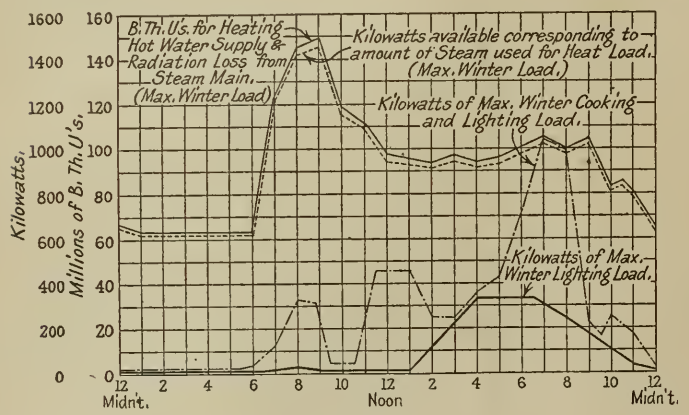

FIG. 1.

20 per cent. to be lost in the boiler, and 90 per cent. of the remainder in the generating plant, out of a total of 14 000 B.Th.U. only 1 120 B.Th.U. are converted into electrical energy.

Taking the approximate fuel consumption in generating stations in this country as 10 000 000 tons per annum, the huge total of 9 200 000 tons represents the approximate value of wasted heat. In addition, in most generating stations condensing plant is employed with cooling towers, and the circulating water is supplied by electrically driven pumps, which absorb a considerable percentage of the current generated. Large fans are also used to blow away the heat from the cooling towers, and the water lost in vapour is another expense which has to be met.

How Can Waste be Reduced?

These facts and figures being assumed correct, the question is, can nothing be done to lessen this waste? This is a difficult problem, but its complexity should not prevent an attempt being made to deal with it. The first main difficulty is to find a market for the heat, though there is the further difficulty of co-ordinating the loads, as heat for warming is only required for six or seven months in the year, and, even during this period, the load will vary tremendously. There is, however, a constant demand for hot water, but the possibility of utilising heat depends very largely upon the position of the generating station in relation to that of buildings requiring heat or hot water, and the amount of the cost of transmitting heat to any great distance.

Electricity a Wasteful Form of Heat.

In spite of the convenience, cleanliness and adaptability of electricity supply and its lower transmission losses, it has already been shown that it is a most wasteful form of heating and quite impossible if coal is to be conserved. The combination of heat distribution with the generation of electricity would give a higher heat efficiency than any other arrangement.

The positions chosen for super stations are close to some waterway, it being considered more necessary to have water for condensing purposes than to be near a coal mine. But no scheme can be considered complete which does not make some provision for the utilisation of waste heat. The scheme also involves the scrapping of many of the existing generating stations, which seems a most calamitous proposition. A possible alternative is to retain such of the existing stations as can be usefully employed as heat distribution stations—utilise them to their fullest capacity, and, if there is a greater demand for heat, then provide additional heat stations, using them also for generating current as a by-product. In this case either a part of the generating plant can be altered to exhaust at a pressure of 60 lbs. per sq. inch, or new plant could be specially designed to meet these new conditions.

Some generating stations in London and in the United Kingdom are extremely well situated for heat distribution, and if, especially in London, the difficulty of fuel delivery is given as a reason for shutting them down, it must be replied that coal has to be delivered to every house or block of buildings in the district, and that this need would be largely eliminated if the system suggested were installed.

By linking these stations up with the super stations, the balance of the electrical load would be made up by the latter. This arrangement makes it possible to provide for a varying heat load and to bring into commission a larger proportion of the plant of the super station during the summer, when the minimum heat load would occur.

The Adaptation of Existing Plant.

Assuming there is a demand for heat in the neighbourhood of an existing generating station, the question arises, can the existing plant be adapted to meet both circumstances? It is, of course, clear that the utilisation of exhaust steam considerably reduces the electrical output, and would therefore involve putting into commission additional plant, and so increasing the fuel consumption and adding to the total cost of production. Against this added cost would have to be set the income from the sale of heat and the economies obtainable by using existing stations for supplying the heat load from the present boiler plant. This would involve the discarding of the condensing plant, and the electrical output would become a by-product. The price charged for the steam supply would be calculated not only upon its actual cost at the station, but also upon the cost of its distribution to the consumers. This would vary according to the distance to which the supply was taken, and should also be subject to any rise or fall in the price of coal.

Heat Requirements.

The heat requirements of a district, of course, vary. In a residential neighbourhood the heat load would be more constant, and included therewith would be the steam for hot-water supply. The maximum demand for this would occur in the morning, with a

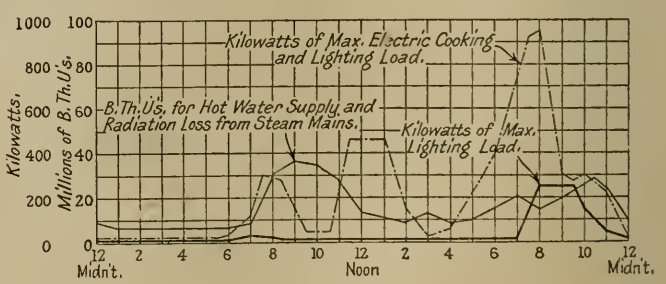

FIG. 2.

lower load in the afternoon, and an increased load again in the evening. Assuming the heat load indicated in Fig. 1 is for a complete day of twenty-four hours, the dotted line across gives the approximate rate of electrical output from generators designed to meet the working conditions, while the assumed lighting load (shown chain dotted) indicates that during certain hours of the day there is a considerable surplus of electrical energy available for other purposes. The lighting plus cooking load is also shown, and it will be noted that the possible electrical output from the heating and hot-water service loads covers the demand for lighting and cooking.

The Effect of the Heating Load.

Fig. 2 shows an assumed summer demand for hot-water supply, lighting and cooking, and it will be seen that the omission of th

* Abstract of Papers read before a Joint Meeting of the Institution of Electrical Engineers and the Institution of Heating and Ventilating Engineers.

heating load makes a great difference. Proportionately also the electrical output is much less, so that, although the lighting load is so small, when the cooking demand is added thereto the peak periods are above the line of the electrical output from the hot-water supply. In other words, if electric cooking were used to the extent shown in the curves there would be three periods per day when all the exhaust steam could not be utilised. It might be possible to provide some form of thermal storage to use the exhaust for the period if there were a large local demand for hot water.

The Utilisation of Waste Heat from Electrical Generating Stations.

By F. H. WHYSALL.

The majority of electrical engineers responsible for the operation of power stations for electricity supply deplore the fact that so much of the heat value of fuel is rejected to the condenser where steam is the source of energy for the prime mover. It has been suggested that special efforts should be made by supply authorities to surround their power stations with industries such as paper-making and sugar-refining, in order that they may sell their exhaust steam for use in industrial processes. Theoretically and thermally no fault can be found with this proposal, but it is when we come to the practical difficulties that doubts arise. In the first place, most of the undertakings with processes suitable for co-operation with this kind of power station are established in special districts. In many cases this difficulty can be overcome, on account of the ease with which electrical energy can be transmitted, and the discussion of this subject should follow the lines of putting forward commercial terms for the co-operation of steam-using industries with the supply authority so that the two may mutually benefit.

The problem is, where steam is required for heating or industrial processes within a radius of $1\frac{1}{2}$ miles of an electric power station, how can it be supplied from the power station with benefit both to the power station and to the consumer of exhaust steam? what are the conditions under which this supply should be given? and what are the commercial arrangements necessary between the parties to ensure mutual satisfaction? The commercial arrangements are the most difficult part of these proposals and, after they have been settled by agreement on some generally accepted scale of charges, we may expect a very great saving in fuel.

Steam Tariffs.

With regard to the charges to be made for exhaust steam, with coal at 10s. the proper charge would be 10d. per 1 000 lb. where the condensate is recovered by the supply authority and the distance is not more than one mile from the power station. For the supply of electrical energy as a by-product from an industrial works making a large use of steam, in order to make the arrangement a success it is necessary to allow the supply to be given when available, and this is equivalent to providing the waste-heat plant with a load factor of 100 per cent. The proper charge for a supply of this kind is 0·1d. less than the fuel cost of the supply authority for this load factor.

The chief point to bear in mind in working out the details of any such proposal is that the benefits should be equally divided between the parties under all the varying conditions likely to obtain in actual practice.

With regard to the supply of exhaust steam from a power station for heating purposes, each case must be considered on its merits. The heat available for transformation into electrical energy depends upon the temperature limits and, if the lower limit is raised to serve another purpose, the economy of generation must suffer accordingly. It is necessary to regard electrical energy as a by-product in this case and, in order to get the most economical results, the back pressure must be kept as low as possible, a maximum of 2 lb. (gauge pressure) being aimed at. This means that the exhaust-steam supply pipes and the calorifiers for the heating systems must be of such dimensions that this pressure is not exceeded. In agreements for supply, a back pressure of $\frac{1}{2}$ lb. per sq. in. at the consumer's premises should be specified. The engine unit must be of a size suited to supply the exhaust steam required for heating purposes when working under full-load conditions.

The Effect of Load Factor on Steam Supply.

The friction load of a 750 kW set is often equivalent to 5 000 lb. of steam per hour, and it is a very large building that will take more than this quantity. It is seen, therefore, that unless the 100 per cent. electrical load factor can be given to the sets used, there is very little profit on the arrangement. Where the heating load is small, an alternative is to "bleed" the turbine or to take off a supply from the receiver between the cylinders of a compound reciprocating engine, the remainder of the steam going to the condenser in each case. It is doubtful, however, in these cases if the electrical energy is generated more cheaply than it would be by a large modern electricity generating station using 11 to 12 lb. per kWh, and the fact that the provision of a load factor of 100 per cent. to the plant supplying exhaust steam for heating purposes is effected at the expense of the load factor at the main power station must be taken into consideration when comparing results.

The Finance of Distribution.

There is also the expenditure on the steam-distributing mains. It is a difficult matter to find room for steam mains which need to be of special design in order to prevent excessive radiation losses. These difficulties can, however, be overcome by an enthusiastic engineer, and wayleaves can be found most readily through the basement premises of buildings *en route*, the proprietors of these premises being induced in most cases to take a supply. The supply of exhaust steam for heating purposes is invariably most satisfactory to the consumer and the demand is generally ahead of the facilities for supply.

It is said that combined stations in America have been abandoned in many cases in favour of a separate central station for the supply of steam for heating purposes only, but this does not necessarily prove that there are not many cases where a properly organised system of collaboration between existing electric supply stations and heating consumers in congested city areas should not be profitable to both parties. It is my opinion that electricity supply authorities cannot afford to ignore the demand for exhaust steam or the possibility of obtaining cheaper supplies of surplus energy from generating stations established in works using low-pressure steam for industrial purposes, and every endeavour should be made by central station engineers to make collaboration a commercial success.

Enamelled Wire *and* Enamelled Wire.

By A SPECIALIST.

Just as there are men *and* men, so there is enamelled wire *and* enamelled wire, and one might say with equal truth in both cases the former is in the majority! Unfortunately, too, the nomenclature alone does not indicate in what class they stand. Every adult male human in the former case, and all black or brown (oxidised) covered conductor in the latter case, claim a common unclassifying appellation.

Non-British Wire for British Conditions.

As an early and persistent believer in the utility of enamelled wire, I view with real concern the flooding of our English markets from abroad with a material the major part of which, to say the best for it, is suitable for use only in cases where conditions are favourable, and reliability is not a serious factor. Unfortunately again, some of our home manufacturers are sacrificing the hitherto high quality of their product in an unwise attempt to compete with a material which will, in time, certainly be appraised at its true value. The uses of enamelled wire have, in the opinion of an eminent engineer with whom I was once discussing the question, "not been scratched," but the manufacturer must look to it that a suitable quality is maintained, otherwise he may find that enamelled wire has itself been "scratched."

The hand of the home manufacturer has perhaps been forced, and he is to blame only in so far as he is making little attempt to encourage the user to exercise some discrimination in his purchases. When one buys eggs, it is elementary economics to state one's needs—new-laid, fresh or cooking—*and to pay accordingly*; yet, incredible as it may appear, buyers of enamelled wire in nine cases out of ten ask simply for a quotation for the particular size or sizes required which, when received, is considered solely on the price. Could one but trace them, innumerable cases of ultimate trouble and expense (not to mention damaged reputations) could be found to have their root in this difference between the buyer of eggs and the buyer of enamelled wire.

The Buyer's Duty.

It must be recognised that there is good enamelled wire and there is bad. In some cases it is imperative that the very best be secured, while in other cases, such as in the production of cheap bells, indicators and like competitive lines, the quality is of less importance. It is certainly the buyer's duty to insist upon a high-grade wire whenever a high-class instrument is to be produced. If he will persist in his cheese-paring in regard to the cost, comparing his quotation from goodness knows where with the quotation from a reputable firm, then he must drive the latter from the market, or worse still, compel him to join the ranks of the purveyor of "cooking eggs."

Wire and Magneto Construction.

As a glaring instance of a penny wise and a pound foolish take as an example the construction of a magneto. As is well known, the English manufacturer was for years ostensibly striving to beat a product of his Continental and successful rival. Many, of course, claim to have succeeded, but—well, ask the motorist—he knows! To me, it is absurd to suggest that the English manufacturer cannot,

at the very least, equal the product of any rival if he only tackles the problem in a proper way. That proper way, obviously, is to take no risk, yet it is within my own personal experience that a firm manufacturing magnetos on a large scale actually dropped the use of an enamelled wire that was admittedly giving satisfaction, and purchased large quantities of imported wire, some even of unknown origin, with what results the said manufacturer alone knows. It cost less money per pound. That's all that mattered. True, this happened a year or more ago, but some of those magnetos are still giving somebody trouble. Think of it! In a magneto valued at anything up to £10, or even more, there is used approximately 4 oz. of fine gauge enamelled wire. This wire is a very vital part of the magneto, and the magneto becomes, perhaps, a very vital part of either a motor-car or a flying machine, and the satisfactory working of these expensive articles is risked for the sake of a few pence only. Enamelled fine wire has been used instead of fine enamelled wire. Do you see the difference ?

Clocks and Eggs.

It is not in magnetos alone that an infinitesimal saving on first cost is allowed to threaten a manufacturer's reputation. There are instances where a few shillings in an aggregate of several hundred pounds will exert more influence than should be permitted. This may appear an exaggerated statement, but consider the matter of a town hall or a public clock. It might be said that this is under observation every minute of the day. Should it stop, it is a subject of public discussion. The fact will, without doubt, be mentioned in the local paper. Whatever the reputation of the makers of that clock may have been, it will certainly suffer as a result. Surely every detail in the construction of such an equipment is worthy of the most careful consideration. According to his lights, the manufacturer does give that care to the minutest detail, but I claim, in the matter of enamelled wire, he still has something to learn. He has become familiar with silk and cotton-covered wires, the quality of which is apparent upon inspection ; but he must, for the sake of his reputation, be made to recognise that enamelled wire is quite a different proposition, and until he is competent to differentiate between " new laid, fresh and cooking," he should insist upon his buyer securing the highest grade material from a firm with a high-class reputation. Risk of trouble lies in any other direction.

You magneto manufacturers who have traced at least a part of your troubles to the enamelled wire : telephone engineers who have been compelled at enormous expense to replace faulty coils in a telephone exchange : cable-makers who have suffered rejections after expending time and money in completing a cable : makers of high-class instruments whose good reputation has been frayed at the edges by saving a few shillings (or pence) in an otherwise first-class instrument—should need no warning. You have had your lesson and should act accordingly. My appeal is made principally to those who have recently adopted, or are considering the adoption of enamelled wire, and to those users who are casting longing eyes on the " Factor's " price list, which is particularly alluring at this moment of money shortage.

No First-Class Wire at the Price.

A really first-class enamelled wire cannot be produced to compete with the inferior grades. The insulating compound is more costly ; extreme care and eternal vigilance is essential in its application ; while the close examination to which it is finally subjected (an operation entirely eliminated with the cheaper grades)—all spell extra costs ; yet cut one out for the sake of reducing the cost and what do we risk ? Here and there must inevitably occur brittle portions of insulation where cracks will develop when the wire is used ; understoved portions which have little or no insulating value rub off in winding and are withal vulnerable spots for attack under any adverse conditions ; rough surfaces, usually very small eruptions which flake off in winding, leaving minute bare spots, and other faults which the experienced eye and touch of the examining operator immediately detects and deletes, so that the buyer may, with confidence, use the wire received from end to end.

Some Insulation !

Many of the cheap grades of enamelled wire are covered by simple oxidising oils similar to linseed oil. The oxidation of the oil is, by boiling, carried to a maximum working limit. This, when applied to the wire and subjected to a moderate temperature, rapidly oxidises to the point of toughness, but what do we get on the finished product ? Not much more than a coat of paint ! To sum up, my advice to the user of enamelled wire is : When you are responsible for the production of high-class work, look askance at anything " cheap " or you may sooner or later add the two missing words.

A further point I should like to touch upon is the matter of impregnating coils which are wound with enamelled wire. This practice should, in certain cases, be encouraged. It is an additional precaution which wisdom dictates, particularly in cases where absolute reliability is essential. In this direction, however, trouble has sometimes been introduced instead of eliminated. Paraffin wax for this purpose must be rigidly avoided. Its deleterious effect may be plainly observed by immersing a sample of enamelled wire in very hot wax. Similar tests made in other oils, such as lubricating oils, show little or no deterioration in the covering. Every instance brought to my notice where impregnating varnish has failed in its function, has led me to the conclusion that the fault lay in the fact that the impregnating varnish and the enamel insulation had no affinity. Insulating varnishes—and enamel insulating medium comes within that category—not having a common base are certain to possess varying coefficients of expansion, and it will readily be recognised that, unless the whole mass expands and contracts in unison, separation and its evils must occur.

Hints for the Manufacturer.

To overcome this difficulty, cannot the enamelled wire manufacturer devise an impregnating varnish which he knows will have the characteristics of his stoving enamel ? This could be used in conjunction with his own product to ensure a thoroughly satisfactory result. Even where it is desired to retain the fine finish of an instrument, which a black impregnating varnish might impair, it should be quite possible to supply a clear varnish which would be equally satisfactory. In this direction, as in all others, utilise the knowledge possessed by your enamelled wire supplier. If he is at all alive he will render all the help he possibly can, and so help to popularise the product in which he is interested.

Modern Gas Works Practice.*

By H. C. WIDLAKE.

In perusing the second edition of Mr. Meade's book we are at once struck by the fact that the work possesses the much-desired, though by no means general, characteristic of being at the same time ambitious, comprehensive and thorough.

Our own interests naturally enough are largely centred in that portion dealing with the employment of electricity in gas undertakings, and we regard the section devoted to that subject as a very clear indication that old prejudices and conservatisms are being gradually swept away and are no longer permitted to interfere with the progress of a great industry.

We cannot help feeling, however, that this portion of the work is dealt with in a somewhat general manner, and takes very little account of those special conditions which have to be catered for on gas undertakings making an extensive use of electrical power. For instance, we hear from time to time of works in which practically every power-driven unit of plant is electrically driven, with perhaps the solitary exception of the coal gas exhausters. We find no mention of such extensive applications in Mr. Meade's book, and would have welcomed a section touching upon such matters as the electrical driving and governing of exhausters, the auto-control of water gas blowing fans, the driving of gas boosters (although this is perhaps a matter which falls under the heading of distribution). Another important matter which might well be included is a description of the precautions which should be observed when a single pole telpherage is introduced into a works which is already served by an ordinary double-pole system.

In most cases electrical power was first introduced into gas works in order to serve some form of electrically operated stoking machines (generally De Brouwer's in the earlier installations), but it is a far cry from those comparatively crude plants to the highly efficient and reliable lay outs which are to-day essential to a works which means to make the fullest possible use of electricity in its processes. It is in connection with such plants, capable of handling the most vital loads, that we should have welcomed further information.

In connection with the measuring of the works finished product we are surprised to find no reference to the Thomas meter, which constitutes a serious rival to the standard station meter in regard to first cost, area required for its accommodation, and its ability to provide the required information in graphic form.

In Mr. Meade's work we have a good book written by a good man, from the value of which the omissions we have noted detract but little as, in any case, the wise engineer who is considering the question of going over to electrical operation will naturally turn to a qualified consultant as a way of short circuiting the difficulties with which he finds himself beset.

The modern gas undertaking, with its many units of power-driven plant scattered over a wide area, affords an ideal field for the use of electrical power, and the acceptance of this fact by gas engineers is bound to have a most beneficial effect not only in regard to the cost of the works finished product, but in bringing about a broader view of the entire subject of power application.

In this respect Mr. Meade certainly voices the opinions of a rising and progressive generation of gas engineers.

* Modern Gas Works Practice. By Alwyne T. Meade. (London : Benn Brothers.) Pp. xi + 815. 2nd Ed. 55s.

The Institution of Electrical Engineers.

At the meeting of the INSTITUTION OF ELECTRICAL ENGINEERS on Thursday in last week, the Institution of Heating and Ventilating Engineers were entertained and two Papers on the "Utilisation of Waste Heat from Electrical Generating Stations" were read and discussed. The first of these Papers, which was from the heat engineering point of view, was read by Mr. C. Ingham Haden and the second from the electrical point of view by Mr. F. H. Whysall. Abstracts of these Papers will be found on another page of this issue.

The meeting was not very largely attended, and a majority of those present seemed to be visitors, although this is not evident in the discussion. This small attendance was a pity considering the importance of the subject.

As there was no formal business and the Papers were short the discussion was begun at a rather earlier hour than usual.

A Pioneer on the Future.

Col. R. E. CROMPTON, who seems to get younger every day, said that if the centrally situated generating stations which were now being altered into purely converting stations could be utilised for heat distribution, and the wayleave difficulty could be overcome, a useful method would appear to have been discovered of providing a new source of income for supply companies' shareholders. His opinion was that the present boilers should be utilised to supply heat as super-heated high pressure steam and so to avoid the transmission losses, which he feared would otherwise be ruinous. He did not think that heating would be carried out by any one system alone, and his view was supported by the enormous increase in the electric heating load which had taken place in the residential parts of London, even during the last twelve months. The principal cause of this increased demand was the "convenience-factor." It was true that the "efficiency-factor" of electric heating was exceedingly low; but at the point of use 90 per cent. of the energy present could be efficiently employed, and it therefore compared favourably with other methods from the consumers' pocket point of view.

Thermal Efficiency the First Objective.

Mr. F. BIGGIN, President of the Institution of Heating and Ventilating Engineers, said that many of the advantages of electric heating instanced by Colonel Crompton were equally present with heating by steam or hot water. In obtaining the highest efficiency from electric generating stations a great waste of thermal efficiency resulted and they, the heating engineers, considered it would be more practicable, wherever there was exhaust steam, to make thermal efficiency the first consideration. The world just now was calling for economy, and any method that would bring that about should be considered.

American Experiences.

Mr. W. H. PATCHELL said that the great question was, did our present methods pay? Up to the present it seemed that they had done so. Large blocks of business premises, other than factories, generally required more heat than light or power, and there obviously electricity would be a by-product. Some steam companies were running with 83 per cent. of the steam, which left the station sold and paid for. That was as much as many electricity supply undertakings could achieve. He gave an account of the development of steam supply for heating in Detroit and showed a photograph indicating the large amount of room taken up by the pipes. In that city special subways had been built to house the pipes. These were 8 ft. high and 8 ft. wide, and the top of the tunnel was from 25 to 40 ft. underground. There were two miles of these subways and they were used for steam pipes only. They contained one 12 in. high pressure pipe and one 20 in. low pressure pipe.

An Outside Supporter of Electricity.

Mr. A. H. BARKER thought that the subject under discussion should be considered entirely from the economic and hygenic angles. Experiments he had conducted in three L. C. C. cottages showed that 80 000 B.Th.U. per day supplied in the form of gas served the requirements of a house of four or five rooms in the cold weather, which, at 1s. per therm, would amount to £10 or £12 per annum. Solid fuel would cost about half this amount to give the same heat requirements, and it was extremely doubtful whether heat could be supplied from a central station through radiators, and with constant hot water, for anything like this sum, especially taking into account the need for providing against breakdowns. That meant that gas and electricity would have to be available as well as steam, and he estimated that to serve 100 000 cottages would cost £100 000, a sum which would only give a return of £6 000 a year. What the community needed was a supply of energy from which all the impurities had been filtered which could instantly be turned into light, heat and power. Electrical engineers undertook to manufacture energy of this kind, but at present in doing so they wasted about 90 per cent. of the raw material. Electrical, mechanical and gas engineers, physicists, chemists, and heating engineers, instead of fighting and sneering at one another should therefore come together and see whether they could not devise some way of manufacturing electrical energy without so high a loss. Gas people could put into their mains 80 per cent. of the energy of the coal, but even so they were obliged to make gas so expensive that the working man could hardly afford to use it. If electrical energy could get anywhere near that figure there would be no form of light, heat or power in the world which could compete with it.

The Mechanical Engineer's View.

The PRESIDENT announced that he was trying to call on heating and electrical engineers alternately, and asked Mr. Beauchamp to speak. Mr. Beauchamp, not being forthcoming, Mr. J. F. RAGGITT said that with regard to the suitability of existing power plant for supplying heat, presumably the bulk of this consisted of reciprocating engines. This was fortunate, as the steam turbine, unless specially designed, was not well adapted for exhausting against a back pressure, and, even when designed as a purely back pressure turbine, would not give such a large output as a reciprocating engine. He discussed the various types of engine in their relation to this problem and considered there was no unsurmountable difficulty in extending the scope of the operations to the heating of districts from combined heating and power stations. In any event, we could not afford to perpetuate a system which wasted 60 per cent. of the heat.

The Purest Grade of Energy.

Mr. W. M. SELVEY said that electricity was the purest and the highest grade of energy, and thought Mr. Barker was a little beside the point in talking about scrap heaps for every steam engine worked by rejecting steam at the lower limit, this being part of a definite process, not of obtaining energy, but of obtaining pure energy. It was a question whether it was more profitable to concentrate wholly on getting the largest possible amount of heat energy from raw material, or to devise processes whereby in the process of getting pure energy the remainder would be left in such a form that it could be usefully employed. After some remarks on the washing habits of the population, which it is as well were made in a cultured audience, Mr. Selvey pointed out that 10 per cent. thermal efficiency which Mr. Haden showed in his heating diagram was not the ideal they were working for. The whole point of the super station was that this figure should be increased at one bound to twenty, and they even had a station which might give twenty-five. If they could reach a figure which would more or less realise Dr. Ferranti's ideal of providing all their energy in the pure form there need be no need to worry about "scrap heaps."

Some Commercial Points.

Mr. W. W. NOBBS viewed with some alarm Mr. Whysall's suggestion of 10d. per 100 000 lb. as the proper price of steam with coal at 10s. a ton. He drew a lurid picture of the plight of many American companies who had fixed too low a rate.

Mr. J. F. DRIVER was an advocate for real central stations once more, in view of the fact that electrical engineers now threw away more than half the heat available in the coal and spent money in doing so. He thought that electrical engineers should follow the gas engineers' example and make a living out of by-products.

A New Thought on Central Stations.

Mr. W. NELSON HADEN's idea of a central generating station was one which would include generation and electricity, and the making of gas and heat, not to speak of a destructor plant. He was very eulogistic about the use of destructors, and mentioned the case of a fairly large town where the whole tramway service was run off such a plant. (Certain supply engineers could give him some other views on this subject.) One advantage of a station such as he suggested would be that the mains of the various services would radiate from one point, so justifying the expense of subways.

Mr. C. I. HADEN, in replying to the discussion, said that heating engineers wanted electrical engineers to realise that there was a demand for heat as well as for electricity, and for that reason he had suggested that retention of existing electricity stations when super stations were ready.

The PRESIDENT, in proposing a vote of thanks to the authors, said the cycle of operations in generating electricity by steam was efficient at the high pressure end and inefficient at the condensing end. Attempts must be made to alter that.

Annual Exhibition of the Physical Society of London and the Optical Society.

(*Continued from page* 73.)

Everett, Edgcumbe & Company.

A varied collection of measuring and controlling instruments was shown by EVERETT, EDGCUMBE & COMPANY. Among these, their E.H.T. voltmeter attracted attention as a new type which is likely to come into favour. It is based upon the principle first employed by Lord Kelvin, and subsequently developed by M. Abraham, the eminent French investigator, of the attraction of two oppositely electrified conductors protected by guard plates. The instrument shown had a maximum range of 40 000 V with additional ranges of 20 000 V and 10 000 V. It is illustrated in Fig. 16. Similar instruments are supplied for all pressures up to 200 000 V. The change over from one range to another is immediately effected by altering the distance between the plates. An important feature of these voltmeters is that, air being used exclusively as the dielectric, they give identical readings with direct current or alternating current of any frequency, which is not the case with electrostatic voltmeters depending upon the use of condensers; moreover, the latter instruments are liable to disturbance through variable leakage affecting the distribution of potential between the instrument and the condenser in series with it.

In the past the electrostatic principle has been considered as suitable only for comparatively large dial instruments, but Everett, Edgcumbe & Company have found it possible so far to reduce the dimensions that a 3 in. dial electrostatic voltmeter reading up to 2 500 V has now been evolved, and is very largely used for wireless installations where space and weight are often of great importance.

Special ohmmeters were exhibited by this firm for measuring the resistance, and thence the temperature, of rotors of machinery when in use, such as the running rotor of an a.c. generator. For the measurement of the temperature of the stator or other high tension windings, resistance units are embedded in the slots as near

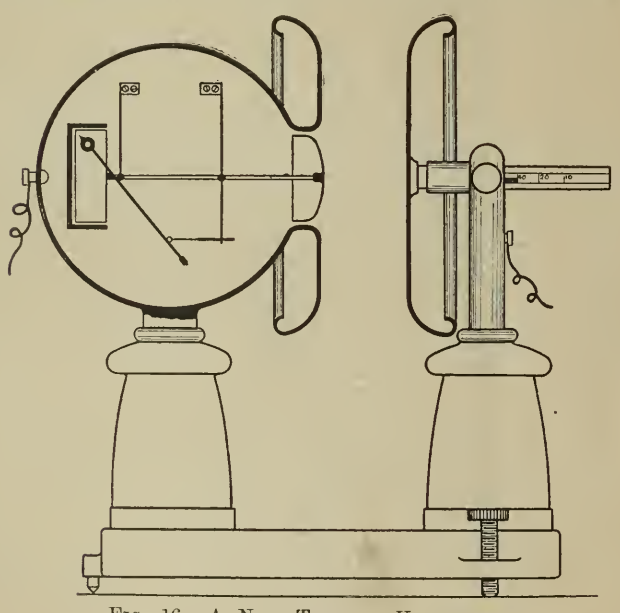

FIG. 16.—A NEW TYPE OF VOLTMETER.

to the conductors as possible, and are connected to an indicator graduated directly in degrees. We also noticed that the firm's illumination photometer had been modified by adding a second test plate. This is tinted so as to reflect only one-tenth of the incident light, thus giving a reducing effect of ten to one. By having this plate along with the usual white plate, two ranges are obtained, one up to 4 ft. candles, and the other up to 40 ft. candles.

Evershed & Vignoles.

Several instruments of interest to marine engineers were shown by EVERSHED & VIGNOLES. These included Needham's pulsator system, which we described last year, and a new form of revolution counter, also due to Mr. Needham. This apparatus is designed for the purpose of counting revolutions, or other operations, at any distance from the machinery. For revolutions up to 400 per min. it is made to count single revolutions; but, if required to count at a higher speed than this, the transmitter is suitably geared down from the revolving machinery so as to count one in every ten revolutions —a nought being added at the unit end of the counter dial. The counter, which is illustrated in Fig. 17, has the appearance of an ordinary mechanical counter; but its working parts are designed upon an entirely new principle. It is combined with a step-by-step motor driven by electric current derived from ordinary electric light mains. In order to secure that the counter shall operate with certainty, it is necessary that the motor, while sufficiently strong to rotate all the counter dials simultaneously when required, shall not move with such violence as to risk damage to the first dial when the latter only is rotated. The ordinary mechanically locked counter is therefore unsuitable, since it is liable to stick

FIG. 17.—NEEDHAM'S REVOLUTION COUNTER.

when all its dials are moved simultaneously, and therefore requires considerable power in reserve. The present counter consists of a number of dials, each arranged to be locked magnetically in any of ten positions corresponding to the digits 0 to 9, but mechanically quite independent, except during the time when a change of indication is in progress. The effect of this magnetic lock is to enable each unit to be made very free from friction; and it has the additional advantage that it helps to reduce the power necessary to change the indication of all digits simultaneously. The step-by-step motor is also novel. While providing ample power for moving the counter, its elements are light enough to work with certainty up to speeds exceeding 400 per min. The motor is of the rotary type, no reciprocating motion being employed. It operates with two wires only instead of the usual three, thus reducing the cost of installation to a minimum. It will work satisfactorily on 70 per cent. of its normal pressure, a feature which enables it to be used on ordinary electric light circuits; and its internal resistance is such that no variation of contact resistance in the transmitter will affect its proper working. The transmitter is a plain make-and-break mechanism, and is made in various forms to suit different requirements.

Recording Instruments.

The recording instruments by Evershed & Vignoles, Ltd., are on the Murday system, having rectangular co-ordinates. In the new design now shown the instrument is more compact, the clock being placed underneath the chart. A continuous roll of chart is provided, 65 ft. in length, or sufficient for one month at the rate of 1 in. per hour. The insertion and removal of the chart is very simple. A reservoir trough is provided for the ink, permitting a continuous record to be obtained on fluctuating loads for the whole period of the chart, without attention. In addition to the ordinary pattern, instruments are made in which two records can be obtained on the same chart.

Foster Instrument Company.

An interesting apparatus for the automatic control of temperature to follow a predetermined programme was exhibited by the FOSTER INSTRUMENT COMPANY. Various methods of automatic control have been proposed and used, but these have been mainly devoted to maintaining the temperature approximately at a constant figure. While this is a desirable condition for many operations, there are others in which the temperature should vary in accordance with a predetermined programme; for instance, in one important manufacturing operation, employing an electric furnace, it is desired that the temperature should rise fairly rapidly to a certain relatively low value, should be maintained at or near that value for a considerable period and should then be rapidly heated up to a higher figure, maintained there for a period and then slowly cooled. The device exhibited is designed to carry out such a programme. A thermo-couple is inserted into the electrically heated furnace, the temperature of which it is desired to control. This thermo-couple is connected to a recorder, the movements of the pen being therefore proportional to the temperature of the furnace. The record is produced by a clock mechanism in the recorder which depresses the pen alternately on to the ink drum at the side of the chart and on to

the chart itself. The pen is brought over to the ink drum by the clock mechanism and, after it has been pressed on to the ink drum and received ink, the clock mechanism leaves the pen free to take up the deflection proportional to the temperature of the furnace.

The Mechanism of Temperature Control.

A divided electrical circuit is arranged, one portion of which comprises the pen arm itself. In one arm of this circuit the contact is made between the pen arm and the circuit when the pen arm is moved over by the clock mechanism towards the ink drum. An alternative circuit is provided when the pen is depressed on to a metal plate which is fixed over the chart. This metal plate is virtually a " template " cut to the shape of the desired temperature programme. The electric circuits are shown in Fig. 18. There is provided in and connected with the recorder a divided electrical circuit coming from the main supply (for instance, a direct current lighting circuit) through the switch S, through a lamp resistance L to the pen arm P in the recorder. When this pen arm has moved over to the left, near the ink drum, it is brought into contact with the contact piece C, thereby energising the electro-magnet R, in a relay. This closes the secondary circuit on that relay, thus operating the motor M_1. The motor operates through a worm and worm wheel to increase the electrical resistance of the rheostat R, thus reducing the current through the furnace.

Alternatively, when the pen arm is free over the chart and is depressed thereon, if the temperature is below that determined by the template, the pen arm will make contact on the template itself and thus through the circuit C_2, and the relay R_2 will close the circuit of the motor M_2. This motor operates to decrease the electrical resistance of the rheostat R, thus increasing the current through the furnace. The circuit through R_2 and M_2 is only completed when the temperature is below that determined by the template. The speed of the motor M_1 is made less than that of the motor M_2 by shunting it with a lamp resistance L_1, so that as long as the temperature is below that determined by the shape of the template, there is a constant balance of tendency to decrease the electrical resistance of the rheostat R and thus to increase the current through the furnace. On the other hand, when the temperature has passed above the limits of the template (whatever that shape may be) there will be no contact made through M_2, but there will be a contact made through M_1 so that there will be a tendency then to increase the electrical resistance of the rheostat R, and thus to decrease the current through the furnace. In cutting the template it is of course necessary to allow for the time lag in the furnace.

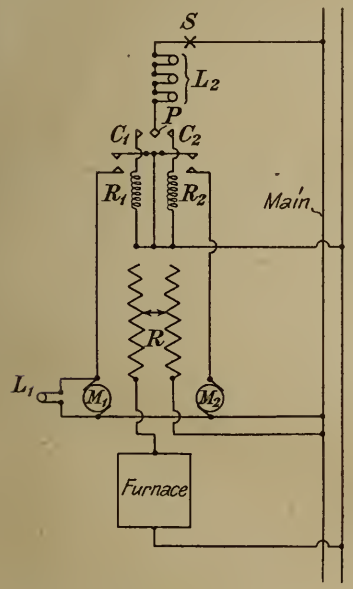

Fig. 18.—Diagram of Foster's Temperature Controller.

Nalder Bros. and Thompson.

A group of interesting and improved alternating current instruments on new principles were exhibited by Nalder Bros. & Thompson, Ltd. Some of them have already been described in our columns. Perhaps the most important of the instruments shown was the Fawssett-Parry relay. This is particularly sensitive and is intended for use in connection with the Merz-Price and similar systems of protection. In the original form of Merz-Price protection the winding of the relay is traversed by a capacity current flowing into the pilot cable and proportional (with the usual design of current transformer) to the current in the feeder to be protected. Thus the tripping current must exceed the value of this capacity current, and therefore a lower current setting, or a more sensitive relay, cannot generally be used. The Fawsett-Parry relay acts easily with one-tenth of the energy required by the ordinary relay. This is a great advantage where, say, a span of a medium pressure line drops on to dry ground, the fault current being then small.

The Fawsett-Parry Relay.

The Fawssett-Parry relay is in principle similar to a moving-iron ammeter. It is made up of rectangular stampings having a rectangular space cut away from the centre, but bridged near the centre by a fixed and a moving iron member in such a way as to leave small air gaps. These members are surrounded by three concentric coils, one of which carries the fault current and the other two the tripping current. The moving iron member is attached to a pivoted spindle carrying a switch arm, the whole being controlled by a small spiral spring. When a fault occurs the out of balance current causes the moving member to be repelled from the fixed member and to be attracted into a slightly tapering gap until the switch arm closes the tripping circuit through the outer two coils in series. This puts extra torque on the movement to make a good contact on the switch arm, and when this contact is closed the outer coil is cut out, leaving in just enough turns to keep the tripping circuit closed. By this means a maximum number of switches can be tripped simultaneously by a given battery. Once the switch

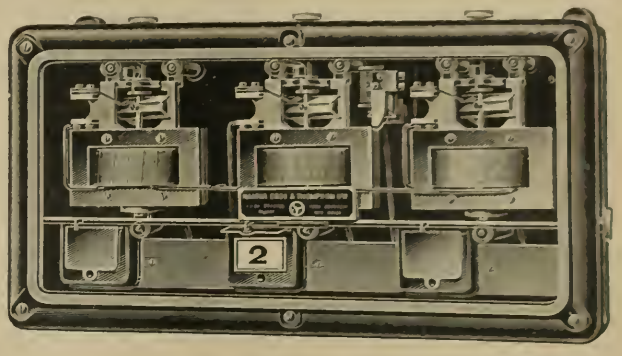

Fig. 19.—Triple Pole Relay Fitted with Inductance.

arm of the relay makes contact the process of tripping the main switch must go on until the latter is opened; this breaks the trip circuit, when the relay returns to its normal position and is thus self-setting. The relay is insensitive to vibration, and as the relay contact is held in always till the circuit is closed there is no sparking. The general appearance of a triple pole relay is seen from Fig. 19. Its field of application is in connection with the Merz-Beard and Merz-Hunter protective systems.

Siemens, Brothers & Company.

The exhibit of Siemens, Brothers & Company included several pyrometers and temperature recorders. Owing to the low E.M.F of platinum-rhodium couples, the needle of the instrument in that case is left free, and the record is made every 30 sec. by a chopper bar depressing the needle onto transparent paper, below which is a typewriter ribbon.

Several types of temperature indicator were shown, including a special locomotive pyrometer outfit, specially designed for use with the superheaters now fitted to most modern locomotives. This equipment consists of a copper constantan couple and a strongly constructed water-tight indicator. The thermo-couple consists of a copper tube, containing a stout constantan wire, wire and tube being insulated from each other by asbestos braiding and brazed together at the end which is inserted in the superheater. Since the copper sheath forms one element of the couple, the instrument responds very quickly to changes of temperature.

Muirhead & Company.

The exhibit by Muirhead & Company included an improved automatic transmitter, an artificial line box and a modified Heurtley magnifier. The original magnifier depended upon the variation in resistance due to the heating up of wires when displaced so as to be near flames. In the present model the flames are replaced by electrically heated wires. The arrangement is shown diagram-

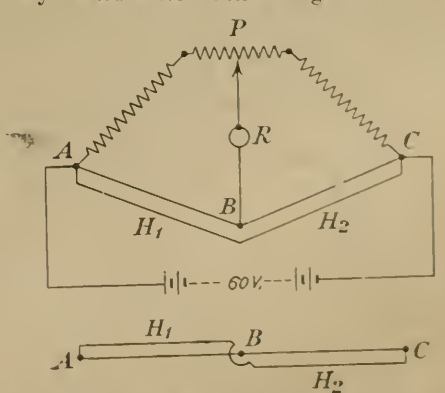

Fig. 20.—Diagram of Heurtley's Magnifier.

matically in Fig. 20. ABC is the moving wire, forming two arms of the bridge, and in proximity to the heated wires H_1 and H_2, one on either side. The bridge is balanced so that no current flows through R. A displacement of ABC towards H_1 or H_2 then upsets the balance and causes current to flow through R in one direction or the other.

(To be concluded.)

Correspondence.

SCREEN, COUNTERPOISE OR EARTH.

To the Editor of THE ELECTRICIAN.

SIR,—Capt. T. L. Eckersley's Paper on "Transmitting Aerial Resistances," as reported in your issue of December 23, 1921, has for me a very great theoretical interest, especially since I feel it is along the lines of a proper image construction of the overhead antenna that progress in greater radio efficiencies is to be made.

It would appear that the earliest disclosed departure from the original earth was that due to Fessenden (1902) in his famous "wave chute" patent. This was followed by a patent to Stone in this country. The theory of the wave chute was essentially that of a screening effect similar to that now suggested by Capt. Eckersley, with, however, this very important distinction, viz: Fessenden's wave chute was earthed at the ends, whereas the newer type of screen constructionally similar to a counterpoise is unearthed throughout.

The question is whether the counterpoise of old is exactly equal in its action to the properly adjusted type of screen suggested. Surely if the question is wholly one of earth current losses, the old counterpoise theory (screen wires insulated throughout) would indicate that a plate slightly above the ground would be better than a network of wires. Yet Lodge as well as Eckersley find that the counterpoise function pure and simple does not wholly satisfy the facts. Would it not be better to regard Eckersley's work as indicating that the earth ground should be eliminated (screened) as far as possible and that the best construction of the screen as to mesh, wire size, and extent are really dependent on the height (Lodge, Eckersley) of the aerial?

In a Paper submitted to the Institution of Electrical Engineers last summer I suggested that the prime necessity was to set up fictitious (or real) dielectric losses to an extent sufficient to produce a system of progressive waves on the antenna. The return through the screen of Eckersley, the wave chute of Fessenden, the earth of Marconi provide that resistance in series with the distributed capacitance which is equivalent to a hysteretic loading referred to in the issue of THE ELECTRICIAN for December 9, 1921. The distributed hysteretic inductance, for a given frequency, is then provided by the skin resistance of the aerial.—I am, &c.

Washington, D.C., January 5. A. PRESS.

THE EXPONENTIAL VALUES AND EXPANSIONS IN POWERS OF θ OF SIN θ AND COS θ.

To the Editor of THE ELECTRICIAN.

SIR,—Will you kindly allow me to correct a careless error in the last paragraph of my letter in last week's issue? To the exponential value of $\cos\theta + j\sin\theta$, each term of the expansion for $\sin\theta$ is multiplied by j, and the resulting series is added to that for $\cos\theta$.—I am, etc., G. W. STUBBINGS.

London, S.E.25, Jan. 21st.

RELATIVE STATUS OF ELECTRICAL AND MECHANICAL ENGINEERS.

To the Editor of THE ELECTRICIAN.

SIR,—With reference to your remarks in THE ELECTRICIAN of the 13th inst., dealing with the re-organisation of the electrical engineering staff of the L. & N. W. and L. & Y. Railways, you have drawn attention to a specific case where the electrical engineer of a large undertaking has been made subordinate to the chief mechanical engineer.

I should like, however, to point out that the majority of vacancies for chief engineers in supply undertakings are filled by mechanical engineers, and in many cases their knowledge of electrical matters is quite superficial.

An electrical engineer is just as capable of managing a supply undertaking as a mechanical engineer, probably more so, in view of the high standard of technical knowledge required when dealing with the various electrical problems which arise from time to time on the larger undertakings.

I believe that the present preference shown to mechanical engineers is due to the following:

(1) Most of the present chief engineers are mechanical men and therefore favour their own type.

(2) The majority of chief engineers were appointed in the days when a high standard of technical knowledge in electrical engineering was of secondary importance compared with a mechanical training.

In conclusion, I should like to say that the "talent" to which you refer, availeth an engineer very little as regards promotion.

Progress depends on influence, but in Government and municipal service seniority carries more weight than ability.—I am, &c.

"ELECTRON."

An appeal to members of the House of Commons has been issued by the INDUSTRIAL VEHICLE SECTION OF THE AUTOMOBILE ASSOCIATION AND MOTOR UNION on behalf of industrial vehicle owners and users with respect to the proposals of railway companies regarding road transport.

Salesmanship and Heating and Cooking.

The third of the series of lectures on "SALESMANSHIP" organised by the British Electrical Development Association was held at the rooms of the Chartered Institute of Patent Agents, London, on Friday last, when Mr. W. A. Gillott opened a discussion on "Salesmanship in Relation to Electric Heating and Cooking."

Capt. J. M. DONALDSON, who presided, in introducing Mr. Gillott referred to the intrusion into both electric heating and lighting of the fetish of the obsolete. To placate this fetish electric radiators were often fitted into fireplaces. This was a mistake, because an electric radiator was portable, and it was not always necessary to heat the whole room. With regard to cooking, an electric oven which could be mounted at a convenient height to save the necessity of stooping was required.

Different Customers, Different Methods.

Mr. W. A. GILLOTT said that salesmen would find that while fundamental principles were similar, different methods of attack must be employed when dealing with different classes of buyers, such as domestic users, hotels, restaurants and when selling appliances to the trade. In one case it would be found better to sell the idea as a means to an end, and in the other to expatiate upon quality and utility as a trade buyer should already be a convert.

Selling electric cooking and heating apparatus brought the salesman into touch with all classes of people. It was therefore necessary to know the subject thoroughly, especially in the case of domestic cooking where the housewife and cook would require advice regarding the methods which would secure the best results. Familiarity with kitchen language and tact were therefore essential qualifications, while a study of the principles of cooking and heating was necessary in order to be able to point out the advantages of using electricity as compared with other methods.

It was as well not to talk too much about price, but to keep cost in the background until the prospective buyer was interested. Quality was the thing to talk. This created a desire for possession, and it would be found that the cost was a secondary consideration. If the efforts to sell were unsuccessful, an endeavour must be made to discover the reason, and the experience used at the next attempt.

Some Important Points.

The claims of electric heating and cooking should be supported by positive facts, and in this connection the following points might be emphasised, cleanliness, the satisfactory cooking results obtained, that electric cooking meant low labour costs, especially in large kitchens, that electric cookers were convenient and safe, and that electric cooking was economical. Above all it should be the aim of salesmen to act in an advisory capacity to their clients.

When dealing with the domestic side of the business it would be found advisable to interest the housewife. This would not be difficult if it was explained how work could be reduced, how cooking could be done with very little attention, and time saved by eliminating stoking, attention to flues, manipulation of gas taps, turning of food, basting, &c. Everyone engaged in the electrical industry should run an electrical household.

Essentials for Development.

There were two essentials for domestic electric development, cheap electricity with a sympathetic supply authority and a small showroom with appliances demonstrating the capabilities of the apparatus. Co-operative effort by the heating and cooking manufacturers, the local supply authority, and the contractors, in giving a series of lectures and demonstrations in selected towns under the auspices of the British Electrical Development Association was suggested. It was regrettable, but none the less true, Mr. Gillott concluded, that electrical engineers on the whole were not salesmen, and the subject of salesmanship was not given the attention it deserved.

Colossal Savings.

Mr. A. F. BERRY, who opened the discussion, pointed to the colossal savings effected by the use of electrical apparatus. The purchase of certain types of ovens was an investment yielding something like 100 to 150 per cent. per annum. The real trouble was that electrical people did not believe that such economies could be effected, and it was a good thing for the industry that the public believed more in the advantages of electric heating and cooking than did electrical engineers.

Mr. STILL said that the heating business had been retarded by the use of heaters of small capacities for warming large rooms. Mr. ROGERS on the other hand referred to a building in the West End where heaters of too large a capacity for the wiring had been installed with bad results.

More Faith Necessary.

Mr. PRENTICE also urged that electrical people should have more faith in electrical apparatus. Salesmen should be con-

versant not only with the good points of the particular cookers they were selling, but with the methods of working them.

A Speaker, whose name we did not catch, said that salesmen should stick to selling goods, the education of the public being left in the hands of the British Electrical Development Association.

Mr. E. R. Morton asked that a hiring scheme should be evolved for electrical apparatus, while Mr. A. G. Whyte pointed out that in Glasgow there were people actually waiting for electric cookers owing to the attractive hiring charges.

Cleanliness and Hiring.

Mr. Howell pointed out that if salesmen were to talk about the cleanliness of electric cookers they should keep their own showrooms clean. More co-operation was needed between the supply authorities and the sellers of apparatus. Mr. W. E. Warrilow also supported the evolution of a hiring system, as in such a system in his opinion lay the solution of the problem.

Education of Architects.

Mr. Young insisted on the need for the education of architects in the usefulness of electricity for heating and cooking. He suggested that a special fund should be provided for E.D.A. to carry on this work.

Mr. Gillott in replying to the discussion agreed that more attention should be paid to the electric water heating apparatus, and referred to a case where money had been saved by these methods owing to it having been formerly necessary to keep the fire alight all night. Capital charges for increasing the distribution network were not so great as were sometimes supposed, as at Billingham, where about seventy houses were electrically equipped, the average maximum demand per house did not exceed 0·8 kW, with 11 kW installed in each house. The education of the public, he thought, was the business of the supply authorities because they were going to get something out of the use of the apparatus, while when a manufacturer had sold his goods he had nothing more to come.

The Protection of Alternating Current Systems.

In a Paper read before the Newcastle Students' Section of the Institution of Electrical Engineers, Mr. R. W. Biles described the characteristic features and relative advantages of the various forms of protective apparatus in general use, and said that the Merz-Price system was now in operation on a 66 000 V system.

With the use of split conductor protection, employing split switches and non-reactance current transformers, if it was desired to take off a small tapping in the middle of a line, in all probability the cost of an additional split switch would not be warranted, and he therefore suggested three arrangements for giving the required supply without the necessity of providing such a switch. These were: (1) To install two precisely similar transformers, each having a capacity equal to half the load required, with H.T. fuses between the transformers and the split conductor line, overload protection being provided on the L.T. side of the transformers; (2) to instal a single transformer with a double H.T. winding, one winding being connected to each split, with H.T. fuses, &c., as before; (3) to instal one transformer with a L.T. switch and with H.T. fuses in each tapping line. Scheme 1 was costly, scheme 3 was the most economical, but introduced certain disadvantages; whilst scheme 2 was probably the most satisfactory.

The author recommended the following as the most suitable type of protective gear to use in particular cases. For the protection of open-ended feeders—earth leakage. For the protection of closed feeders, ring mains and interconnectors—Merz-Price, split conductor, or Hunter four-core. For the protection of generators and transformers—Merz-Beard self-balance, Merz-Price circulating current, or "Between Turns."

New Electrical Society for Glasgow.

A meeting, under the auspices of the Glasgow Branch of the Electrical Contractors' Association for Scotland, was held in the Ca'Dora Restaurant, Union-street, Glasgow, on January 18, Mr. R. A. Ure, Chairman of the Glasgow Branch of the Electrical Contractors' Association, presiding. There was a large attendance representative of the Electricity Supply Authority, Manufacturers, Factors, Consulting Engineers, and Associated and Non-Associated Contractors.

The Chairman explained that the meeting had been called with the view to inaugurating an Electrical Society which would be representative of the various callings constituting the electrical industry. The feeling was expressed that the lack of cohesion of effort on the part of those engaged in the trade was retarding progress generally, and while they as engineers recognised the I.E.E. as their parent institution, some means of meeting under less formal conditions was essential. The proposal to form such a society was agreed to unanimously, and a committee was formed to frame a constitution and report at the next meeting to be held in February.

The Installation of Shaft Cables.

In a Paper read by Mr. E. E. Shatford on the "Installation of Shaft Cables" before the North of England Section of the Association of Mining Electrical Engineers, in Newcastle, it was stated that the types of cables generally used for colliery work were bitumen insulated, paper insulated lead covered, or a combination of both. A shaft cable of any type should be double wire armoured, for mechanical protection, and should have a compounded jute serving over all to protect the armouring from corrosion. The practice of splitting the load between two or more shaft cables was commended, the increase in cost being small proportionately to the advantages gained in the way of security. If the shaft cable was to be looped into one or more seams on the way to the pit bottom, it was advisable to loop in one cable only and to run a second cable direct to the pit bottom, disconnecting boxes being installed at each seam and at the pit bottom.

Installation of Shaft Cables.

The simplest method of installation was to mount the cable drum in the cage, the cable being payed out and cleated up as the cage descended. If the cage was too small to permit this to be done, the cable must be lowered end on until the whole length hung in the shaft. The safest method of lowering the cable was to lash it to a steel rope controlled by the haulage gear, and to lower both cable and rope together. When the final position was reached the cable was fixed into the top cleat and the lashing removed to a point below the second cleat, which was then fixed, and the process repeated until the cable was cleated throughout its length when the steel rope might be withdrawn. If haulage gear was not available the wire rope might be controlled by means of locomotives and spragged trucks, the cable and wire rope being laid out on rollers along the sleepers and lashed together before lowering commenced. When lowering by this method the greatest strain was put on the cable where it passed over the pulley. The cable must, therefore, be kept moving until the final position was reached, and a cleat fixed at once to release the strain. When lowering shaft cables the cable should be run over a large grooved pulley fixed over the shaft in such a position as to lead the cable as near as possible into its ultimate position. This pulley should never be less in diameter than the barrel of the drum, and particular care must be taken to avoid a twist or kink in the cable.

Cleat Design.

The cleats used for supporting cables in shafts should be made of hard wood about 2 ft. 6 in. to 3 ft. long, provided with three or four iron straps and $\frac{3}{4}$ in. bolts. They should be bored to the exact diameter of the cable, the thickness of the saw cut when cutting the cleat longitudinally would ensure a good friction grip on the cable. The distance between the cleats would depend largely upon the weight of the cable, but a good average is 20 to 25 yds. apart and no cleat should carry more than 8 cwts. All cleats should be provided with sheet iron hoods to keep off water and deflect falling stones.

The practice of suspending a shaft cable from the top only was not recommended except for very shallow shafts, on account of the stresses set up immediately below the suspender. This method had the advantage of offering no obstacle to falling material.

Surface Cables.

The soil around pit-heads was notoriously injurious to armoured cables owing to the amount of made-up ground, ashes, &c., usually present, and care must be exercised when laying out the runs. There were only two methods which merited serious consideration from a safety point of view: A culvert built between the power-house and the shaft, with brackets fixed to the side to carry the cables, the top of the culvert being covered with iron plates of stone slabs, or cables slung overhead between the power-house and headgear by suspending from a catenary wire when passing over open ground, or run along the buildings where convenient. Cables laid in the former manner were accessible and repairs or extensions can be effected conveniently. The second method permitted of the cable always being in view. The suspenders should be substantial in construction and of generous width.

Jointing.

Unless the shaft cable was to be looped into one or more seams it should, if possible, be manufactured and installed in one length. If this was impracticable, a horizontal joint should be made in an existing heading. A vertical joint in the shaft could be made, but should be avoided whenever possible, as it was difficult to make in dry shafts and practically impossible in wet shafts. Sweated joints on the conductors should be made, where possible, but if naked lights were not allowed, mechanical connectors must be used. They should give a sound mechanical grip on the strand, and good electrical contact, the resistance across the connector being at least equal to a similar length of uncut conductor. The glands of joint boxes, if the cable was bitumen sheathed, should be provided with long bearing surfaces to prevent damage at this point. The continuity of the armour wires across the joints must be provided for by means of a copper bond.

Electric Traction in Chile.

We announced a few weeks ago that the Westinghouse International Electric Company had secured an important railroad electrification contract in Chile, where the total railway mileage is 5 200, of which about 30 per cent. is privately owned, the remainder being divided into broad gauge and narrow gauge lines. The former extend south from Valparaiso by way of Santiago to Paerto Montt, with numerous branches. The conditions that arose during the war brought forcibly to the attention of the railway management the necessity for electrifying the broad gauge lines, especially the Valparaiso-Santiago line with the Los Andes branch, where traffic was rapidly approaching the track capacity. In addition fuel costs were excessive, while almost limitless water-power was going to waste.

Electric Traction Decided on.

A commission appointed in 1918 to study the problem, reported in favour of electric traction, and on account of the possible economies it was decided to electrify the broad gauge lines, beginning with the Valparaiso-Santiago and Los Andes branches, or the first zone. A loan of $10 500 000 for the purpose was heavily oversubscribed in a few hours.

The initial electrification will include 116 miles from Valparaiso to Santiago, and 28 miles from Las Vegas to Los Andes, the terminus of the Transandine Railroad, a narrow gauge line ; while the narrow gauge longitudinal railroad runs north from Calera, an important station on the line to be electrified. The maximum gradient in this zone is 2·25 per cent., approaching La Cumbre (the Summit) from the west ; there are a relatively large number of curves, the maximum being 10°. The track gauge is 5 ft. 6 in., and there are six tunnels on the main line, the longest (the San Pedro) being 1 600 ft. in length. Three of the tunnels are on the most severe gradient approaching the summit.

Electrical System.

The 3 000 V direct-current system was decided upon as best suited to the conditions. Hydro-electric power will be generated at the Maitines station of the Chilean Electric Tramway & Light Company. This station is being constructed and will utilize the waters of the Rio Colorado. The station will contain three three-phase 8 125-kVA Westinghouse generators (50 cycles), and will have an ultimate capacity of 30 000 kW. This power will be transmitted 37 miles to Santiago by twin-circuit 110 000 V transmission lines. These transmission lines will be connected at Santiago with the system fed by the Florida hydro-electric and the Mapocho steam stations, both of which were constructed some years ago by the Germans and were designed for 50 cycles three-phase power. The total capacity of the three generating systems will be, when completed, approximately 120 000 kW.

Sub-Stations.

The power supply will be distributed by five sub-stations designed to handle a train movement that is approximately 50 per cent. greater than that existing in 1917, with a further provision for tripling the 1917 traffic demands, if necessary. Each station will contain two 2 000 kW motor-generator sets, each set consisting of a 2 800 H.P. driving motor, and two 1 000 kW, 1 500 V generators connected in series. These sets will be designed to withstand a 200 per cent. overload for five minutes without injury, and as an additional safeguard the Westinghouse flash-suppressor will be included. Sub-stations Nos. 1 and 5 will receive power at 12 000 V and Nos. 2, 3 and 4, at 44 000 V. Transformers and switching equipment will be of the latest design, and the Westinghouse developed power-indicating and limiting equipment will be installed.

Electric Locomotives.

Thirty-nine electric locomotives are required for the initial electrification, including six express passenger, eleven local passenger, fifteen road freight, and seven switching locomotives. The main points of interest about these locomotives are given in the following table :—

Type Loco.	Weight.	Length.	Wheel Arrangement	No. of Motors.	Total H.P.	Max. Speed.
	Tons.	Ft. in.				M.P.H.
Express passenger	127	58 6	2-6-0 - 0-6-2	6	2 250	62½
Local passenger..	80	40 6	0-4-0 - 0-4-0	4	1 500	56
Road freight ..	113	49 10	0-6-0 - 0-6-0	6	1 680	40
Switching	65	40 —	0-4-0 - 0-4-0	4	480	34

The locomotives will be equipped with Westinghouse motors. The express-passenger and road-freight locomotives will be equipped with the Westinghouse system of regenerative breaking, with its most modern development, but the local passenger locomotives will not require or justify the regenerative braking feature.

Electrical Undertakings in India.

The Department of Overseas Trade has received the Third Supplement to the List of Electrical Undertakings in India, revised to October, 1921, which contains financial and technical details of the various licenced electrical undertakings in India. A copy of this Supplement may be seen on application to the Department (Room 84), 35, Old Queen Street, Westminster, London, S.W. 1. A further copy is available for loan to firms in the provinces (Reference E.D. 7 753.)

Future of Trolley Omnibuses.

In the course of a discussion at an Institute of Transport meeting at Warrington, last week, it was suggested that the availability of a cheap and abundant supply of electricity might result in the development of trackless trolley omnibus systems in places where it is not possible, owing to the heavy expenditure involved, to build the ordinary tramway track. The point was suggested by a lecture by Mr. E. H. Edwardes, general manager of the Lancashire United Tramways, Ltd., who, in his Paper, discussed the relative merits of the :—(1) Electric tramway, (2) trackless trolley traction, (3) motor omnibuses, (4) motor coaches. Mr. Edwardes was of opinion that all these systems had come to stay, would be further developed, and become more efficient. From estimates, after taking into account capital expenditure, the most economical form of road transport for heavy traffic, with regular services of not less than ten minutes' frequency, was the electric tramcar ; for services of ten to twenty minutes' frequency, trackless trolley traction ; and for anything less frequent, the motor omnibus. A form of traction had yet to be invented which could carry large numbers of people reliably and quickly, at as low a cost per passenger as the electric tram. The trackless trolley type of vehicle had been greatly improved recently, its seating capacity was now considerably greater than that of the motor omnibus, and operating costs were actually cheaper.

New One-Man Tramcar.

The London United Tramways are experimenting with a new one-man tramcar of their own construction. The new car is modelled on the lines of the " safety car " which is so widely used in America. It has been approved by the Ministry of Transport, and has been licensed by the Commissioner of Police. The vehicle is a single-decker, and when running the whole of it is closed in. The motorman sits in the front part of the car in a vestibule, somewhat after the manner of the modern cabriolet motor-car. He operates the car by means of a controller with his left hand, and with his right hand operates the brake, which is of a patent hydraulic type, merely by a turn of the wrist. The brake is of the slipper type, and works on the rail instead of on the wheel. It is held off by the hydraulic pressure, so that in the event of any failure it operates automatically. Further, if the driver lets go of his brake handle, through sudden illness or any other cause, the power is cut off and the brakes applied. Passengers board and alight from the car at the front end, the door and step working in unison, and being operated by the motorman by a lever in the cab. The car cannot be started until the door is shut and the step folded. The experimental car is being tried in the Kingston district, and, if it gives satsfactory results, a number of similar cars will be built by the company. With these small, handy cars it will be possible to give the public a more frequent service in suitable districts, instead of a less frequent service of larger cars.

The Tramways Question in Edinburgh.

Lecturing on the subject of city transport before the local Merchants' Association, Councillor Moncur, Convenor of the Tramways Committee of Edinburgh Tramway Council, said that the introduction of the cable system into Edinburgh was a blunder. Last year the amounts for running charges of the cable cars worked out at 3·75d. per car mile, against 0·5d. per car mile for the electric cars in Leith, and a proposal to save, say, 3d. per car mile, or a total of £75 000, was not one that could be lightly turned down. Last year the maintenance charges were 5·9d. per car mile for the cable cars, and 2·9d. for the electric cars. The electric overhead system had been shown to be the most economical, efficient, and elastic method known to engineering, and it was with the knowledge that they would be assured of that efficiency that it was decided to run no risk even in Princes-street. He could not believe that the erection of centre poles and wires in Princes-street would detract from the amenities in any way. In any case, he considered the advantage of a uniform system far outweighed any sentimental objections.

The Dean of York, whose *locus standi* in the matter is not quite clear, writes to " The Times" " protesting against the proposed action of the city authorities, which would disfigure the street and interfere disastrously with the view." " Surely," he continues, " an effective endeavour will be made to save Princes-street before it is too late by lovers of beauty throughout the kingdom, and by some who have more right to speak and more influence to exert than one who is merely an occasional visitor with a great love of Scotland and of romantic beauty." We feel sure that the financial arguments of Mr. Moncur will appeal more to the canny Scot than the æsthetic ones of the Dean.

The Municipal Electrical Old Stagers.

The question is : When is a municipal electrical engineer an old stager? The answer : When, having been in municipal service before midnight on Dec. 31, 1900, he has ever been a chief. Fifty-one of them, among whom were Messrs. S. W. Baynes, J. K. Brydges, J. E. Edgecombe, R. F. Ferguson, A. L. C. Fell, A. Gay, J. S. Highfield, F. Harman Lewis, W. W. Lackie, E. T. Ruthven-Murray, A. Page, H. Faraday Proctor, G. Scott Ram, Sir John Snell, J. E. Stewart, C. D. Taite, H. Talbot, T. P. Wilmshurst, and C. H. Wordingham, sat down to dinner at the Hotel Cecil on Friday last, with four guests, namely, Ald. W. Walker, Chairman of the N.J.I.C. Electricity Supply Industry, Mr. H. Booth, Mr. W. L. Madgen, a list of names of those who were prevented from being present, and letters from Alderman Pearson, who has been Hon. Solicitor of the I.M.E.A. for so many years, Mr. A. B. Mountain, one of the founders, Mr. A. P. Trotter, Mr. A. Bromley Holmes, and others.

After dinner a group photograph was taken, which we reproduce herewith, and brief reminiscences were given by Messrs. Baynes, Chamen, Christie, Highfield, Ruthven Murray, Faraday Proctor, C. H. Wordingham and R. Birkett. The note of cordial good fellowship and cheeriness was most marked, and all those present seemed greatly to appreciate the opportunity afforded of meeting old friends,

Photo W. O. Newman.

The "Municipal Old Stagers"—After Dinner.

first Hon. Secretary of the I.M.E.A., and Mr. S. T. Allen, President of the I.M.E.A. All these were under the chairmanship of Mr. Arthur Wright, the first President of the I.M.E.A.

The Essential Idea.

The essential idea of the gathering was the reunion, under circumstances as informal as possible, of old friends who had borne the burden and heat of the day in municipal electrical supply. There was only one toast in addition to the loyal toasts, namely, that of the Old Stagers themselves, proposed by Ald. Walker and responded to by Mr. A. Wright and Sir John Snell.

The Organising Hon. Secretary, Mr. C. H. Wordingham, read well remembered, though not seen for many years. Through the kindness of Mr. Hughman, the menu card bore an excellent reproduction of a block published by "Lightning" ("Electrical Times") in 1896 of some of the original members of the I.M.E.A., while Mr. Bentell lent a set of seventeen framed autographs of early members of the I.M.E.A., of whom eleven were present at the reunion. These were a centre of great interest and pleasure. A number of early I.M.E.A. photographs were shown by Mr. H. Faraday Proctor. Many present expressed the hope that the function might become an annual one, but opinions differed as to whether the time limit should be raised as the years went on, or whether the original limit should be maintained until only two toothless, deaf and blind old men were left to hobble in and dine on one another.

Domestic Engineering.

Before the Women's Engineering Society on Tuesday, Miss Gwynne Howell delivered a lecture on "Domestic Engineering," in which she dealt mainly with electrical labour-saving appliances. The lecturer emphasised the need for educating women to the advantages of these appliances, and so to create a demand and bring down the initial cost, which at present was quite beyond the means of the average housewife. Many of the most useful appliances, such as washing machines, were far too bulky for the ordinary house, flat, or maisonette. What was wanted were smaller, more compact machines, and, above all, utility motors which could be attached to several appliances. A further necessity was a universal voltage. In one showroom in London the appliances on one side of the room could not be worked on the same voltage as on the other side. Small labour-saving appliances, such as electric toasters, were being put on the market almost daily, and were becoming a snare to the housewife, as to possess too many of these only meant a change from one kind of work to another, on account of the additional polishing required to keep them clean. An interesting discussion followed.

The Revo Electric Iron.

The following letter, which was written to the Cable Accessories Company on Jan. 12, by Mr. H. W. Teeton, of the Foundry Works, Hanley, is, as the writer states, a good testimony to the excellence of the Revo electric iron :—"I have returned to you to-day, per post, one Revo electric iron, which I supplied to a customer on Dec. 16, 1920. The iron is a 100 V one; it has been in use since this date on a 200 V circuit, and has now burned out. The failure appears to have been in the mica insulation and not in the element itself. I have supplied my customer with a new iron, as I thought it might interest you to see this one, which is certainly a good testimonial to the capabilities of the Revo iron."

An Open Competitive Examination for 15 situations as assistant engineer in the Engineer-in-Chief's Department of the General Post Office will be held in London, Edinburgh, and Manchester, beginning on April 20. Particulars may be obtained on application to the Secretary, Civil Service Commission, Burlington-gardens, London, W. 1.

The S.-E. Lancashire Inquiry.

The inquiry into the South-east Lancashire electricity scheme was concluded on the 19th inst., three days being sufficient for the investigation. After Mr. Tyldesley Jones, K.C., had explained the general principles of the scheme, Ald. W. T. Dagnall, chairman of Manchester Electricity Committee and of the committee responsible for the scheme, gave evidence. He said he did not think that the scheme would suffer by the exclusion of Stalybridge. A smaller Board than forty-eight would be more manageable, but it was not intended the whole Board should do the work. A smaller committee would present its recommendations to the Board.

Mr. S. L. Pearce, electrical engineer of Manchester, gave details of the technical proposals. He said that the statistics compiled by the committee had been criticised, and evidence had been called to support them.

Adjustment of Areas.

At this stage the Town Clerk of Macclesfield, which is not at present included in the provisional district, asked that the town should be included. With a cheap and good supply of electricity, Macclesfield was likely to undergo considerable industrial development, and his Council had passed a resolution favouring inclusion in the scheme. Evidence to a similar effect was given by the Clerks to the Macclesfield and the Bollington Rural Councils, two neighbouring authorities. The boundary of the Macclesfield rural district was within four miles of the Stockport generating station, and Bollington Council felt it was more likely to be helped by South-east Lancashire than by the North Wales area, with which it is now grouped.

The Town Clerk of Buxton asked that his Council's area and those of the neighbouring authorities of Hayfield, Whaley Bridge and New Mills (at present in the North-east Midlands area) should be excluded altogether from any electricity district. If any district was entitled to exclusion on account of its geographical position, that district was Buxton, which was cut off from Sheffield by the Pennine Range.

Sir John Snell said the Commissioners were agreed that physical and economic difficulties were involved in associating Buxton with the Sheffield area.

The Town Clerk replied that more help might possibly be given them by South-east Lancashire than by the Sheffield area, but even from South-east Lancashire they could not expect anything during the next ten, fifteen, or possibly twenty years.

Sir John Snell reminded the witness of the possibility that the railway line between Manchester and Buxton might be electrified—a possibility which lay within the limits of practical politics. Supposing that were done, would Buxton object to receiving such an advantage, and would the association of Buxton with the South-east Lancashire area be considered a disadvantage during the years that might intervene before that electrical inter-connection could be established?

The Town Clerk said he thought not. If, by coming into the area, Buxton could in any way help towards electrifying the line from Manchester, then Buxton would be pleased to come in. But if they were to derive no benefit during the next ten or fifteen years there was the question of the contribution. It was a trifling amount, certainly—only ten guineas a year. From the residential point of view, and from the point of view of community of interest, Buxton was more nearly tied to South-east Lancashire and Manchester than to any other district.

Approval of Railway Companies.

At this point Mr. Tyldesley Jones, K.C., informed the Commissioners that the railway companies in the area, subject to one or two points on which a provisional arrangement had been made, were in agreement with the scheme.

Continuing his evidence, Mr. Pearce said that £13 000 000 represented the cost of extensions of plant which would be required in the ordinary course if the existing systems were continued in the area; it did not, however, mean that an expenditure of £13 000 000 was proposed under their scheme. Actually the scheme was an attempt to save £1 400 000 of that £13 000 000, which would otherwise be incurred. Personally, he was sanguine about the prospects of carrying out the scheme, which rested on a basis of voluntary co-operation. At present there was voluntary connection among authorities which between them accounted for 80 to 85 per cent. of the total number of units generated in the area.

The scheme had been unanimously adopted by the authorities represented at the conference, and at the same time keen hostility was shown towards the idea of setting up a joint electricity authority. As far as he could discover, no undertaking was willing to transfer its generating plant or main transmission lines to a joint authority, and such an authority, to be completely successful, must dominate the whole area—which implied a system of common ownership and common operation, with ample financial powers. As a technical scheme the present proposals were the best which the engineers could put forward.

Opposition of Stalybridge.

The attitude of the Joint Electricity and Tramways Board of Stalybridge, Hyde, Mossley and Dukinfield, which desired to be omitted from the scheme, was explained by Mr. T. Eastham, and Mr. Pearce admitted, in reply to Mr. Eastham, that the Stalybridge undertaking, owing to the non-standard frequency of the current which it supplied, would be precluded for many years from benefiting by inclusion in the scheme. The rest of the area would not be injured if Stalybridge stayed out.

Mr. Eastham objected that it would cost Stalybridge £400 or £500 a year to be included in the scheme.

Sir John Snell asked if Stalybridge would object to being included if it were not asked to contribute to the expenses of the Board.

Mr. Eastham replied that if he were informed that Stalybridge need not pay anything he would obtain fresh instructions.

Mr. Tyldesley Jones said he could not suggest that Stalybridge should pay nothing, but he would suggest that the Stalybridge contribution should be put on a nominal basis of twenty guineas.

More Boundary Adjustments.

On the 19th inst. the Clerk to the Rural Council of Chapel-en-le-Frith asked that part of his rural district should be included in the South-east Lancashire district. At present the whole of Chapel-en-le-Frith was included in the North-east Midlands (Sheffield) area. The rural district embraced seventeen parishes, and as it might be a long time before electric current could be taken across the bleak expanse dividing one part of the rural district from the other, he thought it desirable that the nine parishes to the north of the Pennines should remain in the Sheffield area and the eight parishes to the south be transferred to the South-east Lancashire area.

Mr. Tyldesley Jones, K.C., said the promoters offered no objection to the inclusion of the eight parishes in South-east Lancashire.

Mr. C. D. Taite, chief engineer and manager of the Lancashire Electric Power Company, also gave evidence in favour of the scheme. The electricity undertakings in the area included some of the most efficient in the country. In the statistics prepared for the inquiry the Lancashire Power Company's costs were the lowest, and at present the undertakings of Bolton, Bury and Stalybridge were first, fourth, and sixth respectively in the United Kingdom for the lowness of their working costs.

Agreement with Stalybridge.

After a consultation Mr. Eastham announced that the Stalybridge, Hyde, Mossley and Dukinfield authorities were prepared to come into the scheme, though they did not expect to get any material benefit for the present. They had been impressed by Mr. Pearce's views of its possibilities and were anxious not to do anything to spoil it. It had been agreed that a special clause should be added to the scheme, recognising the case of the Stalybridge joint board as a special one, allowing the Joint Board to retain its frequency of forty, and limiting its financial contribution to twenty-one guineas.

Sir John Snell expressed the Commissioners' satisfaction that agreement had been reached, and a difference of opinion having developed over the drafting of the clause, Sir John said that the Commissioners would settle the points at issue themselves.

Mr. Perkins, who appeared for the Yorkshire Electric Power Company, objected to the inclusion of Saddleworth and Springhead on the ground that it would mutilate the Yorkshire company's area.

Mr. Eastham opposed Mr. Perkins's application on behalf of the Stalybridge undertaking, which also has interests in Saddleworth and Springhead; and Sir John Snell observed that as far as he could see, the powers of the Yorkshire Electric Power Company would remain entirely unaffected by the scheme.

Position of Advisory Board.

A long discussion took place between Mr. Tyldesley Jones and the Commissioners over a clause which gave a constituent authority the right of appealing to the Commissioners against the Advisory Board's recommendations.

Sir John Snell asked if the constituent authorities would agree to be bound by the Commissioners' decision.

Mr. Tyldesley Jones said "No," and instanced the possibility of a constituent authority being compelled by such a decision to spend large sums of money against its will. At present Manchester Corporation were expending several millions in erecting a generating station, and the obligations they were undertaking to outside authorities accounted for about a million of that sum. Supposing that in the future the Advisory Board required them to spend two or three millions in extending that station to cope with the needs of outside districts, and that Manchester's refusal to do so was overruled by the Commissioners. Was it reasonable that Manchester should be bound to raise £3 000 000 on the rates in order to comply with such a decision?

Sir John Snell asked what was the good of appealing to the Commissioners if the parties declined to abide by their decision.

Sir Harry Haward, who confessed that he had a good deal of sympathy with the local authorities in their objection, suggested that the difficulty might be met by limiting appeals to the Commissioners to subjects outside finance, leaving financial points to be dealt with by the constituent authorities themselves.

Mr. Tyldesley Jones promised that his clients would consider the suggestion.

The inquiry then concluded, and Sir John Snell paid a tribute to those responsible for the preparations of the technical details.

Licences of Right have been granted to F. Butterworth for patent No. 13 146/14 for "improvements in and relating to electrical condensers"; to A. L. O. Fauchon-Villeplée, for Patent No. 128 241 (9 243/17), for "improved electric gun or apparatus for propelling projectiles"; and to E. G. Mascarenhas, for Patent No. 153 153 (24 197/19), for "improvements in electric lamps."

Legal Intelligence.

Claim for Electric Motor Repairs.

In the Shoreditch County Court, on Thursday last, the Cohalt Electrical Company sued Mr Roysenthal to recover £14 5s. for work done, including the repair of a 30 H.P 480 V motor, rewinding two field coils, re-insulating two other field coils, and repairing open circuits in armature.

Mr Wilfred E. Hackett, partner in plaintiff firm, said the orders for the work were verbal, the first being on Aug. 21 for repairs to an electric motor. It was defendant's custom to send the electric motors along for repair, and collect them on completion, but in the case of the first item on the claim, he was asked to send the motor by special van, which he did.

After hearing the evidence, Judge Cluer found for plaintiff for the full amount claimed.

Telegraph Wires Over a River.

At the Hull County Court, on Monday, the Postmaster-General sued Captain Barraclough, Barton-on-Humber, for damage caused by the breaking of fourteen telegraph wires by the mast of the defendant's vessel. It was stated that the wires were over the Aire, near Taylor's Wharf, at Leeds.

For the defence it was urged that a sharp look-out was kept over the river, but defendant could not be expected to be looking into the sky to see if it was necessary to lower the mast.

Judge Lock, in giving his decision, said masters of river craft, who were accustomed to going under wires, did not lower the masts unless a warning was given on the bank in the case of exceptionally low wires. Therefore he gave judgment for defendant.

Electric Lighting Plant Dispute.

At the Chester County Court, last week, Messrs. Cheshire Bros. sued Messrs. F. J. Jones and Sons, electrical engineers, and Messrs. Studebaker, Ltd, for the recovery of £39 3s. 6d.

For plaintiffs, it was stated that they received an inquiry for a Lalley lighting set from Monmouthshire, and Messrs. Jones were given the order. Subsequently, an advice note was received from Messrs. Studebaker from which it was known that the erection of the plant had been completed. Complaints were afterwards made of the engine stopping; Mr. Jones suggested certain tests and alterations, and he promised that he would supply a new diaphragm. After the alterations had been effected the trouble still existed, and later on Mr. Jones admitted that the plant was defective.

The manager for Messrs. Jones and Sons denied that the plant was defective when delivered, but another witness said the plant had been badly erected, and the vibration was causing trouble.

Mr. Marshall Tate, manager of the Lalley light department of Studebakers, said the machines were tested in America and in England before being sent out. He did not think there was any responsibility on the firm to put the plant right.

Judge Parsons, K.C., found for plaintiffs as against Messrs. Jones for the amount claimed, and granted an indemnity in favour of Messrs. Jones as against Messrs. Studebaker, Ltd., for the amount payable by Messrs. Jones, with costs.

Wiring Contract Disputes.

The quality of the work in connection with the "wiring" of a dwelling house was disputed at Marylebone County Court last week before Judge Scully, when Mr. Douglas H. Brayne sued Mr. W. A. Clark for £9 balance of an account for work done and materials supplied. Plaintiff wired defendant's house at Putney, the work having been finished about August or September last. He did not send in an account, but asked defendant for payment. He sent in an account later, however, after having asked defendant for payment several times. He had heard of no complaint regarding the work until defendant filed a counter-claim. The cost of the work amounted to £19. Defendant paid him £5 when he commenced the work and another £5 when it was nearing completion.

Defendant in his evidence alleged that the work was improperly done. He arranged with plaintiff to use iron pipes, but that was not done and the wires were exposed. Defendant also failed to keep an appointment when the work was being tested by the County of London Electric Supply Company, who subsequently told him that the work was disgracefully carried out.

Plaintiff said that he could not keep the first appointment, but he kept the second one. He added that in connection with the London County Council housing schemes the wiring was carried out in a fashion similar to that adopted by him, and only about 2½ per cent. of electrical contractors adopted the method suggested by defendant.

Defendant: But I asked you to do it my way, and you ought to have done it. Defendant added that plaintiff had used some of his fittings, although he contracted to use his own fittings.

In reply to the Judge, plaintiff said the fittings were a small matter and would not amount to more than one-sixth of the total.

Defendant said that no fuses were put in until they were supplied by the Supply Company.

Plaintiff: They were in when I was at the second test.

Judge Scully gave judgment for plaintiff for £7, with costs.

At Marylebone County Court, on Monday, Judge Scully heard another wiring dispute. Mr. R. H. Essex, an electrical engineer, sued Mr. F. Shirley for £11 15s. for work done. Plaintiff stated that defendant employed him to install electric light in a workshop. The contract was that plaintiff was to have £1 a day, and defendant was to supply all the materials. Plaintiff spent six and a half days on the work, and later it was agreed that he should receive £6 5s. in discharge of his account. Witness also installed electric light in defendant's flat, and was to receive £4 10s. for erecting the wires and putting a meter in the basement.

In cross-examination plaintiff said he was an electrician and motor mechanic. He was not aware that the defendant had had the work to do all over again.

A solicitor stated that owing to illness the defendant could not appear in court.

Judge Scully gave judgment for plaintiff for the amount claimed, with costs.

Working of an Electric Washing Machine

On Tuesday Mr. Justice Coleridge heard an action brought by Rear-Admiral Sueter and his wife against Harrods, Ltd., to recover damages for personal injuries, alleged to have been caused by the negligence of defendants' servants. The defence was a general denial of the allegations, and a plea that, if defendants had been guilty of negligence, the female plaintiff had herself contributed to it by attempting to put a handkerchief between the rollers of a washing machine, and holding it so negligently and unskilfully that her fingers were drawn with it between the rollers of the machine.

In opening the case, Mr. Hardy said that Admiral Sueter and his wife thought of acquiring a "Thor" electric washer, which Messrs. Harrods were offering for sale, and it was arranged that an experienced demonstrator should be sent with the machine. In August, 1920, the demonstration took place at plaintiffs' house, and during the demonstration Mrs. Sueter's fingers were drawn between the rollers, and, it was alleged, the cartilages of the joints were badly crushed and she suffered a severe shock, which made massage necessary. She received other medical treatment, and she was incapacitated for some time. It appeared that Mrs. Sueter asked if she might try the wringing out of her handkerchief in the wringing part of the machine, and the man who was giving the demonstration agreed. The man then turned the switch, and the barrel and the wringer began to revolve. Mrs. Sueter tried to feed the handkerchief into the wringer, but she could not get the wringer to bite the handkerchief. Suddenly the rollers reversed themselves. Mrs. Sueter's hand was drawn right in and crushed. Counsel said the man was so incompetent that he could do nothing to release Mrs Sueter's hand; he could not stop the machine, nor could he in any way release the rollers. Admiral Sueter's electrician kicked away the plug connecting the machine with the house wire, and the Admiral released the pressure from Mrs. Sueter's hand by unscrewing the top of the wringer.

Admiral and Mrs. Sueter gave evidence as to how the accident occurred, and Dr. Windsor described the nature of the injuries, which he admitted in cross-examination were not of a serious kind.

This closed plaintiffs' case, and after the demonstrator from Messrs. Harrods and other witnesses had given evidence for the defence, the Judge, without calling upon counsel to address him, delivered judgment in favour of Messrs. Harrods. He said that he was satisfied that the accident happened not from any circumstances over which they had control, or for which they ought to be held responsible, although he was disposed somewhat to doubt the competence of the operator. The real cause of the accident, however, had never been pleaded. There would be judgment for defendants, with costs.

Dispute about Telegraph Posts.

At Paignton County Court, on Monday, His Honour Judge Terrell, K.C., gave his decision as arbitrator on a difference which had arisen under the Telegraph Acts between Sir Robert Harvey, of Harberton, and the Postmaster-General.

In giving his decision, His Honour said that the case arose out of the intention of the Postmaster-General to extend the telegraph service from Totnes to Tuckenhay Mill. The Postmaster-General proposed to erect twenty-eight telegraph posts in the hedge alongside the road from Painsford Cross to Langridge Cross, Totnes, and to place in the field adjoining the hedge six stays. Sir Robert Harvey was willing to consent subject to a payment by the Postmaster-General of 1s. a year per post. The Postmaster-General offered to pay 6d. a year for each stay, but he claimed the right to place and maintain the poles without payment. He found that Sir Robert Harvey had given his consent upon terms, which were not prohibitive, and which were commonly agreed to between the Postmaster-General and private owners. Although the language adopted by the Telegraph Act of 1916 was very obscure, he thought he should be right in holding that the introduction of the condition to the granting of the consent was a refusal within the meaning of the Act of 1916.

His Honour said he had, however, to satisfy himself that the refusal to give consent was contrary to the public interest. The only evidence on that point was that of Mr Aldridge, the Superintendent Engineer of the S.W. District, who said the poles were required to supply a telephone service to Tuckenhay Mill. That was a purely private line, and in no sense a matter of public interest. The poles would, if required, be used for general telephone purposes. He understood that at present the poles would not be required for general telephone purposes, but, if required, they would be used hereafter. Mr. Sheldon, Engineer for the Exeter Section, told him that before that line was erected applications for a public line to Ashprington and Dittisham were made, and at the latter place they had been asked to put a telephone call office. He did not say they intended to extend a line to the villages. The Postmaster-General had not satisfied him that the refusal was contrary to the public

interests; the refusal simply affected the private interests of Tuckenhay Mill. The other question he had to determine was that of payment. Sir Robert Harvey asked for 1s. a pole, which was the almost universal payment before 1916. The Postmaster-General considered that no payment should be required in respect of the poles and wires, but he was willing to make a small nominal payment for the stays. He came to the conclusion that the application of the Postmaster-General had failed, and that the refusal of consent was not contrary to the public interests. If he was wrong as to that, then he held that the payment of 1s. per pole was a reasonable and proper condition to the giving of consent. His Honour, therefore, dismissed the application, with costs.

Hastings Tramway Arbitration Appeal.

On Monday Mr. Justice McCardie had before him a special case stated by the arbitrator in the dispute between Hastings Corporation and the Hastings Tramway Company. It related to the construction to be put upon the word "cable" in a section of the 1920 Act relating to the construction of No. 1 tramway along the sea front.

Mr. Roskill, K.C., appeared for the Tramways Company, who appealed against the arbitrator's award, and Mr. McMorran, K.C., was for the Corporation.

Mr. Roskill explained that the dispute arose out of the Hastings Tramway Act, 1920. The tramway was one mile six furlongs long, and the Act of 1903 provided that it should not be constructed on the overhead system. The Dolter surface contact system, which was adopted, proved unsatisfactory, and it was discontinued by order of the Board of Trade in 1914. Then it was worked on the petrol electric system, and that also proved unsatisfactory, and finally the company was authorised to use the overhead system. Certain words in the Act threw upon the company the obligation of connecting new lamps, which they had had placed on the tram standards, with the existing main. The Corporation contended that the company must place a new lighting cable, or an addition to the existing one. Mr. Roskill read the section of the Act, and said the arbitrator ordered them to provide a main cable for a stretch along the Front. He had found that, because the Corporation had chosen to place upon each of those standards, 40 yards apart, two 200 V gasfilled lamps, instead of one arc lamp on each standard, 80 yards apart, and because that necessitated an extra cable, therefore there was an obligation upon the company to provide that extra cable.

Mr. McMorran said it was a condition of the withdrawal by the Corporation of their objection to the overhead system that they were to get a new lighting system provided at the expense of the company. That was all the Corporation got in return for their assent to the overhead system. Once the Corporation proved a new cable was necessary, that cable must be provided by the company.

His Lordship, in giving judgment, said he thought Mr. Roskill was right. There was no statutory obligation on the company to provide a main cable, but only an inter-connecting cable. His Lordship was satisfied that from every point of view the Act supported Mr. Roskill's contention, and he allowed the appeal, with costs.

The Institute of Metals.

The annual meeting of the Institute of Metals will be held in London on March 8 and 9, when ten Papers will be presented for discussion. At the annual dinner at the Trocadero on Wednesday, March 8, lady members will be present.

The annual May lecture will be delivered on May 3 by Sir Ernest Rutherford, on "The Relation of the Elements." The autumn meeting will be held at Swansea from Sept. 20-22. From October to December (as well as during the present quarter) meetings of the various local sections—membership of which is free to members of the parent body—will be held in London, Birmingham, Sheffield, Glasgow, Newcastle-on-Tyne, and elsewhere. Last year the membership of the Institute increased from 1 298 to 1 410.

Power Supply Amenities at West Ham.

Many of the large power users in West Ham met last week at the Beta Works of Estler Brothers to receive the report of a preliminary committee appointed to investigate the condition of the supply of electricity for power in the district. The report was read by Mr. B. Estler, who referred to the frequent stoppages in supply and to the circular issued to consumers early in December last, asking them to reduce their consumption of current during the afternoons. This had occurred in spite of a promise made that after March, 1921, when it was expected that new plant would be installed, there would be an improved supply. The frequent stoppage and the curtailment asked for had been a serious matter for manufacturers and workers. The committee had made inquiries as to the price of electricity in West Ham, and found that it compared very unfavourably with other undertakings. This occurred, too, in spite of its large demand, one of the greatest in the kingdom, its good load factor, and favourable situation. Figures of the cost and price of electricity in West Ham and other undertakings about London were given in proof of this statement. After a lengthy discussion, in which several present gave details of the present heavy charges for their power, the following resolution was carried unanimously: "That this general meeting of the power consumers of West Ham, which has been called, resolves itself into a West Ham Electric Power Consumers' Association, with the object of obtaining an adequate and proper supply of power from the West Ham Corporation at a reasonable cost."

Electricity Supply.

Bedford Town Council has decided to grant an honorarium of £350 to the Borough Electrical Engineer, Mr. R. W. L. Phillips, in recognition of his services in connection with the new generating station.

Hull Electricity Committee report that the damage done to the mains and undertaking of the Electricity Department has been repaired at a cost of £2 600, the premises of 2 400 consumers having been overhauled.

Preston Electricity Committee has recommended the extension of the time limit for the purchase of the National Electric Supply Company's undertaking from the end of February, 1922 to the end of February, 1923.

At the annual meeting of the Stalham Electric Supply Association the Rev. M. C. Wallis was re-elected chairman of the committee. It was resolved that interest be paid to subscribers of over £35 at the rate of 7 per cent.

In view of the approaching completion of the super-power station at Portobello, the Edinburgh Electricity Sub-committee recommend the appointment of a sales superintendent for the Electricity Department, at a salary of £500 per annum.

It was stated at last week's meeting of Accrington Electricity Committee that no communication had yet been received from Blackburn Corporation with reference to the Commissioners' suggestion to lay an inter-communicating cable between the two towns.

The Stafford Town Council has, by sixteen votes to seven, rejected a recommendation to increase the salary of the Borough Electrical Engineer and Manager, Mr. W. H. Robins, from £550 to £650 per annum, in recognition of his services in connection with the recent extensions.

With the object of developing the domestic cooking, heating and cleaning load, Hackney Electricity Committee propose, in conjunction with the British Electrical Development Association, to hold an Electrical Exhibition at the King's Hall, Hackney Public Baths, from Monday, April 24, to Saturday, April 29 inclusive.

Hove Council have decided not to take more than 20 per cent. of the current required for their electricity supply department under the arrangement for bulk supply from Brighton. Hove will therefore continue the use of their Holland-road generating station for some time longer, though the price of fuel and wages will no doubt determine how long this arrangement will continue.

The Electricity Commissioners will hold a Local Inquiry at the Town Hall, Wolverhampton, on Tuesday, the 21st prox., and following days, with reference to the area to be included in the proposed North West Midlands Electricity District, and to consider the Scheme submitted by the Conference of Authorised Undertakers for the improvement of the organisation for the supply of electricity within the district, and for the establishment of a Joint Electricity Authority.

Glasgow Finance Committee have intimated to the Office of Works that in view of its decision, together with the Kirk Session, to install electric lighting in the Cathedral, the Corporation consider themselves free from any obligation with regard to the lighting or heating of the Cathedral. They also refuse to remove the present gas fittings, as requested, and leave the Office of Works to do as it thinks best with regard to the disposal of these fixtures.

The Hydro Electric Development Company has been notified by the Treasury Committee that no facilities under the Government's credits schemes can be granted for the Grampian Hydro-Electric project. It is stated that the Government will recognise the value of the undertaking as a means of relieving unemployment later on, for the Committee have intimated that they will reconsider their decision when the Provisional Order passes all its Parliamentary stages.

In reply to a question by Mr. Burgess at last week's meeting of Bristol Town Council, Sir John Swaish said the total number of lamps at present in the streets was as follows:—Arc and gasfilled, 712; incandescent electric, 1 588; gas, 7 890; oil, 177. The number of gas lamps still to be converted to electricity was 384. The average cost of the conversion per lamp (including reinstatement of ground) was £15. The total cost would therefore be about £5 760. In 1913-14 605 lamps were converted; in 1914-15, a further 760; in 1915-16, 1 610. War economy prevented further conversions, but last year nine lamps were converted. The balance of the cost of these conversions was only paid off last year. There was very little difference in the maintenance charges. Of course, the electric lighting was the better, and as soon as possible they hoped to be able to extend it.

New Schemes and Mains Extensions.

The Urban Council has invited the Weston-super-Mare District Electric Supply Company to submit a scheme, with charges, for lighting the town, or any part of it.

Okehampton Town Council are considering the acquisition of the electric light installation owned by Mr. G. K. Blatchford. The plant has been inspected, and Mr. Blatchford has submitted two schemes.

Although considering it inadvisable to enter formal opposition to the Grampian Electricity Order, Banff Town Council have protested against Parliamentary sanction being given to the proposed diversion of the River Spey or its tributaries. A copy of the resolu-

tion is to be sent to the Prime Minister, the Secretary for Scotland, the Lord Advocate, and the Member of Parliament for the county.

ADWICK Urban Council will support the electricity reorganisation scheme of Sheffield and Rotherham Corporations for the NORTH-EAST MIDLANDS ELECTRICITY DISTRICT, provided there is distinct representation for urban districts.

Application has been made to the Electricity Commissioners by PRESTON Corporation for sanction to a loan of £420 000 for the construction of a generating station on the south side of the Ribble, to provide for two turbo generators.

At the monthly meeting of LANARK Town Council, last week, the proposals of the Electricity Commissioners in regard to the delimitation of the West of Scotland Electricity District were referred to the Electricity Committee for consideration and report.

OXTED Parish Council has decided to support the application of the Sevenoaks and District Electricity Company to the Trades Facilities Advisory Committee for a guarantee of capital, in order that they may extend their mains to Oxted and Limpsfield.

With reference to the application for a Special Order to supply electricity to the town and district by the Hutton Electric Company, BRENTWOOD Urban Council have decided to send a deputation to the Commissioners, together with representatives of the Billericay Rural Council before deciding to support the application.

A petition, together with a private Bill, has been submitted to the JERSEY States Assembly, asking for powers to erect a power station on the island to provide electric light. It is proposed to electrify the two railways and to institute a service of electric omnibuses. The whole is to be laid down free of cost to the island.

After considerable negotiations, the Electricity Commissioners have granted power to ACCRINGTON Corporation to borrow £100 000 for additional plant at their electricity station, which is urgently required. It is understood that these powers are not contingent upon the laying of an electric cable between Blackburn and Accrington, as the Commissioners strongly recommended a short period ago.

The Minister of Transport gives notice that he proposes to confirm the SPECIAL ORDER authorising AMBLE URBAN DISTRICT COUNCIL to supply electricity. Objections may be sent to the Ministry of Transport by Feb. 15. A copy of any objection must also be sent to the Council's Solicitor, Council Offices, Amble, or their Parliamentary Agents, Messrs. Lees & Company, Palace-chambers, Bridge-street, S.W. 1.

At a meeting of Hemel Hempstead Rural District Council last week, it was stated that the Electricity Commissioners were considering the advisability of cancelling the powers of the Chesham Electric Light and Power Company to supply electricity to KING'S LANGLEY, and that the Council had decided to support an application to be made by Watford Council for powers to supply in the district, provided satisfactory terms could be arranged.

At a meeting of CARDIFF Waterworks Committee last week, a long report was submitted by Mr. Priestley on the suggestion that the water in the new pipe line might be utilised for the generation of electricity. The report stated that Manchester, Liverpool, and Birmingham were all engaged upon new pipe lines carrying far greater quantities of water than in the second pipe line for Cardiff, and that not one of those cities had found it expedient to complicate the question of water supply with that of hydro-electric power stations.

In a report to the Corporation Electrical, Lighting, and Tramways Committee on proposed plant extensions, Mr. C. G. Morley New, the City Electrical Engineer, stated that the industrial depression had kept down the maximum load and output on the feeders. The generating plant at Roath Station had not yet been usable, and for some time they had been contending against difficult and uneconomical conditions. The boiler capacity needed to be increased immediately. He recommended the extension of the boiler-house plant by three water-tube boilers. The estimated cost would be £59 300, including accessories and building work.

A scheme recently put forward by the West London Branch of the Electrical Trades Union, for wiring small property in the Borough of HAMMERSMITH, has been considered by the Electricity Committee, who recommend that a sum of £500 be allocated for the purpose, subject to the details of the scheme being approved by the committee. A loan of £30 000, further on account of the sanction issued by the Electricity Commissioners last March for extensions to the electricity undertaking, is to be taken up through a private source at 6 per cent. interest. Sanction has been received to a loan of £2 500 for the scheme to link up the Battersea, Fulham, and Hammersmith generating stations, and the Public Works Loan Commissioners have been asked to lend the money.

A proposal to pay a consulting fee to Mr. G. G. Bell, the Borough Electrical Engineer, for work in connection with the linking-up scheme, was referred back to the Electricity Committee by the Finance Committee on account of the important principle involved. The Electricity Committee, having considered the matter further, reiterated their recommendation, and explained that a similar fee was paid for laying the first main between Fulham and Hammersmith, and that the three Councils shared the expense. The work is being carried out by the engineers of the three undertakings in rotation, and it has been agreed that the present main, which is a duplicate one, should be laid under Mr. Bell's supervision. The other Councils and the Commissioners have agreed to the proposed payment. A special meeting of the Council is being held this week to consider the matter.

CONWAY Council have entered into an agreement with the North Wales Power and Traction Company, under which the company will erect overhead transmission lines for the supply of electricity to the borough. There will be one line on the Conway side of the river to a sub-station at Beechwood Court, and another on the Llandudno Junction and Deganwy side, from the transmission line which will deliver current to Llandudno. The cost will be about £10 000, including transformers and switchgear, and this sum the Council will lend to the company, who will repay it in twenty-five annual instalments with interest, the Council agreeing to take a minimum quantity of energy equal to 320 000 units per annum at 1½d. per unit. The Council have decided to proceed at once with a canvass for consumers.

Alteration of Charges.

OSWESTRY Electric Lighting and Power Company are seeking powers to raise the price of electricity from 8d. to 1s. 3d. per unit.

MUSSELBURGH AND DISTRICT ELECTRIC LIGHT AND TRACTION COMPANY has appealed to Inveresk Parish Council against a proffered 47½ per cent. abatement of their parochial assessment, and have asked for a 75 per cent. abatement. The matter has been referred to the Law Committee of the Council.

The recent agreement made by DUDLEY Electricity Committee with the Shropshire Power Company for a reduction in lighting prices, on the understanding that no further reductions were to be pressed for within the next six months, was discussed at some length at the meeting of the Council last week. It was pointed out that the restriction fell hardly upon the power users, but the Mayor (Mr. H. W. Hughes) said the alternative to accepting the bargain was to go to arbitration, which was a lengthy and costly process. He thought they would be well advised to make the best of a bad job. The price of current for lighting would be 3¾d. per unit for customers of under 700 units, plus 60 per cent., making it 6d., while for power purposes the price would remain at a penny per unit, plus 115 per cent. Eventually the matter was referred back to the committee with a view to securing the attendance of the manager of the Power Company.

Electric Traction.

Eight new tramcars have just been delivered to the RAWTENSTALL Corporation.

STOURBRIDGE Town Council have decided to oppose the Black Country Tramways and Light Railways Bill.

It is stated that the LONDON AND NORTH-WESTERN RAILWAY COMPANY contemplates electrifying the North London line from Broad-street to Poplar.

An application for twelve days' holidays in the year instead of eight as provided in the national agreement has been granted to BELFAST tramwaymen on account of the terrible conditions under which they have been working in consequence of the bombing and firing to which the cars have been subjected.

By a majority of 188, DUBLIN tramway men have agreed to accept a reduction in their wages of 2s. per week from Feb. 1, and of 2s. from March 1, after which wages are to remain stationary to September 1. This will be the first reduction in their wages since the end of the war, and will bring them practically on a level with those prevailing in England.

Owing to the fog on Sunday a COLLISION BETWEEN TWO TRAMCARS occurred near New Cross Railway Station, one car ramming the other with such force that the front part of the car was telescoped into the other. The stairs were carried away, and the controllers were forced into the inside of the car. The driver was seriously injured, and a number of passengers were cut by splinters of glass.

The residents of Upper Norwood are organising OPPOSITION TO THE L.C.C. BILL for powers to extend the tramway from the Norwood terminus through Knight's Hill, Penge, Sydenham and Catford to Lee Green, in order to link up with the lines to Eltham. The opinion of the residents is that if more travelling facilities are required omnibuses should be introduced, and not trams. Moreover, as the proposed route would pass along Westow Hill, a narrow thoroughfare, and the principal shopping centre in the neighbourhood, tramcars would, they say, be a source of danger. There can be little doubt that on the proposed route tramcars would be safer than double-deck omnibuses, and their opposition must be based upon prejudice rather than on the merits of the case.

Trade Inquiries.

A firm established at Lyons desire to obtain agencies for Lyons and south-eastern France of United Kingdom manufacturers of vulcanised fibre for insulation. Particulars from the Department of Overseas Trade. Reference No. 75.

The Canadian manufacturers of a powerful ELECTRIC WATER-HEATER desire to dispose of their manufacturing rights in the United Kingdom. Particulars may be obtained at Canadian Government Trade Commissioner's Office, Portland House, 73, Basinghall Street, London, E.C. 2.

Personal and Appointments.

Mr. W. Finlayson, senior, engineering assistant in the Melbourne (Victoria) municipal electricity department, has resigned.

Mr. H. C. Day has been appointed electrical engineer and tramways manager to Heywood Corporation, in the place of Mr. D. H. Davies, who has been appointed to a similar position at Chesterfield. There were sixty-seven applicants.

Mr. Hope, who has been on the staff of the Burton-on-Trent Corporation Electric Tramways Department since they opened in 1903, is leaving for New Zealand, and the staff have presented him with an inscribed silver wallet containing a Bank of England note.

A reward of £500 has been offered for the apprehension of the person or persons who fired on Mr. Henry Vanderbot, the traffic manager of the Cairo Electric Tramways Company, who succumbed to his wounds on Sunday. Mr. Vanderbot was shot on Jan. 3, after the dismissal of a large number of workmen.

Mr. George Russell, telegraph superintendent of the Glasgow and South Western Railway, has been appointed chairman of this year's conference of the Telegraph and Electrical Engineers of the British Railways. Mr. Russell, who has been telegraph superintendent of the Glasgow and South-Western Railway Company for twenty-four years, was chairman of the conference in 1903.

In recognition of his long service as chairman of the Tramways Committee of the Leicester City Council, Ald. S. Flint, an ex-President of the Municipal Tramways Association, has been presented with a silver rose bowl mounted on an oak pedestal, subscribed for by the members of the committee. Ald. Flint is taking over the chairmanship of the new Electricity Committee, and is succeeded by Ald. G. Banton.

A portrait of the late Sir Gilbert Claughton, Bart., formerly chairman of the London and North-Western Railway Company, who had large interests in the industrial undertakings (iron and steel, gas and electrical) in the Black Country, has been presented to the Staffordshire County Council. He was an alderman of that body, and the gift was made from the County Council Picture Fund. The painting has been hung in the Stafford County Buildings.

Business Items, &c.

The Electro-Mechanical Brake Company have now opened London offices at Donington House, Norfolk-street, Strand, W.C. 2, with Mr. W. F. Knight in charge. (Telephone No., Central 1888.)

The Wardle Engineering Company have appointed, as from Jan. 1, H. L. Nathan, Ltd., 159, Great Charles-street, Birmingham, their representatives for Warwickshire, Staffordshire, Shropshire and Worcestershire.

Mr. A. Hinderlich informs us that he has taken over the sale of the wrought copper cable sockets and the resistance nets hitherto handled by the Protector Company, Ltd., and will carry on the business at the old address, Central Hall, Southall, Middlesex (Tel. : Southall 121).

Wailes Dove Bitumastic, Ltd., at their recent annual meeting, added to the board of directors Mr. Percy Hedley, engineer, St. James's-court, London, and Mr. Thomas Macdonald, son of Mr. Charles Macdonald, who has been associated with the company for many years.

Royce Limited, electric crane makers, Trafford Park, Manchester, have received an order for a 2-motor electric telpher, with self-dumping crab of 1-ton capacity, from the Worcester Corporation in connection with a scheme for an extension of the plant at their electricity station.

New electrical works have been opened in Linacre-road, Litherland, near Liverpool, by the Delta Electrical and General Engineering Company. The firm is specialising in lighting installations, motor repairs, armature winding, and is also undertaking toolmaking and millwright's work.

The productions of C. A. Vandervell & Company will be exhibited on Stand No 69, at the Scottish Motor Show, which opens in Glasgow to-morrow (Saturday). The exhibit embraces all the latest electrical productions of the firm, including the C. A. V. Willard starting and lighting battery. A full range of commercial, motor-car and motor cycle productions is also on view, comprising dynamos, starters, batteries, lamps, and electrical components of all descriptions

In connection with the visit of the Japanese Commercial Mission to Edinburgh on Saturday, Jan. 14, the Edinburgh Chamber of Commerce made arrangements for a visit to the electrical engineering works of Bruce Peebles & Company. On arrival at the works the party divided up into three sections, each section starting from a different point, to avoid confusion in the works. Considerable interest was shown in the work on hand for Japan, which includes Peebles-la Cour motor converters and induction motors for the Imperial Japanese Navy and the Kure Naval Arsenal. At the conclusion of the visit the party were addressed by Sir John Cowan (chairman of the company).

The Yorkshire Electric Power Company is seeking Parliamentary power to divide the whole of its issued and unissued £10 ordinary and £5 cumulative preference into £1 shares. The authorised capital is £2 000 000, and the issued capital now consists of 83 000 £10 ordinary and 54 328 £5 cumulative preference shares. The company has also raised £360 000 by debenture stock.

Institution Notes.

The next Salesmanship Conference will be held at the rooms of the Chartered Institute of Patent Agents on Feb. 17, at 7.30 p.m., when Mr. Haydn Harrison will open a discussion on "Salesmanship in Relation to Electric Lighting." Mr. S. T. Allen (President of the I.M.E.A.) will preside.

The Fuel Research Board have made arrangements for the recognition of the Lancashire and Cheshire Coal Research Association as the local committee working under the Board for the purpose of dealing with the physical and chemical survey of the coal seams in the area. The chairman of the committee is Mr. Robert Burrows, and the director of research Mr. F. S. Sinnatt.

The Association des Ingénieurs Electriciens Sortis de l'Institut Electrotechnique Montefiore announce that the international competition for the triennial Montefiore prize (interest on 150 000frs. 3 per cent. Belgian Funds) will take place in 1923. The prize is awarded for the best original work on the scientific progress or the technical applications of electricity in any of its branches. The works may be in French or English, printed or typed. Of the jury of ten electrical engineers, five are Belgian and five foreigners. Twelve copies of each work must be sent on or before April 30, 1923, to M. le Secretaire-Archiviste de la Fondation George Montefiore, 31, rue St. Gilles, Liège.

A students' meeting of the Chelmsford Engineering Society was held on Thursday, Jan. 19, in the Agricultural Institute, under the chairmanship of Mr. G. F. Barrett, when two junior members read Papers. Mr. J. A. Sayer dealt with "Search-Light Projection," and explained fully the electric arc and the methods of projecting a powerful light beam. Reference was made to an experiment carried out during the war, in which the light was reflected from a screen of liquid containing a solution of metallic salts sprayed into the air under pressure. By this means the beam of light could be reflected in any direction, while the search-light was safely concealed under the ground. Mr. E. Tomalin read a Paper on "The Production of Profile Gauges by Grinding," in which he described the usual workshop practice and methods of forming profiles of various shapes to a high degree of accuracy. It was claimed that profiles on gauges 1-16 in. thick could be ground to an accuracy of one ten thousandth part of an inch. Both lectures were followed by interesting discussions.

At a meeting of the Belfast Association of Engineers last week a paper was read by Mr. J. M'C. Girvan on "Electricity Supply; the Factors Determining the Cost to Consumer." Mr. Girvan stated that the first essential for low cost of production was that the demand should be of long duration, for the standing charges, which were determined solely by the magnitude of the demand, were thus spread over a large number of units. The second factor was the diversity of the demands. If the demands were simultaneous the standing charges per kW were a maximum; if they did not occur simultaneously the standing charges were proportionately less. The greater the area to be supplied, the more likely the load factor and the diversity factor would be improved. In conclusion, Mr. Girvan dealt generally with the situation in the Belfast electricity undertaking, and pointed out that they had to pay out of revenue for the upkeep of three stations, the existing East Bridge-street station, the temporary power station, and the non-productive new power station in the course of construction.

Telegraph and Telephone Notes.

The new underground telephone cable between Leeds and York has just been brought into use.

The Ascot Telephone Exchange, in Upper Village-road, Sunninghill, has been completed, and is now in operation.

A Rio de Janeiro telegram states the steamer "Cormorant," owned by the Western Telegraph Company, has been lost off the coast of Brazil. The "Deseado" saved the crew.

The Great Northern Telegraph Company has re-opened its office in Petrograd for the transmission of telegrams between Russia and other countries, excepting Finland.

A sufficient number of subscribers having been obtained in Caithness to warrant the installation of a telephone exchange, the P. O. Telephone Department have intimated that the work of erection will be begun at once. The service will be the first step towards linking up the north with the trunk line to the south.

The Japanese have now renounced their rights to the former German submarine telegraph cables in the Kiaochau (China) leasehold. The cables affected are the Chefoo-Tsingtao and the Tsingtao-Shanghai lines, which were laid by the Germans. The Tsingtao-Sasebo cable, which the Japanese laid down, will be operated by a joint Chino-Japanese commission, subject to the terms of existing contracts to which China is a party. The Japanese have agreed to hand over to Chinese control, subject to fair compensation, the two wireless stations in the leasehold, one at Tsinan-fu and the other at Tsingtao, immediately the Japanese troops are withdrawn from these points.

Arrangements have been made for putting Germany into direct submarine cable communication with the United States. It is announced that the Commercial Cable Company has agreed to lay

a new cable from New York to the Azores, a distance of 2 302 miles. At the Azores connection will be made with a new cable from Emden, which the Deutsch Atlantische Telegraphen Gesellschaft have contracted to lay. The cost of the manufacture of the cable and of the laying is estimated at £2 500 000, and the contract is to be carried out in eighteen months. The new cable will establish a direct service between the two countries. Since the Armistice cable messages to and from Germany have passed through either England or France, an arrangement to which American business interests object. Mr. Clarence Mackay, president of the Commercial Cable system, in making the announcement concerning the new cable, stated that his company ceded none of its rights or claims against the Allied Powers in connection with the former German cables, which they have diverted to their own uses. Naturally, the new cable will be of the latest design.

ABERDEEN Chamber of Commerce, last week, decided to make another effort to secure an extension of UNDERGROUND CABLES from Edinburgh to Aberdeen, to obviate such a situation as was brought about by the recent snowstorm through the destruction of overhead wires. Mr. Robert Milne, ex-president, in making a motion to approach Aberdeen Town Council with a view to getting Dundee Town Council and Chamber of Commerce to join Aberdeen in a representation to the Postmaster-General, said that the previous day the Aberdeen fish markets had upwards of £20 000 worth of fish on their hands, and they could not place a single quotation by telegram into the hands of a customer, or get a reply back. The messages were five, six, and seven hours delayed in dispatch, and the industry was paralysed. He had been on two delegations to the Postmaster-General. In 1911 they were met with platitudes; in 1913 they had a stiff reception, and were told it would be very expensive—£30 000 to Dundee, and another £30 000 to Aberdeen. On the last occasion they met the Postmaster-General he said that, in place of extending the underground cables, he was going to erect powerful wireless installations with phantom circuits. Those circuits had been "phantom" ever since.

Wireless Notes.

A wireless station with a radius of 300 miles has been opened at Grand Bassam, IVORY COAST, French West Africa.

A temporary wireless service is being established between STORNOWAY and the mainland until the cable communication, which broke down during the recent snowstorms, has been restored.

Farmers in FRANCE are to be advised by wireless of the Paris Observatory's weather forecast at the time it is made instead of waiting for the morning newspapers. Instructions on the erection of a wireless receiver are to be sent to all interested, and they will not be subject to any State tax for enjoying this privilege.

The RUNDEMANDEN RADIO-TELEGRAPH STATION, which is close to Bergen, and was equipped on the Telefunken system in 1912, is to be modernised by the Norwegian Radio Company, of Christiania. The new station will have a radius of 3 000 kilometres for telegraph, and 600 kilometres for telephone, by day, and a proportionately greater radius by night.

In urging the need for an improved and cheaper news service between England and India, the "Times of India" states that this can only be accomplished by COMPLETING THE IMPERIAL WIRELESS CHAIN, the future of which is prejudiced by the attitude of the British Post Office in "adhering to experimental and second-rate methods" while India is in direct communication with the Marconi station of Carnarvon. Recently, for a month at least, the London correspondent of the "Pioneer," of Allahabad, has been sending his news to India through the Carnarvon station, and it has been received in India intact. In December the Marconi Company offered to erect within twelve months a wireless station in India at its own cost. The station would be for commercial service with Great Britain, and elsewhere if required, and the expenditure would be not less than £400 000. As an alternative the company would erect the station and conduct the service on a joint account with the Government of India, on a basis similar to that approved recently by the Australian Parliament.

Mr. E. T. Fisk, managing director of Amalgamated Wireless (Australasia), Ltd., is reported by the "Industrial Australian" to have said the company are now fully prepared for establishing a modern WIRELESS SERVICE BETWEEN AUSTRALIA AND ENGLAND, and that, in order to provide for the growing traffic between Australia and North America, he has also made arrangements for a station to be established in Western Canada capable of communicating with Australia. Arrangement have also been made for sending and receiving commercial, social and Press messages between Australia and the United Kingdom at one-third of the existing cable rates. He has also an undertaking that if the Marconi Company erects and operates stations in India and South Africa capable of communicating with Australia, they will make similar traffic arrangements in regard to such communication. The Australian and the English high-power stations will be equipped with apparatus for duplex automatic reception and transmission. The main Australian station will be in the vicinity of Sydney or Melbourne, and the stations in other parts of the Commonwealth, besides acting as feeders for the trunk station, will afford facilities for communication to and from ships at sea.

Imperial Notes.

CONDOBOLIN (N.S.W.) Council have borrowed £7 000 for electricity supply purposes.

BALLIVA (N.S.W.) Council are negotiating for a supply of electricity from a local butter factory.

The N.S.W. Railway Commissioners have agreed to supply electricity in bulk to BANKSTOWN (N.S.W.) Council.

A petition has been presented to CORAKI (QUEENSLAND) for a poll on the question of borrowing money for establishing electricity works.

It is announced that the CANADIAN PACIFIC RAILWAY is likely to acquire the tramway service operated in Kingston and district by the West India Electric Company, another Canadian concern, with headquarters at Montreal.

As the outcome of his recent visit to CEYLON, Lord Northcliffe has expressed the opinion that, in regard to the proposed development of hydro-electric power, Ceylon has the same opportunities as Tasmania, especially in view of the high price of coal.

The "Daily News" states that a COMPANY has been FLOATED, with a capital of five lakhs, for the supply of electricity in the municipality of NAVASARI, INDIA (B.B. and C.I. Railway) and the adjoining area. Engines, generators, switchgears, &c., will be required.

CASINO (QUEENSLAND) Council have passed a resolution in favour of the adoption of an electric supply scheme, in conjunction with a project for pumping the town water electrically. The expenditure is estimated at £16 000. The proposal will require confirmation by the ratepayers.

The Victorian Railway Commissioners have arranged for the construction of h.t. feeder lines for the shires of LILYDALE, FRANKSTON, MORNINGTON and DANDENONG, and for the supply of electricity to these districts from metropolitan undertakings pending the carrying out of the Morwell scheme.

The High Commissioner for CANADA has received a cablegram from the Department of Customs, Ottawa, announcing that the enforcement of the provisions of the Marking of Imported Goods Act has been postponed by Order in Council until the close of the next session of Parliament.

The Minister for Works has reported to the Tasmanian Parliament that the transmission line from the Great Lake to Launceston, in connection with the TASMANIAN GOVERNMENT HYDRO-ELECTRIC UNDERTAKING, will be completed by Aug. 1 next. The steel required for the towers has now been obtained, chiefly from England.

BOMBAY Corporation is considering a scheme for the construction of a tube railway at an approximate cost of 2½ crores of rupees (about £1 600 000). It is suggested that the work should be undertaken by one of the two railway companies serving Bombay or by the tramways company, and, failing either of these, by the Corporation with Government assistance.

The TASMANIAN Minister of Works recently presented to the House of Assembly a statement on the progress of the STATE HYDRO-ELECTRIC DEPARTMENT. £932 507 was expended on the undertaking during the year ended June 30 last, bringing the total expenditure to £1 996 860, and £930 250 is to be spent during the current year. The Waddamana development of the Great Lake power scheme is rapidly approaching completion, and the whole plant should be in operation in less than a year

The Parliamentary Public Works Committee of the TASMANIAN HOUSE OF ASSEMBLY have reported in favour of building an ELECTRICALLY DRIVEN VESSEL to supersede the "Kangaroo," which has made the trip between Hobart and Bellerive several times daily since 1855. The estimated cost of the proposed new vessel is £30 000, including £15 000 for machinery, £16 000 for hull, and £2 000 for upper structure. The dimensions are to be:—Length, 140 ft.; beam, 35 ft.; depth, 8½ ft.; and the speed, 5 knots.

Though great efforts have been made to establish the IRON AND STEEL INDUSTRY IN AUSTRALIA on a satisfactory basis, it is reported that, owing to the severe competition of overseas manufacturers, the enterprise will have to be restricted to the production of rails and structural sections. Consequently the Commonwealth Government have been asked to impose a duty of 50 per cent., as anti-dumping legislation is not considered sufficient protection. The trouble is attributed mainly to the high rates of wages allowed by the Australian arbitration courts.

In connection with the proposal of the GOVERNMENT OF INDIA to establish a central organisation to buy all stores, whether imported or not, it is reported that the railway companies may also come into the scheme, and the local governments, the native States, and municipalities can come into it too, if they wish. The Bengal Chamber of Commerce, although to some extent an interested party, supports a proposal by the Calcutta Import Trade Association that the stores organisation should make it a rule to invite public tenders for all purchases above a limit of, say, Rs. 5 000

The "Times" Melbourne correspondent states that the Commonwealth Government has REFUSED ADMISSION INTO AUSTRALIA OF SIX GERMAN ENGINEERING EXPERTS engaged by the Victorian Government to supervise the erection of briquette machinery for the Morwell electricity scheme. Permission had been granted to import the briquetting apparatus, at a cost of £100 000, from Germany, on the plea that it was not obtainable elsewhere. The action of the Federal Government is taken under the amended Immigration Act of 1920, which

classes persons of German parentage and nationality as prohibited immigrants for a period of five years. The Act gives the Federal Government the power to grant exemption, but the Government refuses to exercise it, saying that the Victorian Government could have obtained experts from North America.

The directors of the HONGKONG TRAMWAY COMPANY have decided to assign the whole of the tramway undertaking to a new company, to be incorporated under the Hongkong Companies' Ordinance in exchange for shares of that company. The capital of the new company will be 325,000 shares of the nominal value of $5.00 each, treated as fully paid up, which will all be issued to the existing company. This arrangement is being carried out in order to avoid the incidence of English taxation, and particulary the corporation profits tax. It will also diminish differences in exchange.

The SYDNEY correspondent of the "Telegraph" states that Mr. McGregor, the British Trade Commissioner, in his report on Australian trade conditions, lays stress on the importance of Australian trade with British manufacturers in view of a probable considerable increase in the population in the future. Australia buys 60 per cent. of her overseas requirements from the United Kingdom, which proportion should increase to 75. The principal weakness is in machinery, engineering material, and metal manufacture, of which the United Kingdom percentage is 57 out of total imports of £39 000 000. There is, he states, abundant evidence that many firms are doing business in Australia without studying local conditions, or formulating a sales policy.

The KINGSTON (JAMAICA) correspondent of the "Times Trade Supplement" states that the Governor of British Guiana, at the opening of the annual session of the Combined Court, intimated that the Government intended to ask for a vote to carry out a contour survey of the colony above the Great Falls on the Demerara River in order to decide whether or not a reservoir lake can be established to enable a good permanent head to be maintained for hydro-electric works. The Governor stated that it was not likely that the colony would undertake the construction of hydro-electric works out of its own funds, but capitalists in Great Britain would be disposed to do so once they were satisfied that they would find a market for hydro-electric power if it were provided.

It is stated that very little interest is being shown in Canadian Government circles regarding the report of the Joint International Commission on the DEEPENING OF THE ST. LAWRENCE waterway for the purposes of navigation and water power. The report declares the project feasible and recommends a division of the cost of construction between Canada and the United States on the basis of benefits received through navigation; but the general opinion seems to be that, while the construction of the waterway will prove beneficial to the Dominion, owing to the financial position of the country, the scheme could not be undertaken for some years. The estimated cost of making a 30ft. channel on the St. Lawrence River from Lake Ontario to Montreal would be $269,000,000 (£54,000,000 at par), and on the Welland Canal to $60,000,000 (£12,000,000).

A notification issued by the INDIAN GOVERNMENT on Dec. 17 last gives the following amongst other new valuations for IMPORT DUTIES upon articles imported into India :—Telegraph instruments and apparatus imported by a railway company (formerly duty free), 2½ per cent., *ad. val.;* implements, instruments, apparatus, and appliances not otherwise specified, 11 per cent., *ad val.* This heading does not include the following articles, on which the duty is 2½ per cent., *ad val.* :—High-pressure switchboards, oil switches, and oil circuit breakers, motor starters and controllers, with accessories and resistances (for use with machinery and not with vehicles or lifts), regulators and rheostats (except regulators for fans other than induced or forced draught fans), and resistances intended for purposes other than the control of machinery, transformers, static converters and static condensers of 3kVA capacity or over.

Obituary.

The death is announced of Sir WILLIAM CHRISTIE, the Astronomer Royal from 1881 to 1910.

While attending to a switchboard at the Phœnix Dynamo Works, Bradford, recently, Mr. LAWRENCE WATERHOUSE, engineer, of Horsforth, near Leeds, fell against a live wire and was instantly killed.

The death is announced of Prof. J. H. COTTERILL, M.A., F.R.S., who was for many years Professor of Applied Mathematics at the Royal Naval College, Greenwich. He was born in 1836, and was the youngest son of the Rev. J. Cotterill, of Blakeney, Norfolk. He was educated at Brighton College, and after serving an apprenticeship in the engineering works of Messrs. Fairbairn at Manchester went to St. John's College, Cambridge. In 1866 he became Lecturer and in 1870 Vice-Principal of the Royal School of Naval Architecture at South Kensington. The school was removed to Greenwich in 1873, and became part of the Royal Naval College, in which Cotterill was Professor of Applied Mathematics till his retirement in 1897. Prof. Cotterill was a clear and original teacher, and he was the author of several well-known works, including "The Steam Engine, considered as a Thermodynamic Machine," and a treatise on "Applied Mechanics." These text-books passed through several editions, and had much influence on the teaching of these subjects in engineering schools. He was elected a Fellow of the Royal Society in 1878.

Foreign Notes.

A Presidential decree approves the installation of a factory for making electric light bulbs in HAVANA.

The Rhenish Westphalian Electricity Company, in agreement with the A.E.G., have decided to increase the capacity of the GOLDENBERG POWER STATION to 3 000 000 kW, and so make it the largest in Germany. The present output is 200 000 kW.

A hydro-electric plant for lighting and power has recently been installed at Tensa, COLOMBIA; a new telephone system at Cartagena; and a new electric lighting plant at the pier of Buenaventure, in order to provide the town with energy for power and lighting.

Owing to British competition, a "Times" correspondent states that United States trade with VIGO, SPAIN, shows a considerable decrease, especially in boiler tubes, chains, steel and iron cables, hardware, sheet metals, including tinplate, and electrical supplies.

A new and powerful LIGHTHOUSE for NIGHT-FLYING AEROPLANES will be erected on Mont Afrique (1 835 ft.), near Dijon. It is claimed that the light on Mont Afrique will be the strongest in the world, and will be 1 000 000 000 c.p., with a range of 100 miles, or, in very clear weather, 180 miles.

Owing to having ex-enemy members, the UNION INTERNATIONALE DE TRAMWAYS ET DE CHEMINS DE FER D'INTÉRÊT LOCAL, of Brussels, was sequestered in 1919, and was legally dissolved in November last. It has, however, been decided to reform the association this year, but ex-enemy representatives will be excluded.

A fire which broke out recently in the Vitkovice Iron Works in MORAVIA caused serious damage. The shunting plant was entirely destroyed, with all plant and material, and owing to the damage caused to the electrical equipment work in the engine shops has had to be suspended, throwing 2 000 men out of work.

A Reuter's message from Washington states that the Republican members of the Finance Committee of the Senate have come to a tentative agreement that the basis for assessing import duties under the NEW PERMANENT TARIFF LAW should be the American wholesale price at the time the article was shipped to America.

In the course of a speech delivered at the recent opening of the Antananarivo-Ambatolampy section of the Southern Railway in MADAGASCAR, the Director of Public Works mentioned that the electrification of two sections of the Tamatave-Antananarivo line was under consideration, and sketched out a comprehensive plan of railway development for future years.

According to a message from MOSCOW, a Government decree has been published directing an immediate start on the electrification of industries, railways, wharves, &c. Numerous new powerful electrical stations are to be erected, and old ones are to be extended. The decree, which carries out the instructions of the recent Congress of Soviets, places electrification on a footing of equal national importance with coal mining, metallurgy, and other leading industries.

The Commercial Secretary to H.M. Legation at Christiania reports that the AKER (NORWAY) Municipal Council have agreed to guarantee that sufficient capital to complete the two electric railways, for which concessions have been granted to the A/S Akersbanerne, shall be at the disposal of the company. The Council have also undertaken to guarantee a loan of two million kroner, to be taken up by Akersbanerne for commencing the building of both railways, conditionally upon both being constructed simultaneously and the work being initiated during the present winter.

Electricity development on a large scale is reported from FUKIEN (CHINA). The following are recent promoters of electric light companies: Wu Shih-hwang (Tungan), Chen Chen-sin (Kienyung), Lin Kien-tsing (Yungtai). There are also stated to be numerous other activities on a smaller scale. Merchants at Sinshihchen, Kashing, Chekiang, have established an electric plant under the name of "Chen Sin Electric Light Company," with a capital of $25 000. Machinery has already arrived, and subscribers total over 400.

A Bulletin issued by the Chinese Government Bureau of Economic Information states that the Chung Hsin Telephone Company of Kiahsin, Chekiang, has been registered by the Ministry of Agriculture and Commerce; a telegraph office has been opened at Sintsichen, Chihli; the Tsilu Electric Company, organised by Ma Wei-chia, has been granted registration by the Ministry of Communications; and the Ever Bright Electric Company has been organised in Chang Hsin, Chekiang. Mr. Wang Yu-puh, formerly manager of the Wuhsin Electric Company in Wuchow, is manager. Buildings are now under construction, and will be completed about April, 1922.

Recent Wills.

MR. SEPTIMUS YOUNG, late of Head, Wrightson and Co., has left estate valued at £10 329.

Mr. F. G. HART, of Easthope, Epping, M.I.E.E., for many years associated with Messrs. Peto & Radford, has left estate valued at £19.168.

Mr. HERMANN SLOOG, M.I.E.E., M.S.E., M.Soc.C.E. (France), secretary of the Groupe inter-Universitaire Franco-Britanique, the Société des Ingenieurs Civile de France, and the Office National des Universités et Ecoles Française, and agent in Great Britain for Danto, Rogo et Cie., Lyons, manufacturers of enamelled iron apparatus, has left estate valued at £1 726.

Miscellaneous.

The TOLGARRICK RADIUM MINE, near Truro, is to be reopened.

LONDON COUNTY COUNCIL have decided, subject to the consent of the Ministry of Health, to PROSECUTE ISLINGTON Borough Council for allowing the issue of black smoke from the shafts of their electricity works.

The British Electrical and Allied Manufacturers' Association announce that the BEAMA TECHNICAL CABLE CODE, by John F. Shipley, M.I.E.E., will be ready on Feb. 6. The published price will be 5 gs. net, plus postage.

Lord Weir of Eastwood will preside at A COSTING CONFERENCE to be held on Feb. 3, at 2.30 p.m., under the auspices of the Institute of Costs and Works Accountants. Tickets may be obtained from the Secretary, 38, Grosvenor-gardens, S.W.1.

Dr. W. F. Dearden (Medical Officer to the Port Sanitary Authority), lecturing at the Y.M.C.A., Manchester, on Tuesday on the HEALTH PROBLEMS OF MODERN INDUSTRY, said that it did not appear to be sufficiently understood that good lighting was absolutely essential as a working requirement in the factory and elsewhere.

The Metropolitan Railway Bill, and the North Metropolitan Electric Power Supply Bill are among the PRIVATE BILLS passed by the examiners last week for the first reading in the House of Commons. In the first METROPOLITAN RAILWAY BILL the company is seeking power to guarantee or subscribe an amount not exceeding £50 000 to the association organising the British Empire Exhibition, 1923.

The council of the UNIVERSITY OF BIRMINGHAM, in a report to the Court of Governors, make acknowledgement of the following gifts: The Watford Electric & Manufacturing Company, per Hunter, Ogle & Company, an automatic Watford motor starter; Donovan & Company, an up-to-date distribution board; Mr. George Ellison, a circuit relay and a complete motor starter and circuit breaker; and Dr. Ratcliffe, wireless apparatus.

The following have been appointed a special committee of the Royal Dublin Society to deal with the WATER-POWER RESOURCES OF IRELAND:—Sir John Griffith, Lord Powerscourt (chairman of the Committee of Agriculture), Mr. George Fletcher (chairman of the Science Committee), Mr. John Good (chairman of the General Purposes Committee), Prof Hackett, the Right Hon. Frederick Wrench, Mr. Edgar Anderson, and Prof. P. F. Purcell.

H. K. LEWIS & COMPANY have just issued a new list of "College Textbooks and Works of Reference in Science and Technology." The titles are arranged alphabetically under authors' names, and are classified under eighteen subjects, some of which, such as chemistry, engineering (civil, electrical, mechanical,) &c., are again divided. The subjects are arranged alphabetically, and a contents list is also included. The list will be sent post free to any address on application.

Dr. Walter W. Seton, organising secretary of the RAMSAY MEMORIAL FUND, states that a commemorative medal of the late Prof. Sir William Ramsay has been executed by the French sculptor, M. Louis Bottée, and will be struck shortly, when it is known how many medals will be required. The price of the bronze medal, including postage, will be 5s. to subscribers to the Ramsay Fund and 7s. 6d. to all other persons. Those desiring a medal should forward a remittance to Dr. Walter W. Seton, Ramsay Memorial Fund, University College, London.

With the object of interesting business men in this country in the forthcoming INTERNATIONAL INDUSTRIES FAIR OF SPAIN, which is to be held at Barcelona from March 15 to 25, a meeting was held in London at the Spanish Club last week, over which the Spanish Ambassador presided, and was supported by Sir Maurice de Bunsen (late British Ambassador at Madrid). The forthcoming fair will be the third to be held in Barcelona, and the exhibits are to be assembled in groups, not according to countries, but according to the various industries represented, and the classification will include the following sections: Metallurgy and hardware; mechanical and electricity; photography and cinematography; water power and hygienic applications; glassware; heating, lighting; transports and conveyances; and books.

From a statement of RATES LEVIED IN VARIOUS TOWNS, issued by Mr. W. A. Davis, borough engineer of Preston, it appears that of county boroughs, Stoke-on-Trent, paying £2 14s. 2d. for rates per head of population, is the cheapest, and Bradford, which pays £6 17s. 7d. per head, the dearest, with Manchester and Bootle in close attendance. Of the boroughs, Ilkeston, £2 12s. 7d., is the cheapest, and Chatham, £6 18s. 6d., the dearest; of the urban districts, Heston and Isleworth, £2 4s. 9d., is the cheapest, and Ebbw Vale, £2 8s. 11d., the dearest. Attention is called to the fact that high rateable value often goes with low rates, while the contrary is equally true. We note with interest that of eighty-two county boroughs no fewer than seventeen contribute nothing for the relief of the rates from any of their trading undertakings, such as markets, electricity, tramways, gas, water, motor omnibuses, and estates. On the other hand, most of the county boroughs had to help at least one of their undertakings from the rates, so the happy position of just being on the right side has not yet been widely attained.

Companies' Meetings, Reports, &c.

The directors of the EDISON SWAN ELECTRIC COMPANY have decided not to pay a dividend on the preference shares for the half-year to the 31st inst.

MONTREAL LIGHT, HEAT AND POWER CONSOLIDATED have declared a dividend of 1½ per cent., and the MONTREAL LIGHT, HEAT AND POWER COMPANY a dividend of 2 per cent. to shareholders of record at Jan. 31.

The directors of the LANARKSHIRE TRAMWAYS COMPANY recommend a dividend of 6½ per cent. for the past half-year, making, with the interim dividend of 5 per cent. paid to June last, a dividend of 5¾ per cent. for the year 1921.

The accounts of the BRITISH URALITE COMPANY show total debit balance of £14,383. The bankers have applied to the court for the appointment of a receiver, and the directors see no alternative but to place the company into voluntary liquidation.

The results of the working for the year 1921 of the ANGLO-ARGENTINE TRAMWAYS COMPANY, as cabled from Buenos Aires, will permit of the payment of a half-year's dividend on the 5½ per cent. cumulative second preference shares. This payment, amounting to 2s. 9d. per share, less income-tax at 6s. in the £, will satisfy the arrears to June 30, 1917, and will be made to shareholders on the books of the company at Feb. 7, 1922.

The report of the EAST LONDON RAILWAY COMPANY for 1921 states that the Joint Committee's traffic receipts for the past year cannot be furnished, as accounts between the companies in respect of receipts and working expenses have not been rendered during the period of Government control. The gross receipts are estimated at £87 189, which would give the company £48 826, instead of a minimum rental of £30 000 per annum. The arrears of interest to Dec. 31, 1921, in connection with the electrification of the line will be reduced by an amount (when agreed) representing the balance of revenue for the year due to the East London Railway in excess of the minimum rent of £30 000.

For the two years ending March 31, 1920, the balance at the credit of the profit and loss account of CHADBURN'S (SHIP) TELEGRAPH COMPANY, after paying directors' fees, depreciation, &c., amounted to £14 421, to which was added £6 052 brought in from March 31, 1918, making a total of £20 473. From this amount £7 200 has been deducted, representing four half-yearly dividends which have been paid at the rate of £6 per cent. per annum on the preference shares, leaving £13 273. Of this sum a dividend has already been paid on the ordinary shares at the rate of £6 per cent. per annum, less income tax, for the two years ending March 31, 1920, and the balance of £6 073 has been carried forward. The directors again have to record that, owing to the exceptional circumstances recently prevailing, it is impossible to submit at the present time a balance-sheet and profit and loss account for the year ending March 31, 1921. They, however, confirm the payment of a dividend of 6 per cent. on the ordinary shares, and the usual dividends on the preference shares, for the year in question.

The Chairman of the GREAT INDIAN PENINSULA RAILWAY COMPANY (Sir Charles H. Armstrong), who presided over the annual meeting on Friday, referred to the proposed electrification of the Bombay suburban lines, and said that all preliminary work had been completed. They were quite ready to go ahead when the necessary funds could be found. If, as was likely, the Government of India were unable to help them, it would not be difficult to arrange a satisfactory financial transaction in this country by which payments would be spread over a period of several years, but an arrangement of that nature would need the sanction of the Secretary of State. The importance of the work was very urgent, as it would not only reduce the cost of working, but would be of material assistance to Bombay in the years to come in helping to move expeditiously its rapidly increasing population. The cost at present prices was by no means excessive—very moderate, in fact—and the return on capital would be immediate and satisfactory. Offers of the character referred to had been made already, and they had also had similar offers in connection with the supply of rolling stock, of which they were badly in need.

Benn Brothers' Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"The Cabinet Maker" Special London Number: "Landmarks of the London Furniture Trade"; "The Retail Furnishing Trade of London," by Sir Samuel Waring, Bart.: "London Furnishing Trade Organisation."

"The Chemical Age": Special Fertiliser Issue: Contributions by P. Parrish, "Neutral Sulphate of Ammonia": Dr. E. J. Russell, "Physico-Chemical Soil Problems": A. B. Williams, "Potash Mines of Alsace": A. G. Cowie, "Potash in Compound Fertilisers": F. C. O. Speyer, "Sulphate of Ammonia Position," &c.

"Farm and Home": "Draining Agricultural Land of Capital": "State Loans for Farmers": "Feeding Dairy Cows."

"The Fruit Grower": "Insect and Horticulture": "The Hover Fly": "Imperial Fruit Show": "Postal and Telephone Services."

"Gardening Illustrated": "Our Show Medal": "Single Chrysanthemums," and "Forced Solomon's Seal."

"The Hardware Trade Journal": "The Cutlery and Silver Trades": "The Sheffield Scheme: Have Retailers really very much to fear?": "Evolution of File Making."

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, 116-118, Chancery-lane, London, W.C. 2.

Berry, Wiggin & Company, Ltd., 3, Short-road, Stratford Market, E. 15. (178 880). Registered Jan. 6. Capital, £1 500 in £1 shares. Manufacturing chemists, manufacturers, exporters and importers of and dealers in bitumen, asphaltums, waxes, resins, pitches, and tars, chemical compounds, &c. Permanent directors : C. R. Berry and A. E. Wiggins. Private company.

A.H. Development Syndicate, Ltd. (179 052), 16-18, St. Bride Street, E.C. Registered Jan. 16. Engineers, manufacturers of all kinds of apparatus. Nominal capital, £100 in 100 shares of £1 each. Directors : E. S. Hunter and E. K. Hunter. Remuneration of directors, £100 each. Qualification of directors, one share. Private company.

S. Gurney & Company, Ltd. (179 073). Registered Jan. 16. To acquire and carry on the business of silk lamp, electric, and candle shade manufacturers and importers, now carried on at 29, Kirby Street, Hatton Garden, E.C., and elsewhere. Nominal capital, £2 000 in 2 000 shares of £1 each. Directors : A. K. Bulley, and Lelia A. Cooke (Miss). Private company.

Johnson & Slater, Ltd. (179 066), 119/121, The Albany, Oldhall Street, Liverpool. Registered Jan. 16. Manufacturers and dealers in electrical goods and accessories of all kinds. Nominal capital, £1 000 in 1 000 shares of £1 each. Directors : E. J. Johnson (chairman), and W. O. Slater. Qualification of directors, one share. Private company.

John R. Kinsey & Company. Ltd. (179 092), 350, Lower Addiscombe Road, Croydon, Surrey. Registered Jan. 17. Electrical engineers and motor repairers. Nominal capital, £5 000 in 5 000 shares of £1 each. Directors : J. R. Kinsey, A. W. Wood, L. E. Napper, and H. W. Leyland. Qualification of directors, £100. Private company.

Kirby Johnson & Company, Ltd. (12 017). Registered in Edinburgh, Jan. 17. Capital £3 000, in £1 shares. To acquire and develop the business of H. L. Kirby Johnson & Co., 62, Gordon-street, Glasgow, and to carry on the business of electrical engineers, engineering contractors, &c. First directors : H. L. Kirby, T. Young, and F. Greenwood. Qualification, 100 shares.

Shropshire Electrical & General Engineering Company, Ltd. (179 180), Corve Bridge Works, Ludlow, Shropshire. Registered Jan. 17. Electrical, consulting, and general engineers. Nominal capital, £500 in 500 shares of £1 each. Directors : E. Townson, A. Taverner. Qualification of directors, £200. Private company.

Teignmouth Electric Lighting Company, Ltd. (179 116), 2 and 3, Orchard Gardens, Teignmouth, Devon. Registered Jan. 18. Electrical engineers, electricians, engineers and contractors, and suppliers of electricity. Nominal capital, £10 000 in 10 000 shares of £1 each. Minimum subscription £4 000. Directors : W. M. Bird, A. P. Dell, F. C. M. Giles, E. W. Parsons, J. A. Purves, and G. Rossiter. Qualification of directors, £100. Remuneration of directors, first year of the company £175; second year not less than £150; third year not less than £120. Public company.

J. R. West, Ltd. (179 094). Registered Jan. 17. Electrical and mechanical engineers. Nominal capital, £300 in 6 000 shares of 1s each. Directors : J. R. West, and H. Causton. Qualification of directors, 100 shares. Remuneration of directors, £100 each. Private company.

Forty Years Ago.

(The Electrician, Jan. 28, 1882.)

A Concession.—The Postmaster-General has, in deference to a request from the Wolverhampton Chamber of Commerce, allowed the word "Wolverhampton" to be paid for as one word on all foreign telegrams.

The Government and the Telephone Companies.—A rumour was, according to the "Standard," current on Wednesday last to the effect that the Government contemplated purchasing the telephone undertakings of this country. We have reason to believe that there is no foundation whatever for this rumour.

Electrical Patents, 1881.—From a perusal of the records of the Patent Office, it may be roughly estimated that the following patents were taken out in 1881 :—Electric lighting and appliances therefor, 162, telegraphs and telephones, 111; secondard batteries, 28; other batteries, 22; electric clocks, 7; compasses, 6.

A New Electric Light Company.—The prospectus of the Hammond Electric Light & Power Supply Company has been issued. The company has a capital of £250 000, of which it is proposed at present to issue one-half. The company is formed to purchase from Messrs. Hammond & Company their existing electric light business, including their "Brush" concessions and "Lane Fox" license.

A Government Cable Depot.—We recently stated that tenders had been invited by the Government for the erection of a cable depot at Woolwich. This depot is now in course of erection, and will include cable tanks, offices, &c. The total cost is estimated at £10 000, and a staff of telegraph engineers will be attached to the works, which will chiefly be devoted to the Post Office cables round the coast, and connected with the various islands in the British seas. Operations hitherto performed for the Government by private firms at a cost of some thousands of pounds per annum will now be carried out by the Post Office.

Social Notes.

Mr. J. C. Cubitt has been presented with a case of cutlery by members of Crompton and Company's Cricket Club, Chelmsford, on the occasion of his forthcoming marriage.

The Dundee Sub-Centre of the Institution of Electrical Engineers will hold a smoking concert on Monday, January 30, at 7.30 p.m., at the Royal British Hotel, Dundee.

The Greater London Division of the Electricity Supply Commercial Association are holding their second Bohemian concert at Anderton's Hotel, Fleet-street, on Wednesday evening, March 1, under the chairmanship of Mr. D. C. Clark. Tickets may be obtained at 2s. 4d. each from members of the E.S.C.A., or from Mr. G. S. Watts, 121, Little Ealing-lane, Ealing, W. 5. Ladies are especially invited.

Calendars, Diaries, &c.

An artistic wall calendar for 1922 has been issued by the D.P. Battery Company, consisting of twelve small monthly sheets below a water-colour of Peveril Castle.

In addition to a handsome desk blotter, the Hart Accumulator Company have sent us a useful desk calendar, consisting of twelve monthly cards in a frame mounted on a stout yellow card, the upper half of which is black, and cut to the shape of a storage battery.

The Liverpool Electric Cable Company have sent us their calendar for 1922. This measures 10in. by 12in., and consists of twelve good-sized monthly slips below a coloured illustration entitled "The 'Mauretania' in the Mersey." The whole is mounted on a stout brown card.

The "Mechanical World" Year Book, 1922, which is published by Emmott & Company, at 2s. 6d. net, now reaches its thirty-fifth year of publication. The present edition has been enlarged by the addition of about twenty pages, largely accounted for by the section on boiler construction, which has been rewritten, and a considerable amount of new matter added. We also note some useful details regarding pipes and tubes, while the tables on the thermal properties of solids, liquids, and gases have been restored. A useful feature is a classified buyers' directory in several languages.

The "Practical Electrician's" Pocket Book and Diary, 1922, is published by S. Rentall & Company, at 3s. net. The usual care is noticeable in the production of this little book, and in this edition several chapters have been rewritten and new chapters added, with the result that the pages have been increased in number by about forty, though by the employment of thin paper the publication has not increased in bulk; a point worthy of notice in a pocket book. New chapters contain information on motor converters, current limiters, railway signalling apparatus, and the care of ignition, lighting, and self-starting sets for motor vehicles. Some up-to-date details on mercury vapour rectifiers, and on the tungar rectifier for garage charging, are also given. Tables of electricity supply undertakings, revised up to a few weeks ago, are also included.

Prices of Metals, Chemicals, &c.

Tuesday, Jan. 24.

	Price.	Inc.	Dec.
Copper—			
Best selected per ton	£69 0 0	—	—
Electro Wirebars .. ,,	£73 5 0	—	15s.
H.C. wire, basis ..... per lb.	0s. 11 1/16 d.	—	1/16 d.
Sheet ..... ,,	0s. 10¼d.	—	¼d.
Phosphor Bronze Wire (Telephone)—			
Phosphor-bronze wire, basis..... ,,	1s. 3 1/16 d.	—	1/16 d.
Brass 60/40—			
Rod, basis ..... ,,	0s. 7½d.	—	—
Sheet, basis..... ,,	0s. 10½d.	¼d.	—
Wire, basis ..... ,,	0s. 10⅝d.	—	—
Pig Iron—			
Cleveland Warrants per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 SWG ,,	£22 0 0	—	—
Lead Pig—			
English ..... ,,	£24 10 0	—	£1
Foreign or Colonial .. ,,	£23 0 0	—	17s. 6d.
Tin—			
Ingot ..... ,,	£159 0 0	—	£6 5s.
Wire, basis ..... per lb.	2s. 2d.	—	⅛d.
Aluminium Ingots	£120 0 0	—	—

Salammoniac.—Per cwt. 65s.-60s.
Sulphur (Flowers).—Ton £10 10s.
" (Roll-Brimstone).—Per ton £10 10s.
Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.
Copper Sulphate.—Per ton £28 10s.
Boric Acid (Crystals) —Per ton £65.
Sodium Bichromate.—Per lb. 5¾d.
Sodium Chlorate.—Per lb. 3½d.
Rubber.—Para fine, 1s. 0¾d.; plantation 1st latex, 9⅛d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Company.

Tenders Invited and Accepted.

UNITED KINGDOM.

Salford Guardians. Jan. 31.—Small alterations and additions to electric wiring and fittings in Pavilion B of the Infirmary at Pendleton. Particulars from the Clerk, Poor Law Offices, Eccles New-road, Salford.

Northfleet. Jan. 31.—Installation of the electric light at the Council's Offices. Particulars from the Surveyor, Mr. J. A. Mitchell.

Warrington Corporation. Feb. 6.—Main e.h.t. switchboard extension. Specification, &c., from the Borough Electrical and Tramways Engineer.

Dublin Electricity Supply Committee. Feb 7.—One or two years' supply of extra high-pressure and low-pressure cables, cable laying, and supply of troughing, section pillars and joint boxes. Specification, &c., from the City Electrical Engineer, Fleet-street, Dublin.

Islington (London) Borough Council. Feb. 16.—One year's supply of stores, including cables, electricity meters, fuse boxes, compounds, lamps, wires, electrical sundries, transformers, carbons, arc lamp globes, insulators, &c. Specification, &c., can be obtained at the Town Hall.

Hampstead (London) Borough Council. March 15.—Supply of various stores for six or twelve months, including electrical engineers' stores and oils for the electricity station. Form of tender, &c., from the Town Clerk.

Aylesbury Corporation.—300 kW converter, with e.h.t. and l.t. switchgear. Specifications, &c., from the Borough Electrical Engineer.

AUSTRALIA.

Australian Commonwealth Government, Feb. 15 :—30 tons approximate Wheatstone tape paper white (Schedule 544). Particulars from the Supply Officer, Australia House, Strand, London, W.C. 2.

Victorian Government Railways.—Feb. 15.—*Supply and delivery of : (1) Fifty track relays, four front and two back contacts, fifty track relays, eight front and two back contacts, fifty line relays, six front and two back contacts (Contract No. 34 739) ; (2) 100 three-position line relays (Contract No. 34 740) ; (3) 100 electric signal mechanisms (Contract No. 34 738) ; (4) electro-mechanical interlocking apparatus (Contract No. 34 822) ; (5) fifty miles insulated copper wire (Contract No. 34 823). Local representation is essential.

Victorian Railway Commissioners. Feb. 15.—*Hydraulic pig iron breaker, including tools, gears, accessories and spares, for Bendigo workshops. (Contract No. 34 191.)

Deputy Postmaster-General, Brisbane. Feb. 15.—*Telephone apparatus and parts, including bells, buzzers, chambers for transmitters, induction coils, condensers, cords. (Stores schedule No. 544.)

New South Wales Government Railways and Tramways Department (Electrical Engineer's Branch).—Feb. 22, 1922.—*Supply, delivery, erection and maintenance of one 5 000 kW 50 cycle turbo-alternator with condenser and accessories, at Zarra-street power house, Newcastle. (Contract No. 556.) Tenders, on proper forms and accompanied by a preliminary cash deposit, to the Secretary for Railways, Phillip-street, Sydney, N.S.W. Local representation is essential.

Commonwealth of Australia. March 8.—Switchboard apparatus and parts (schedule 545). Particulars from the Supply Officer, Room 101, Australia House, Strand, London, W.C. 2.

Victorian Railway Commissioners. March 8.—*Thirty-five cabin transformers for power signalling. (Contract No. 34 863.)

Postmaster-General's Department, Brisbane. March 8.—*Telephone switchboard apparatus and parts, including calculagraphs, caps, plane convex lens, retardation coils, cords, generators, indicators, jacks, keys, lamps, pegs, plugs, meters, relays, telephone sets &c. (Stores schedule No. 545.)

Deputy Postmaster-General, Brisbane. March 15.—*Protective apparatus, including arresters, carbon blocks, fibre fuses, protectors and terminals. (Stores schedule No. 546.)

Commonwealth of Australia. March 15.—Protective apparatus. Particulars from the Supply Officer, Room 101, Australia House, Strand, London, W.C. 2.

Municipal Council of Sydney (Electricity Department). April 24.—*Supply, delivery, and erection of two 2 000 kW rotary converters ; one 10 000 to 12 000 kW turbo-alternator.

NEW ZEALAND.

Public Works Department, Wellington. Feb. 28.—*Supply and delivery, ex ship's slings Lyttelton, of a bank of three 11 000 V reactances, complete, for the Lake Coleridge electric power scheme.

Public Works Tenders Board, Waikato Power Scheme. March 6.—*(Section 45) two 2 500 kWa alternators, three-phase, 50 cycle, 5 000 V, at 166⅔rds rev. per min., with a power factor of ·8. Excitation at 220 V. (Section 46) two 3 100 h.p. water turbines of the double-runner Francis type to operate the generators mentioned in Section 45. (Section 47) two exciter sets, each consisting of one 200 kW d.c. generator, and one 350 h.p. asynchronous motor, together with a Tirrill regulator. The generator shall have an output of 220 V, with a full-load current of 7 000 A. The motor shall be of 350 h.p., with a power supply of 400 V, three-phase, 60 cycle. The synchronous speed of the sets shall be 750. (Section 48) four Stoney sluice gates for the pits, appertaining to the turbines mentioned in Section 46. Tenders to the Secretary, Public Works Tenders Board, Government Buildings, Wellington.

Dunedin City Council. March 31.—*Supply and delivery of one 150 h.p. three-phase induction motor and reduction gear for the Mornington Cable Service.

Auckland Harbour Board. April 25.—Four double-barrel electric winches for the Central Wharf, Auckland. Specifications from W. & A. McArthur, 18-19, Silk-street, Cripplegate, London, E.C. 2.

SOUTH AMERICA.

Argentine Ministry of Public Works. Feb. 21, 1922.—*Nine electric motors, 36 tip waggons, 1 centrifugal pump with electric motor. Specification expected at the Department of Overseas Trade by Dec. 28.

BULGARIA.

Bulgarian Department of Posts, Telegraphs and Telephones. Feb. 8. *Supply of the following telegraphic accessories :—Twenty terminal boxes for 40-pair cable, 1 000 combined lightning arresters and 1 A fuses, 500 combined lightning arresters in fuses (different type), 300 transformers, 700 condensers (2 micro-farad), twenty junction-boxes with protective devices for 40-pair cable.

Bulgarian Department of Posts. Feb. 14.—*Bronze in plates and bars, iron and steel plates and bars, and insulating materials.

Bulgarian Department of Posts, Telegraphs, and Telephones. February 20.—*2 000 telephone instruments for table use, with local battery and magneto. Also for spare parts.

Bulgarian Department of Posts. Feb. 27.—*Electricians' small tools, including 900 pairs pincers, 20 brazing lamps, 100 soldering irons, 1 500 bits, 300 axes.

Bulgarian Department of Posts. March 8.—*Porcelain insulating tubes for telephones (10 000), insulating tubing (impregnated paper) for telephones (2 200 metres), ebonite caps (1 700), and insulated copper wire (1 000 metres).

Bulgarian Post and Telegraph Authorities, March 15.—*The supply of 1 A fuses, cartridge fuses for protection from lightning, 3 A fuses, line annunciators, carbon lightning arresters.

Bulgarian Postal Authorities, March 21.—*Telephone, pole-line hardware (4-pin carriers for insulators, bolts, etc.).

Bulgarian Postal Authorities, March 27.—*3 000 junction pieces for batteries. Delivery required within four months.

** Particulars from the Department of Overseas Trade.*

London County Council Education Committee have accepted the tenders of H. J. Cash & Company, for electric lighting work at Sherrington-road, Greenwich, schools, £506 ; and Webb-street, Bermondsey, schools, £519.

Hackney Borough Council have accepted the tender of the Stanton Ironworks Company, at £909 13s. 9d., for condensing-water circulating pipes in connection with the extension of the electricity power-house at Millfields-road.

Hammersmith Borough Council have accepted the tender (the lowest received) of the Enfield Ediswan Cable Works, Ltd., for 2 500 yds. of 0·1 sq. in. 3 core l.t. cable at £947. Five tenders were received, the highest being £1 007 10s.

It is reported in Sheffield that Metropolitan-Vickers, Ltd., have secured, in the face of keen competition, an electrical contract in South Africa of the value of £1 000 000. German firms are said to have made a vigorous effort to secure the business.

The General Electric Company inform us that the alternator of the turbo-alternator set for the Eastbourne Corporation, the contract for which was recently awarded to W. H. Allen, Son & Company (Electrician, Jan. 6, p. 24), will be a G.E.C. machine, manufactured by the firm at their Witton Works, Birmingham.

Sydney (N.S.W.) City Council have decided to place an order with the Electricity Meter Manufacturing Company for 1 000 5 A 240 V s.p. meters at £3 each, on condition that when the company develops a satisfactory meter which is cheaper to manufacture, a reasonable preference will be given to the Council in the matter of price, in return for their efforts to foster local manufacure.

London County Council have accepted the following tenders : Dorman & Smith (lowest tender), for two main power distribution boards and power sub-distribution boards in connection with the electrical installation at the new County Hall, £1 014 7s. 11d. (five tenders were received, highest £1 696) ; W. J Furse & Company (lowest tender), for the supply and installation of lightning conductors at the new County Hall, £1 411 1s. 8d. (four tenders received ; highest £1 765 3s. 4d.). The Council have also authorised the ordering of additional mains and circuit cables up to the value of £3 000 under the existing sub-contract with the Pirelli General Cable Works, Ltd.

Swansea Borough Council have reversed the decision of the Electricity Committee to place a contract with a British firm, although a French firm's quotation was lower. The committee recommended the acceptance of the tender of Ferranti, Ltd., for a transformer at the sum of £1 408 7s. This was the lowest British tender : but the French firm, Le Transformateur, tendered at £900. Col. Sinclair, chairman of the Electricity Committee, said that but for the difference in the rate of exchange the French price would be double. He showed that no less than £870 of the sum quoted by the British firm would be expended in wages, and emphasised that the acceptance of the French tender meant throwing British workmen out of employment for weeks. On a division, however, the contract was awarded to the French firm by a large majority.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Partnerships Dissolved.

GOODENDAY John, and FRENK, Albert Simon, electrical contractors, 101, Dale-street, and 62, Smithdown-road, Liverpool, co. Lancaster, under the style of Goodenday & Frenk, by mutual consent as from Dec. 1, 1921. Debts received and paid by A. S. Frenk.

HORSFALL, Robinson, and HARRISON, Richard, electricians and armature winders, Waltham-street, off Doncaster-road, Barnsley, under the style of Harrison and Horsfall, by mutual consent as from Jan. 18, 1922. Debts received and paid by R. Horsfall, who will continue the business.

JAMES, Arthur Leonard, and WHITE, Albert, electrical engineers, &c., 56, Wiverton-road, Sherwood-rise, and 52a, North-gate, Old Basford, Nottingham, under the style of A. L. James, by mutual consent as from Dec. 31, 1921. Debts received and paid by A. White, who will continue the business.

Bankruptcy Information.

FAWCETT, Ernest, 20, St. Anne-street, Liverpool, electrical and heating engineer. First meeting, Feb. 1, 11.30 a.m., Offices of the Official Receiver, 11, Dale-street, Liverpool. Public examination, Feb. 13, at 10.30 a.m., Court House, Government Buildings, Victoria-street, Liverpool.

TRUELOVE, Harold (trading as H. Truelove & Company), 19, Shepley-street, Stalybridge, Co. Chester, electrical engineer. Receiving order, Jan. 18. Creditor's petition.

Notice of Intended Dividend.

BAKER, Reginald Percival, and STUBBS, Frederick Clarence, trading together in co-partnership as the Sheffield Electric Construction Company, 124, Pond-street, Sheffield, electrical engineers. Last day for receiving proofs, Feb. 8. Trustee, L. J. Clegg, Official Receiver's Offices, 14, Figtree-lane, Sheffield.

Company Winding-up.

CEDES ELECTRIC TRACTION, LTD. Last day for receiving proofs, Feb. 9. Liquidator, H. E. Burgess, 33, Carey-street, Lincoln's Inn, London, W.C. 2.

Company Winding-up Voluntarily.

PEARLITE ELECTRIC WELDING COMPANY, LTD. J. C. Burleigh, Bond Court House, Walbrook, E.C. 4, appointed liquidator.

Liquidator's Notice.

PEARLITE ELECTRIC WELDING COMPANY, LTD. (in voluntary liquidation). Meeting of creditors at Bond Court House, Walbrook, London, E.C. 4, Jan. 31, 11 a.m. N.B.—The above is a formal notice to comply with Section 188 of the Companies (Consolidation) Act, 1908. All creditors have been, or will be, paid in full.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

CHARNOCK, Mr. M. J., 339, Icknield Port-road, Birmingham, electrical engineer. £21 4s. 3d. Nov. 11.

CROXON, Ralph Wilfred, 38a, Brixton-road, S.W., electrician. £13 6s. Nov. 15.

JACOBS, ARTHUR (trading as Arthur Jay), 20, St. Thomas-square, Hackney, electrical engineer. £10 19s. 7d. Nov. 10.

WASSELL, Mr. G. W., 4 Tividale-road, Tipton, electrical engineer. £10 14s. 6d. Nov. 15.

WOODS, Mr. A., 8, Ladbroke-grove, Holland Park, electrician. £16 3s. 8d. Nov. 15.

Bills of Sale.

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1822 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

BENNETT, Albert Richard, 119, Blackfriars-road, Southwark, electrical apparatus maker. Jan. 20. £30.

JACKS, Filmer, 57, Peacock-street, Gravesend, electrician, &c. Jan. 18. £30.

OSBORNE, Oliver James, 16, London-road, Maidstone, electrician. Jan. 18, £50.

SEAGE, Albert, 114, Airdale-avenue, Chiswick, electrical engineer. Jan. 23. £60.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

"ALFO" ELECTRICAL ENGINEERING COMPANY, LTD., Liverpool. Registered Jan. 12, £250 debentures, to G N. Kenney, Glenolden, Birkenhead-road, Moreton, electrical engineer; general charge.

BOURNE END AND DISTRICT ELECTRICITY CORPORATION, LTD. Registered Jan. 11, £850 debentures, part of £20 000; charged on land at Bourne End; also general charge.

Satisfactions.

BIRMINGHAM DISTRICT POWER & TRACTION COMPANY, LTD. (late BIRMINGHAM & MIDLAND TRAMWAYS, LTD.). Satisfaction registered Jan. 12, £40 000; and further advances, &c., registered Jan. 24, 1918.

NAIROBI ELECTRIC POWER & LIGHTING COMPANY, LTD., London, E.C. Satisfaction registered Jan. 17, £1 000, part of amounts registered Sept. 29, 1913, and July 30, 1915.

Receivership.

WATSON, FOGGO & COMPANY, LTD. G. H. Highcock, of The Retreat, Victoria-road, West Kirby, ceased to act as receiver or manager on Dec. 15, 1921.

Bankruptcy Proceedings.

BLOWER, Arthur Ernest, lately trading as Blower & Cooper, electrical engineers' merchant, 1-3, Paul's Bakehouse Court, E.C. This debtor attended at the London Bankruptcy Court last week for public examination on a statement of affairs showing gross liabilities £762, and an estimated deficiency of £484. He began business in partnership in Sept., 1917, when he and his partner bought for £750—payable as to £100 down and the balance on or before Aug., 1924—the stock, fixtures, and book debts of a business carried on at the above address. He introduced no capital, but had a trade connection, and was to receive 60 per cent. of the profits, while his partner, who brought in £100, was to have 40 per cent. They were fairly successful until Dec., 1920, when the partnership was dissolved. Under the deed of dissolution he took over his partner's interest in the business and goodwill, but the proceeds from the stock and book debts were to be paid into a joint banking account and applied in payment of the partnership debts and in reduction of the amount due to the vendor of the business. He continued alone until August last, when, owing to trade depression, he closed down. Since Dec., 1920, the business had resulted in a net loss of £284. The debtor added that £275 of his debts represented the unpaid balance of the purchase price of the business. The examination was concluded. The following are creditors: Vulcan Electrical & Mechanical Company, £15; Wandsworth Electric Mfg. Company, London, £32; Trevelyan & Company, Birmingham, £19; Boyton, C. & Sons, Ltd., Wealdstone, £20.

Private Meeting.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

PLANET ELECTRIC COMPANY, LTD. (in voluntary liquidation), St. George's Road, London, S.E. The creditors of the above were called together recently, at the offices of Dollman & Pritchard, 52, Tavistock Square, London, W.C., when it was stated that the shareholders had passed the usual resolutions for voluntary liquidation, and had appointed Mr. S. H. Swallow as liquidator. An approximate statement of affairs presented, disclosed liabilities of £1 177, of which £877 was due to the trade. The assets were estimated to realise £918, or a deficiency of £259. The assets consisted of: stock estimated to realise £350; good book-debts, £350; furniture, fittings, and lighting installation, £160; plant, £55; and cash in hand, £3 3s. 8d. The company was registered some three years ago with a nominal capital of £2 000. The issued capital was £1 908, of which £1 246 was subscribed for in cash. The last balance sheet was prepared as at June, 1921, and disclosed a loss of some £600. A resolution was passed confirming the voluntary liquidation with Mr. Swallow as liquidator, while a committee was appointed consisting of the representatives of Rose Bros., Ltd., Lion Engine Company, Ltd., Telga Company, and Fuller United Electric Company, Ltd.

Arrangements for the Week.

FRIDAY, Jan. 27th (to-day).

PHYSICAL SOCIETY.

5 p.m. At the Imperial College of Science, London, S.W. Papers to be read "On the Diffusion of Solutions," by Mr. T. H. Littlewood, M.A.; "A Special Apparatus for the Measurement at Various Temperatures of the Thomson Effect in Wires," by Mr. H. R. Nettleton, M.Sc., and "A Defect in the Sprengel Pump—Its Causes and a Remedy," by Mr. J. J. Manley, M.A.

ELECTRICAL POWER ENGINEERS' ASSOCIATION. (SOUTHERN DIVISION.)

7 p.m. At Central Hall, Westminster, London, S.W. Lecture on "The Metering of Steam by Means of Orifices," by Mr. J. L. Hodgson, B.Sc.

INSTITUTION OF ELECTRICAL ENGINEERS. (STUDENTS' SECTION OF SCOTTISH CENTRE.)

7.30 p.m. At the Royal Technical College, Glasgow. Paper on "The Economical Production of Electrical Power," by Mr. R. G. Kendall.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

7.30 p.m. At the Literary and Philosophical Society, Newcastle-on-Tyne. Paper on "The Use of Compressed Air in Diesel-Engined Ships," by Mr. W. Reavell.

INSTITUTION OF ELECTRICAL ENGINEERS. (IRISH CENTRE.)

8 p.m. At the Royal College of Science, Dublin. Lecture on "The Development of Electricity Supply in Switzerland," by Mr. E. M. Johnson.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Lecturette on "Fuels and the Boiler House," by Mr. L. M. Jockel.

TUESDAY, Jan. 31st.

ENGINEERS' CLUB, MANCHESTER.

7.15 p.m. At Albert Square, Manchester. Address on "A Business Trip to Canada and the U.S.A.," by Mr. J. P. Bedson.

INSTITUTION OF ELECTRICAL ENGINEERS. (STUDENTS' SECTION OF N.-WESTERN CENTRE.)

7.30 p.m. At Houldsworth Hall, Deansgate, Manchester. Paper on "Some Electric Lift Control Systems," by Mr. W. O. Brakenridge.

ILLUMINATING ENGINEERING SOCIETY

8 p.m. At the Royal Society of Arts, John-street, London, W.C. Discussion on "The Use of Light as an Aid to Aerial Navigation," opened by Lt.-Col. L. F. Blandy, D.S.O.

WEDNESDAY, Feb. 1st.

INSTITUTION OF ELECTRICAL ENGINEERS. (WIRELESS SECTION.)

6 p.m. At Savoy Place, London, W.C. Papers on "The Determination of the Decrement of a Distant Sending Station," by Major J. Erskine-Murray, and "Some New Methods of Radio-Navigation," by Major J. Erskine-Murray and Capt. J. Robinson, Ph.D.

INSTITUTION OF ELECTRICAL ENGINEERS. (SOUTH MIDLAND CENTRE.)

7 p.m. At the University, Birmingham. Lecture on "Single and Three-Phase Alternating Current Commutator Motors with Series and Shunt Characteristics," by Dr. S. P. Smith.

INDUSTRIAL LEAGUE AND COUNCIL.

7.30 p.m. At Caxton Hall, London, S.W. Lecture on "The Curse of Work," by Mr. H. T. Smith.

THURSDAY, Feb. 2nd.

INSTITUTION OF ELECTRICAL ENGINEERS.

6 p.m. At Savoy Place, London, W.C. Paper on "The Interconnection of A.C. Power Stations," by Messrs. L. J. Romero and J. B. Palmer.

LIVERPOOL ENGINEERING SOCIETY. (STUDENTS' SECTION.)

7.30 p.m. At the Royal Institution, Colquitt-street, Liverpool. Paper on "Sound Ranging," by Mr. E. G. Stepheus.

FRIDAY, Feb. 3rd.

INSTITUTE OF COST AND WORKS ACCOUNTANTS.

2.30 p.m. At the Holborn Restaurant, London, W.C. Costing Conference on "The Necessity for Scientific Costing."

JUNIOR INSTITUTION OF ENGINEERS

8 p.m. At Caxton Hall, London, S.W. Lecturette on "Utilisation of Waste Heat from Internal Combustion Engines," by Major W. Gregson.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MEWBURN, ELLIS & CO., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

COMPLETE SPECIFICATIONS.

140 789 SCOVILL MANUFACTURING CO. Automatic control mechanism for electric furnaces. (28/6/18.)
145 675 SIEMENS & HALSKE AKT.-GES. High-tension electric transformers. (30/6/19.)
146 873 RENAULT, L. Electric starting and lighting systems for automobiles. (2/12/13.)
146 914 SIEMENS-SCHUCKERTWERKE. Portable electric welding apparatus. (3/5/19.)
146 990 WESTERN ELECTRIC CO., LTD. Telegraphic ciphering and deciphering mechanisms. (4/12/18.)
147 664 KOHLER CO. Electric generating systems. (2/3/16.)
147 850 GES. FÜR DRAHTLÖSE TELEGRAPHIE. Wireless telegraph transmitters. (22/12/17.)
147 890 FERY, C. Primary batteries. (1/12/14.)
149 349 METROPOLITAN VICKERS ELECTRICAL CO., LTD. Electric wireless receiving apparatus. (5/8/19.)
168 350 FELLOWS, A. W., & GARDNER, W. A. Electric distributing device for the ignition systems of internal combustion engines. (5/6/20.)
168 360 AJAX, LTD., COOPER, C. A., & SELL, D. F. Containers for electric batteries and other electrical apparatus. (29/4/20.)
168 363 TUCKER, J. B., & TUCKER & CO., LTD., J. H. Electric contacts. (20/5/20.)
168 394 TAGGART, J., SCOTT, & RADIO COMMUNICATION CO., LTD. Vacuum-tube relay devices and the like especially for use in wireless signalling systems. (29/5/20.)
168 407 MACRORIE, A. K., AIREY, H. MORRIS, & SHEARING, G. Supports for filaments for thermionic valves. (31/5/20.)
168 409 MARR, G. Construction of combined electric switch and plug coupling. (1/6/20.)
168 432 KIRKHAM, J. Auxiliary device for use with sparking-plugs. (6/3/20.)
168 443 BRITISH THOMSON-HOUSTON CO., LTD., & JEWITT, D. E. Systems of electric ship propulsion. (12/6/20.)
168 474 RELAY AUTOMATIC TELEPHONE CO., LTD. (BETULANDER, G. A., & PALMGREN, N. G.). Arrangement for testing lines or line groups, particularly in automatic and semi-automatic telephone plants. (2/7/20.)
168 479 BROWN, G. R. Process and apparatus for electrostatic separation of finely divided discrete material. (7/7/20.)
168 499 WALKER, H. E. Junction boxes and the like for electricity distributing systems. (24/7/20.)
168 508 MULL, R. S. S. Process for utilising mica for electrical purposes. (4/8/20.)
168 514 HOWARTH, O. Apparatus for measuring the maximum demand demanded from an electricity supply. (13/8/20.)
168 537 JOHNSON & PHILLIPS, LTD., & HOCKLY, A. Means for holding in close contact a movable truck and stationary cubicle of an electric switchboard or other relatively movable members. (7/10/20.)

APPLICATIONS FOR PATENTS

October 3, 1921.

26 056 DAVIS. Recording telephone calls.
26 060 SUTHERLAND, COOKE, COPELAND & ROGERS Device for recording telephone calls.
26 078 CLAREMONT & SCHOLES. Electric junction boxes.
26 089 RYAN. Relays for reception of signals, &c.
26 098 HEESCH. Automatic electricity meter. (27/8/21, Denmark.)
26 102 BENNETT. Switches.
26 125 DENNY. Switches.
26 127 HUTH & OPPENHEIMER. Transmission of signals by electric oscillations. (2/10/20, Germany.)
26 141 GOLDSMID-STERN-SALOMONS (Fayol). Incandescent lamps.
26 147 LINDNER. Electric pocket lamps.

October 4, 1921.

26 135 GENILLER. Incandescent lamps for advertising, &c.
26 162 SMITH & ANSELL. Indirect lighting fitting.
26 212 RICKETS. Electric appliances for seam or line welding.
26 214 LEVIN. Electrolytic cells for generating oxygen and hydrogen.
26 220 WALKER. Radio-telephone transmitter.
26 227 JOFEH. Telephone mouthpieces
26 229 SOC. ANON LE FER. Production of electrolytic iron. (19/10/20, France.)
26 231 METROPOLITAN-VICKERS ELECTRICAL CO. Steam turbines.
26 238 FROST. Electrically heated vulcanising apparatus.

October 5, 1921.

26 258 TAYLOR. Overhead electric transmission.
26 291 BROOK. Electric lamps.
26 302 ELECTRIC CONTROL, LTD., & ELLEFSEN. Electric control for lifts, haulage gear, &c.
26 307 PHI-KAPPA SYND. & KLUIJTMANS. Combined switches and fuses.
26 308 PHI-KAPPA SYND. & WATSON. Electric heating apparatus.
26 314 CASH. Releasing arms of starting gates by electric power. (11/10/20, S. Africa.)
26 332 B. T.-H. CO. (G. E. Co.) Wireless signalling systems.
26 330 ANDERSON & ELLISON. Magnetic blow-out devices for electric circuit controlling apparatus
26 336 ZWEIGBEROK. Brakes for railway and tramway vehicles.
26 345 WATANABE. Steel for making magnets.
26 354 SULLIVAN. Submarine telegraph cables.
26 355 TELEPHONE MFG. CO. (1920) & SMITH. Automatic exchange telephone apparatus.

October 6, 1921.

26 366 WALTERS. Horizontal electrically-driven pumps.
26 383 BARNETT. Automatic electric switch.
26 388 WALL. Direct current dynamo.
26 417 HATCHER. Commutators.
26 425 AUTOMATIC TELEPHONE MFG. CO. Telephone systems. (15/10/20, U.S.)
26 427 ROMBACH. Electric lamps.
26 431 B. T.-H. CO. (G. E. Co.). Wireless signalling systems.
26 436 WATTS, WILLIAMS & CO. & MIDDLETON. Dynamo and accumulator sets.
26 449 SMITH. Inductances, inductance coils, &c.
26 466 BRYAN & TATHAM. Switch.
26 475 ABRAHAM. Wireless telegraphy. (6/10/20, France.)

October 7, 1921.

26 501 Fildes. Storage of fuse wire.
26 511 Hougardy. Switches.
26 541 Judge. Commutator rotating disc and terminal for ignition discs.
26 549 & 26 550 Igranic Electric Co. (Cutler-Hammer Mfg. Co.). Electro-magnetic brakes.
26 553 Phi-Kappa Synd. & Kluijtmans. Electric heating and cooking apparatus.
26 561 Berry. Electric lamps and fans.
26 567 Chamberlain & Hookham & James. Circuit interrupting devices.
26 568 Valentine. Commutators for electric ignition systems.
26 580 B. T.-H. Co. (G. E. Co.). Electric signalling devices.
26 585 Hermet & Izoard. Electric lamps.
26 589 Amphlett & Lewis. Electric ignition apparatus.

October 8, 1921.

26 612 Bosch (R.) Akt. Ges. High-tension ignition systems. (23/10/20, Germany.)
26 613 Jones. Electric contacts or connections.
26 662 Johnson. Automatic control of electric lamps for motor vehicles, &c.
26 670 Spencer & Co. & Sharp. Magnetic separators.
26 673 B. T.-H. Co. Electron-discharge devices. (28/10/20, U.S.)

October 10, 1921.

26 729 Phi-Kappa Synd. & Watson. Electric irons.
26 732 Telephone Mfg. Co. (1920). Warning signals for platelayers, &c.
26 744 Hyman & Saxby. Telephone apparatus.
26 746 Cardwell. Electric ignition apparatus.
26 768 Oldham. Electric connections
26 780 Dinnibier. Electrical entertainment devices. (9/10/20, U.S.)
26 793 Bardt. Manutacture of electrodes.
26 801 Bardt. Storage batteries.
26 802 Huth & Kühn. Apparatus for influencing electric waves produced by cathode tubes for telephony. (2/12/19, Germany.)
26 807 American Radio & Research Corporation. Rectification of alternating currents. (8/10/20, U.S.)
26 820 Gurney. Reflecting devices for electric lamps, &c.

October 11, 1921.

26 821 Mechanical Supplies, Ltd. & Baynes. Relays for amplification of sound, &c.
26 836 Automatic Telephones Mfg. Co., Electrical Improvements, Ltd. & Beard. Indication position of apparatus or condition of circuits at a distance.
26 841 Moore. Electric contact makers.
26 852 Midland Electric Mfg. Co. & Barber. Ironclad switches.
26 853 Midland Electric Mfg. Co. & Barber. Adpustable time-lags for circuit breakers.
26 887 Ball Bearing Works, J. Schmid-Roost. Current transmission devices for ball bearings in electrically driven rail vehicles. (6/11/20, Switzerland.)
26 892 Western Electric Co. Electric signalling systems. (11/10/20, U.S.)
26 899 Cambridge & Paul Instrument Co. Adjustable sensitive relays.
26 900 Turner & Lucas. Terminals for electric circuits.
26 901 Danks, Lucas & Miller. Electricity measuring instruments.
26 903 Andersen. Transmission of pictures by telegraph and telephone.
26 905 Siemens - Schuckertwerke. Electric precipitating plants. (28/10/20, Germany.)
26 927 Lodge Fume Co. (Metallbank u. Metallurgische Ges.). Circuit breaker.
26 931 B. T.-H. Co. (G. E. Co.). Thermostatic elements.
26 932 B. T.-H. Co. & FitzGerald. Relays, &c.
26 945 Pasteur. Automatic circuit breakers. (12/10/20, France.)

October 12, 1921.

26 963 Taylor. Electric transmission of power with underground cables.
26 976 Taylor. Eliminating currents in lead sheating of cables.
26 981 Taylor. Improving current-carrying capacity of existing three-phase cable systems.
27 023 Austin & Macfarlane. Electric driving of machines on c.c. series system.
27 034 Rooke & Hatcher. Electric machines.
27 045 Coales, Darby, Garrard & Railing. Combined expansion joint and clamping support for electrical box bars.
27 049 Haefely et Cie. Insulators. (6/11/20, Switzerland.)
27 052 Hoar. Canopies for electric light fixtures, &c. (22/10/20, U.S.)
27 057 B. T.-H. Co. (G. E. Co.). Electrical apparatus.
27 089 Siemens-Schuckertwerke. Purifying gas by electricity. (22/10/20, Germany.)
27 102 Wolf & Zeketmaier. Electric heating and cooking appliances. (27/10/20, Germany.)
27 107 Rosenbaum, Huth & Loewe. Telegraphy or telephony. (15/9/15, Germany.)
27 108 Huth. Generating and strengthening oscillations for wireless telegraphy, &c. (17/5/19, Germany.)
27 110 British Lighting & Ignition Co. & Turner. Switches.

October 13, 1921.

27 119 Tracy. Electrical connection.
27 131 Kratt & McClelland. Electric motors for gramophones.
27 139 West Lancashire Electrical Co. & Speed. Portable electric water heaters.
27 140 West Lancashire Electrical Co. & Speed. Method of controlling water heaters.
27 145 Roberts. Device for varying illuminating power of electric lamps.
27 148 Rice & Weir. Controller for electrical advertising signs, &c.
27 159 Russell. Electric irons.
27 160 Lancashire Dynamo, &c., Co. & McLeod. Apparatus for changing velocity ratio and relative direction of rotation of two rotatable parts.
27 164 Eastern Telegraph Co. Apparatus for maintaining equality of speed in two or more motors, &c.
27 189 Kawakami. Accumulators.
27 197 Kemp. Electric condensers.
27 208 Graham. Mouthpieces, &c., for telephone transmitters and receivers.

October 14, 1921.

27 222 Robinson. Electric diaphragm warning horn.
27 230 Angold, Railing, & Orsettich. Brush-holders for electric machines.
27 231 Aitken. Automatic, &c., telephone exchange systems.
27 246 Parsons. Switches.
27 283 Finizio. Electric irons.
27 293 Loke. Electric furnaces, &c.
27 295 Payne. Wireless apparatus for producing continuous oscillations.
27 308 Hunt. Holders for incandescent lamps.
27 309 B. T.-H. Co. (G. E. Co.). Means for producing oscillations.
27 310 B. T.-H. Co. (G. E. Co.). Radio receiving systems.
27 324 Dubois & Reynold. Electric cut-out apparatus. (14/10/20, Switzerland.)
27 335 Motorenfabrik Oberursel A. G. Arrangement of magneto in cycle auxiliary engines. (12/2/21, Germany.)
27 337 Compton & Musgrave. Key contacts for electrically-operated organs, &c.
27 344 Ever-Ready Co. (Great Britain) & Mummery. Invert electric batteries.
27 346 Zehnder. Electro-magnetic chucks. (16/10/20, Switzerland.)
27 356 Combination Metallic Packing Co. (1921) & Harrison. Field magnets of magneto-electric generators, &c.
27 357 Combination Metallic Packing Co. (1921) & Harrison. Dynamo-electric machines.
27 358 Combination Metallic Packing Co. (1921) & Harrison. Armatures of magneto-electric generators.
27 359 Combination Metallic Packing Co. (1921) & Harrison. Magnetos, &c.

October 15, 1921.

27 360 Brown. Apparatus for making communication secret in wireless telegrapny and telephony.
27 365 Horton. Contrivance for generating electrical energy.
27 367 Harris & Wiseman. Supports for electric conductors.
27 407 Habann. Production of high-frequency oscillations for transmitting messages, &c
27 433 Sprosen & Wiseman. Electric lamps for vehicles.
27 435 Automatic Telephone Mfg. Co. Relay circuit arrangements for telephone, &c., systems (17/11/20, U.S.).
27 437 Koeh & Schwarz. Three-phase induction motors.

October 17, 1921.

27 464 Parsons. Adjustable electrical contacts.
27 484 Woodmancz. Electric switchgear for automobiles
27 497 Emtage. Electric indicators.
27 504 Vries de Waal. Electricity as mechanical advertising apparatus.
27 512 Naamlooze Venootschap Metaaldraadlampenfabr., Holland. Incandescent lamps, &c. (29/7/21, Holland.)
27 519 Rickets. Electric welding devices of resistance type.
27 522 Monger & Ruler-West. Electric model and toy apparatus, &c.
27 527 Todman, Ryall & Co. Cooling electrical machines.
27 528 Todman, Ryall & Co. Electric machinery.
27 529 Todman, Ryall & Co. Brush-gear for electrical machines.
27 533 Bergmann Elektricitäts Werke A. G. Starter for 3-phase short-circuited motors. (25/10/20, Germany.)
27 538 New Switchgear Construction Co. & Hall. Protected switches.
27 546 Woods. Electric motors.
27 549 Siebe, Gorman & Co. & Jenner. Battery plates.
27 550 Muller. Electric alarms. (4/7/21, Germany.)
27 581 Siemens & Halske A. G. Telephone systems. (16/10/20, Germany.
27 636 Everett. Alternating current protective devices

October 18, 1921.

27 575 Crankshaw & Markland. Automatic electro-magnetic lock for carriage doors, &c.
27 599 Mullard Radio Valve Co. Suspension of filaments in vacuum tubes, &c.
27 620 Oppenheimer. Electric lamps, &c
27 622 Estler Bros. Trolly collectors for tramcars or motor vehicles.
27 636 Edgcumbe. Alternating current protective devices.
27 639 English Electric Co. Brakes of tramcars, &c.
27 651 Speedy & Eynon. Switches, &c.
27 665 White (Magnetic Power Typewriter Co.). Electrical actuating means for type-bars of typewriters, &c.
27 668 B. T.-H. Co. (G. E. Co.). Systems of illumination.
27 674 Hodgson. Stand for electric irons. (29/10/20, New Zealand.)
27 677 & 27 678 Ellison. Switches, &c.
27 683 Illingworth. Electrodes.
27 689 Pollak (Siemens & Halske A. G.). Telephone systems.
27 690 Park & Rose. Device for rendering inoperative simultaneously prime movers and brakes of mechanical and electric vehicles, &c.
27 692 Aregall. Interrupter rheostats.

October 19, 1921.

27 763 B. T.-H. Co. (G. E. Co.). Electric machines.
27 787 Ges. für Drahtlose Telegraphie. Means for operating electrical signals, &c. (22/10/20, Germany.)
27 788 Pollak (Siemens & Halske A. G.). Telephone systems.

October 20, 1921.

27 808 Crust. Switch plugs.
27 822 Rogers. Electric horns.
27 835 Bridges. Steam-electric plant.
27 843 Murdoch. Electric machines.
27 846 Licht Akt. Ges. Manufacture of wires from metal having high melting point. (22/10/20, Switzerland.)
27 849 Young. Electrical transmitter microphones.
27 868 Western Electric Co. Carrier telegraph circuits.
27 874 British Generator Co. & Constable. Electric heating of water, &c.
27 883 B. T.-H. Co. (G. E. Co.). Radio signalling systems.
27 885 Ben-Ayad. Automatic electric ship's lead.
27 889 Bullimore. Containers for secondary batteries.
27 893 Godsell. Telephone systems, &c.
27 896 Loth. Looating losses in electric cables or lines.
27 901 Durtnall. Systems of operation for electric locomotives, trams, &c.
27 902 Etchells. Switches for train lighting systems.

October 21, 1921.

27 934 Electric Construction Co. & Close. Overload trip retarding device for circuit breakers, &c.
27 937 Field. Electrical instruments.
27 977 Knight. Incandescent lamps.
28 016 Metropolitan-Vickers Electrical Co. Electric railway motor control systems. (5/11/20, U.S.)
28 017 B. T.-H. Co. (G. E. Co.). Electrical discharge apparatus.
28 047 Schattner. Circuit making and breaking device.

October 22, 1921.

28 063 Thomas. Electric fly and insect killer.
28 074 Cable Accessories Co., Reeves & Davis. Portable electric lamp-holders.
28 079 Cowper-Coles. Apparatus for reproduction by electro-deposition.
28 087 Bignamy. Starter, transmission-gear, and dynamo drive combined.
28 089 Schröder. Electrically welding high-speed steel to tool shanks, &c.

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CONTENTS.

Notes of the Week.

Autocracy at Wimbledon.

Recent occurrences at Wimbledon are enough to make the least communistically minded see red. For the Borough Council, becoming dissatisfied with their chief electrical engineer's work after twenty-one years' service, on Tuesday night held a special meeting, at which it was proposed that Mr. Tomlinson Lee's engagement should be terminated as from May 31 next, but that he should virtually be dismissed at a few hours' notice. This proposal was agreed to by sixteen votes to six, without any statement as to why or wherefore. It is only right to add that requests as to why this course was adopted were made by a stalwart minority, but nothing was disclosed, for the quaint reason that publicity would be against Mr. Lee's interests. For his part, we understand that Mr. Lee courts a full inquiry. This he certainly should have.

Immediate Action Required.

It is obvious, whatever the cause of the Council's action, that this sort of thing cannot be allowed to pass without both protest and action. It is likely to cause both. For the Electrical Power Engineers' Association (of which Mr. Lee is a member), the Chief Technical Assistants' Association, and the Associated Municipal Electrical Engineers all made representations to the Council before the meeting, asking for an inquiry, and pointing out that, however justified the dismissal might be on facts, to effect it so summarily means virtual ruin for the man concerned. The Ministry of Labour have also been approached, as they were when a similar case occurred with subordinate employees of the undertaking a short time ago—for this is not the first time that Wimbledon has offended—to force the Council to come into the open. Much might be written about the ethics of the whole matter, but it is not worth while. It is sufficient to say that if the conduct of municipal affairs is allowed to fall into the hands of those whose actions are mainly directed by swollen views of their own importance, such regrettable incidents will follow. The ratepayers of Wimbledon have the remedy in their own hands, and the E.P.E.A. might give them a chance of using it by running a candidate at the next election. In any event, the matter should not be allowed to drop.

Overhead or Contact Rail.

The discussion on "The Electrification of English Main Line Railways," which took place at a joint meeting of the Institutions of Electrical, Civil and Mechanical Engineers in Birmingham was not confined to the arid field where talk on systems alone flowers, but ventured into the more fruitful pastures where questions of greater engineering interest flourish. This is as it should be. For even when the great problem of the system is settled, if ever it is settled, there still remains the question, far greater in practical importance, of how best to apply the system, and especially whether it is better to use the overhead line or the contact rail. As might be expected, each solution has its supporters. Mr. Willox, fortified by his experience on the Metropolitan Railway, told the meeting that the contact rail was cheap to maintain and that even during such operations as the Baker Street widening was no source of danger to platelayers and others working on the line. On the other hand, Mr. C. F. Bengough, after a very just summing up of the advantages and disadvantages of each system, gave his vote in favour of the overhead line on account, principally, of its low maintenance costs.

The Overhead System Leading.

This question of choice of system is one which cannot, we feel, be given a general solution at the present time. Indeed, we doubt whether a general solution can ever be given. For on long stretches of underground lines, where the clearances are small and ingress by unauthorised persons is impossible, both economically and from the engineering point of view it may be found better to continue to use the contact rail. On the other hand, in shunting yards and in the open country, where the line can be used as a convenient path for adventurous humans

and cattle, the overhead equipment may give commercial advantages which will outweigh any engineering shortcomings. It is true that these engineering shortcomings have not been small or easy to avoid, but the Paper read by Sir Philip Dawson before the Institution of Electrical Engineers eighteen months ago, and the results of the experiments on the Lancaster-Morecambe-Heysham branch of the Midland Railway, which we publish to-day, show that they are being eliminated. Again, the higher the working pressure is raised, the greater the advantages of the overhead system, and as our standard is becoming rapidly de-standardised, this may very likely be a deciding factor. That, however, is for the future. At present it is interesting to note that Sir Vincent Raven has announced that the overhead system is to be used in the York-Newcastle electrification on the North Eastern Railway.

The "Geddes Axe" and the Electricity Commission.

The "Geddes Axe" will find no dead wood to lop in the Electricity Commission, which is conducted with a small staff and very economically. Moreover, although a Government department, it is not on all fours with most others of that kidney, owing to the important fact that the cost is defrayed by the industry, and not from public funds. For the first two years the excess of expenditure over the revenue of the Commissioners is advanced by the Treasury, but this loan must be refunded within the next three years. But even if this did not put it outside the Geddes purview, there would be little to economise. In fact, the Commission is so miserly that the industry, which pays, feels that an increase in the staff employed at Gwydyr House would be beneficial. The vast and increasing mass of work now pouring on to the Commission's desks could then be more quickly dealt with and a glow of satisfaction would result in the invisible queue outside Gwydyr House. The Commissioners have full authority to employ an adequate staff. They should do so for the good of the industry. This being so we hope that the report that the Geddes Committee is recommending the root-and-branch abolition of the Electricity Commission is without foundation. Such a recommendation could only have been made under a misconception.

Conspiracy and Protection of Property Act.

We have often wondered why electricity-supply authorities have been so slow in invoking the aid of Sec. 31 of the Electricity (Supply) Act of 1919 when their employees go on strike without notice or before effective steps can be taken to provide a staff for the maintenance of supply. Perhaps it is because their own consciences are not always clear. Fortunately for the industry, such strikes are very rare, but nevertheless the continuity of electricity supply is such an important matter, from the points of view of both commercial and public safety, that no avoidable cause of interruption should be countenanced. We are glad, therefore, to see that the Lancashire Electric Power Company have taught four of their engine-room attendants a much-needed lesson, and we hope it will not be lost upon the employees of other supply undertakings.

A Trumpery Quarrel and its Consequences.

The employees concerned were summoned under Sec. 31 of the 1919 Act, which extends Sec. 4 of the Conspiracy and Property Act of 1875 to electricity supply stations, and were fined £5 each and ordered to pay the costs of the prosecution. The trouble arose out of a trumpery dispute between the employees themselves, no industrial principle being involved. The four defendants left the station at 1.20 a.m., after only an hour's notice. Fortunately, two charge engineers were on the premises and, as a result of urgent messages, the men on the morning shift came on duty early. The defendants admitted their conduct was illegal and contrary to the rules of their union, and pleaded that they should not be sent to prison. Fortunately for them, the Bench took a lenient view of the case.

Tramway Charges Legislation.

Owners of tramway undertakings will be glad to learn that there is a good prospect of fresh legislation this year on the question of tramway fares. Tramways have had a bad time of late. Increases in maintenance charges and the competition of the motor omnibus have badly affected their financial position, and any sign of relief will be doubly welcome, though it is doubtful if continued high fares will provide an adequate remedy. It is, however, announced that the Ministry of Transport contemplate the introduction of a Bill to continue the increase of charges authorised by the Tramways (Temporary Increase of Charges) Act of 1920, and the Association of Municipal Corporations is urging the Minister to take the opportunity of including clauses relating to trolley vehicles fares in the Bill.

Careless Legislation.

As our readers are aware, the Temporary Increase of Charges Act will expire on February 15, 1923, and as it is desired to provide for this contingency as well as to remodel the constitution of the Advisory Committee set up by the 1920 Act, a fresh Bill becomes necessary. Before making an Order to authorise increased fares on an undertaking, the Minister must refer the application to an Advisory Committee, of which the Light Railways Commissioners formed a part. Now, by the Railways Act of last year, the powers of the Commissioners were transferred to the Minister of Transport and the Commissioners themselves were abolished! This is a good specimen of modern "rush" legislation. One grievance is remedied and two more created owing to the habit of dealing with some only of the interlinked subjects on which it is desired to legislate.

The Institution and Hydro-Electrics.

The development of what may be called hydro-electric technology has reached a critical stage in this country. The examination of the water-power resources of this country by a Board of Trade Committee and their various reports have shown that there is power of this kind worth developing in these islands, and the Committee themselves have suggested the lines along which this development should take place. As we noted last week, a start has already been made with two fairly important schemes in Scotland. But technically it may be wondered whether our engineers are quite ready to begin. There are some, it is true, who have had experience with similar schemes in other countries, but, generally speaking, the information is limited both in amount and disposition. For this reason, if for no other, the subject is one which requires early treatment in electrical circles, and we should like to see a meeting of the Institution arranged at which the Committee's reports could be discussed and the technical position made clear. This development is a British problem and it should be a British duty to solve it.

Hydro-Electric Developments—Some Drawbacks.

The year 1921 was remarkable, among other things, for a failure of what might almost be termed one of the laws of Nature, *i.e.*, the approximate constancy of the rainfall in a given watershed. Owing to the comparative scarcity of hydro-electric stations in this country little attention has been directed to the extraordinary predicament in which the drought of the past year placed certain countries, notably Italy and Switzerland, whose reliance upon the natural water-powers has in many cases hitherto been absolute. Even in France, where the reliance is not so great, it is common knowledge that in the Department of Isère there was only sufficient water available for a supply of energy to be given on three days out of each week.

Some Revision of Ideas Necessary.

This is a type of difficulty which is far greater in the case of the purely hydro-electric station than in stations using steam or gas engines, for in these last two cases, should one source of supply fail, another can be resorted to, or the plant be converted so as to use the fuel in a different form, *i.e.*, as pulverised coal or fuel oil in place of gas. With a water-power plant, on the other hand, no substitution is possible. Although such an occurrence may not be repeated for a number of years, and although, probably, in the case of hydro-electric stations that may be erected in Great Britain arrangements will be made for an auxiliary stand-by plant, not dependent upon water power, the fact that such a drought is possible shows that, for the sake of continuity of supply, our general ideas as to watercourses being a perpetual source of power must undergo some revision, and such a contingency must in future in every case be guarded against.

Bankers and Taxation.

Were it not that both our politicians and our bureaucrats despise and fear the expert, they might gather some useful hints as to future conduct from the speeches made by the chairmen of the various banks, whose annual general meetings have recently taken place. One and all they condemned the Government's financial policy, and one and all they indicated the ruin that will overtake the trade and industry of the country unless some reduction is made in the present scale of taxation. The critic of any Government action is always suspected (often wrongly) of being not entirely disinterested in his strictures. But no such indictment can be made on this occasion. Bankers, though all business men, are not all of the same political tint, and their unanimity, therefore, has something more behind it than merely a desire to harass well-meaning ministers and overworked officials. Those same ministers and officials would, therefore, do well to hear and obey, for as Mr. Reginald McKenna, chairman of the London Joint City and Midland Bank and one-time Chancellor of the Exchequer, pointed out, "The present taxation has probably exceeded the maximum which can be imposed without greatly impairing the national spirit of enterprise. . . . The remedy is to reduce the national expenditure."

The Labour-Saving House.

The competition organised by the "Daily Mail" to secure the best design of labour-saving house suitable for professional-class families has had some interesting results. The principal is that, though the approximate total cost was laid down as £2 500, none of the designs submitted could be carried out for less than £3 000. This seems to have been mainly due to conservatism. For though the chief object of the competition was to secure the extended use of labour-saving devices, and especially of a kitchen which, while being small and well arranged, should contain everything for, and no more than, was required for cooking, all the architects clung to the idea that the kitchen must also be the servant's sitting-room, and so made the house larger than had been originally intended. Incidentally, it may be remarked that such a kitchen is most easily obtained by the use of electric cooking apparatus, which can be, at the same time, accessible and out of the way. We are glad to see that the part electricity can play in domestic labour-saving is fully recognised by the competitors. The dining- and drawing-room fireplaces, in most of the designs, are fitted with plugs, while in the hall and on the landing are similar outlets for supplying the vacuum cleaner, and in the bedrooms, too, plugs have not been forgotten. We hope that it will soon be found possible to erect houses according to these designs, so that some very interesting ideas may be turned into practice.

Imperial Wireless.

Politically speaking, the report of the Wireless Telegraph Commission, which we publish to-day, takes us back to 1912, when a contract for the erection of eighteen stations, which were to form an Imperial Wireless Chain, was let to the Marconi Company. But nothing is to be gained by traversing those muddy lanes of past history. Anyone who wishes to do so will find the facts set out in the files of The Electrician. It will be sufficient to say that little was done with what would now be called a grandiose scheme, and to-day the only tangible results of many manœuvrings, if we except the present report, are the stations at Leafield and Cairo.

Past History.

It is true the war intervened to prevent further attempts being made to establish a system of Imperial wireless communication until, in November, 1919, a Committee was appointed under the chairmanship of Sir Henry Norman to consider the question afresh. The Marconi Company refused to give evidence before this Committee, and put forward in March, 1920, a scheme of their own, in which they proposed to establish, at their own expense, a "network of wireless communications to serve the ends of the whole British Empire," paying to the Government, in addition, 25 per cent. of the profits. In June, 1920, the Committee recommended the establishment of an Imperial wireless system, using the thermionic valve, except at Leafield and Cairo, where arcs were to be employed. They also recommended the appointment of a Commission to design the stations, and that the stations should be erected by the Post Office engineering department and the corresponding Dominion and Indian authorities. It is this Commission, which met under the chairmanship of Lord Milner, and consisted of Dr. W. H. Eccles, Mr. L. B. Turner, Mr. E. H. Shaughnessy, with Lt-Col. C. C. Crawley as secretary, whose report we deal with to-day.

"Severely Technical."

The report, as Dr. Eccles remarks in an explanatory foreword, is of a "severely technical nature." It makes twenty-eight pages of medium octavo, the first six of which are taken up with preliminaries and the last sixteen with detailed recommendations on the plant that is to be installed. In between the introduction and the conclusion

are sandwiched six pages of matter on the development of high-power thermionic stations, the choice of wave length, transmitting antennæ, masts and towers, earth screens, and the methods of reception and the design of receiving stations. This information, in vulgar parlance, in spite of its "severely technical nature," is worth the money.

The Valve Advantages and Disadvantages.

Among these technical points, it is interesting to find the statement that this country remains the home of the valve and that, with the exception of a little work in the United States, practically nothing has been done elsewhere with this means of high-power transmission. This is, therefore, an excellent reason for using the valve, even if the Commission had not been limited by the report of Sir Henry Norman's Committee to its employment. The chief difficulty about its application is, of course, that it has not, so far, been used for such high powers as are specified for a Chain station, though experiments at Carnarvon have been conducted at powers very nearly as high as the 120 kW laid down. There should, therefore, be no insuperable difficulties to the erection of these high-power sets, for the main disadvanage about this form of transmission is the large consumption of the valves themselves. This point is well made in the Committee's report. As, however, valves with replaceable filaments are now on the market, both in silica and glass containers, the cost of renewals should continue to fall, while the time may soon arrive when filament renewals will be an operation that can easily be accomplished by the station engineer.

From this point of view, the work that has recently been carried out, notably by the Mullard Valve Co., with silica valves, is of the highest importance. For it is by the use of either silica or metal containers, rather than in the employment of glass, that ultimate success is likely to be obtained. As regards the supply of valves, there need be no anxiety, as the number that can be turned out is already greatly in excess of that laid down by the Committee as being necessary for use in the Chain stations.

Station Design.

In the general design of the stations, the Commission have wisely permitted themselves considerable latitude, so that the power employed may, in future, be doubled if necessary, and so that the aerial current may be adjusted to suit special conditions. This, of course, is all the more easy, for the cost of the generating plant is small compared with that required for the accessory power plant, buildings, sites, aerials, towers, earths, and other apparatus which are common to all systems. Extensions and developments will also be facilitated by the standardisation of the different parts which the Committee recommend.

Aerials, Earths, Screens, and Masts.

It is to be noted that the aerials are to be supported on steel towers and will not be directional. Counterpoise earths or earth screens are to be used, and the main building is to be below the aerial. There is no indication that the screens will cover the building and so reduce the losses, but the lead-in will go from the buildings straight up to the aerial system, thereby minimising the losses in the steel masts and avoiding harmonics. This is satisfactory. For, as is well known, great trouble has, in the past, been caused by the generation of heavy currents in steel masts, a trouble which the Commission evidently intend shall now be circumvented. As regards mast design, the Commission are not erring on the side of caution. The masts themselves are to be 250 metres high, and will be designed to take a horizontal pull of 10 tons, with a factor of safety of 3. Taking into consideration the wind load on the down lead and the span of 1 300 ft., this horizontal pull should be considerably increased. On receiving apparatus and its problems the Commission are silent. They apparently regard the problem of atmospheric elimination as unsolved, but they make no recommendations, which is rather disappointing.

The Development of the Arc System.

Referring once again to the question of systems, though, as has been pointed out, the Commission were practically limited to a consideration of the application of the valve, they have nevertheless extended the use of the arc to the stations in East Africa and at Singapore and Hong Kong, where combined arc-valve transmission is to be employed. This is very wise, not the least for the reason that, if experience proves that a mistake has been made in recommending so wide an application of the thermionic valve, retreat will be possible. In any event, by giving scope for further development, competing ideas in technical progress will not be unduly stunted.

It is for this reason a pity that the high-frequency alternator is not to be tried, though that, of course, is not the fault of the Commission. At any rate, the two systems, which are to be erected in parallel, will allow the present rather vague costs for valve provision and renewals given in the report to be checked, and as the arc is comparatively cheap and its performance known, it can be relied upon to deal with the traffic as a second string, whose performance is not far short of the first choice.

A Welcome Olive Branch.

A small, but pleasing, feature of the report is the suggestion that the Marconi Company should be asked to tender for a part of the apparatus, on the ground that the tests at Carnarvon show them to be capable of building a thermionic valve station of the size required. It is to be hoped that this olive branch will be accepted, and that, for the sake of technical progress, a not very edifying chapter in wireless history will be closed. This is the more necessary as the enterprise, invention and hard work of the Company in the design and manufacture of large valve sets has put them far ahead of the Signal School, whose report of 1919-20 disclosed an optimism which results have not justified.

Is a Wireless Chain Advisable?

Leaving technical matters, as the Committtee do on this particular question, it may be asked whether, in these economical days, it is wise or even necessary to build such stations at a cost to the Imperial Government of some £853,000. The existing telegraph cables, it may be argued, are sufficient to deal with the international traffic for many years to come, and it would therefore be better, for both financial and technical reasons, not to go on with this scheme for the present. We do not agree. These stations are long overdue. They have an immense strategic importance, as the war amply showed. In case of hostilities they can be more easily protected and can work with greater flexibility than a cable. In time of peace they form a useful addition to the facilities which the cables provide, and, in addition, as Dr. Eccles has pointed out, they will greatly aid both Press work and propaganda in a way which is not only of the highest importance to political development and industrial progress, but will tend to assist, by bringing nations into closer contact, towards the stabilisation of a world peace.

Electric Traction Experiences

On another page of this issue we publish an article of, what we may be forgiven for terming, the highest interest. In 1908 the Midland Railway Company equipped the short length of railway between Lancaster, Morecambe and Heysham on the high tension overhead single-phase system of electric traction, principally with a view to obtaining data regarding operation and equipment which could be applied with confidence on a large scale. Mr. J. Sayers and Mr. J. Dalziel, the two engineers most intimately concerned with the construction and performance of this line, have now taken the wise, and, in some ways, the heroic, course of permitting us to place on record the experiences they have gained during the past fourteen years. We hasten to add that the record, though inevitably one of failure, is certainly something a great deal more—a record of education

Improvements in Overhead Design.

When the line was equipped, the best designs and material available at the time were used. But in the case of the overhead equipment, fourteen years' working has shown that the design could be improved by, for instance, abandoning the original arrangements for tightening the trolley wire by weights, by reducing the horizontal stagger over the centre of the running rails, and by substituting for a straight line lay out of the trolley wire in the vertical plane a wave form which has overcome all the troubles due to pull-off insulators and has given a greater flexibility and absence of hard spots, points which are most desirable in any overhead system which is to be employed for high-speed traffic. In fact, it may be said that by these means the great crop of troubles due to pull-off insulators, of which we ourselves witnessed an example, has been entirely eliminated. In appearance the new suspension is preferable and it follows the curvature of the line better.

Insulator Difficulties.

The experiences with the insulators originally employed were not very happy. This is not, perhaps, unnatural. The line is exposed to all varieties of gales and to a great deal of weather, mostly bad. It is not surprising, therefore, that weak points soon began to be discovered, especially in the litharge and other cements used for fixing the insulators. These weaknesses arose in spite of the careful tests that had been applied before erection. This particular difficulty was overcome on the catenary insulators by the use of insulating links in addition to the other insulators or by the use of the Diabolo type of insulator, both of which adaptations have proved quite satisfactory. It is interesting to note that Mr. Sayers' view is that a small quantity of really sound porcelain, combined with a robust construction of the supports and fastenings, provides the best type of insulator for this purpose. There is much virtue in these adjectives.

The greatest failures from the insulation point of view were, however, at the pull offs, and in spite of various attempts to improve these supports, it was at last decided to abandon their use altogether. This was made possible by the employment of the modified system of overhead equipment which we have noted above.

Motor Equipment.

As regards the motor equipment, experience has been more gratifying. It must be obvious that this equipment is old, and Sir Philip Dawson's recent remarks on improvements in single-phase motor design show how much that connotes. Nevertheless, the equipment has been generally satisfactory, and this particularly applies to that part of it which was obtained from America. In the German equipment it was found, on the other hand, that the lubricating system was too elaborate, and broke down under the stress and strain of normal working; that the design employed caused excessive bearing wear, leading to core looseness and consequent connection breakage which gave a good deal of trouble. A series of electrical troubles, consisting of short circuits between the commutator segments, also occurred. These were finally traced to the bad mechanical design of the commutator quill, which was made in two halves, and so permitted the access of dirt to the commutator. Dirt also caused insulation failures on both rotor and stator windings, and this particular defect was overcome by cementing the windings up solid.

The Role of Dirt in Electrical Operation.

This whole chapter of accidents is an interesting commentary on the part dirt plays in electrical progress, and of the great importance of eliminating it by every possible means. Again, resistance and connection troubles were prevalent, passing from point to point in a most puzzling fashion. Finally, all these difficulties were overcome by increasing the area of contact between the commutator connection lugs and the resistance strips by the use of tubular connectors with large contact areas. The expansion of the resistance strips owing to heat, and their subsequent breakage, has also caused trouble. As might be expected, vibration was another source of worry, while the brush holder design employed has been a cause of anxiety.

Most Useful Experience.

In fairness to all parties we must add that, with the few exceptions noted, the Midland Railway engineers have retained the original equipment, instead of scrapping it, and have directed their efforts to the more useful work of discovering improvements rather than of providing replacements. In the meantime design and manufacture have moved and, especially in the case of the motors, the equipment available to-day is very different from the equipment of 1908.

Main Line Conditions.

Nevertheless the experience that has been gained is of the very greatest use, and forms a good basis for future advances. This, we feel, applies particularly to the radical changes made by Mr. Sayers in the overhead equipment. It is not generally realised that the use of electric traction on main lines will impose different and very much more arduous conditions than those present on sections where purely suburban traffic is dealt with. This is of the greatest importance. For it may be predicted with a fair degree of certainty that main line electrification means the employment of the overhead system, and for this system to be used at high speeds an equipment possessing the highest degree of flexibility, both of bow and contact wire, is essential. Though it may be argued that maximum flexibility has not been obtained with Mr. Sayers' new system, at least it will be admitted that a great step has been made in that direction. Our illustrations are sufficient guarantees of that.

Finally, though perhaps not altogether germane to the matter in hand, a word may be said about the generating plant. The problem that has been overcome was not easy. To use gas engines for such a load was, perhaps, in slang terms, asking for trouble, but the results are at least interesting, even if they are not likely to lead to such wide imitation as in the case of other experiments with which we have dealt.

Notes on Theory of Grassot Fluxmeter.

By R. B. BURROWES.

The author, in dealing with the Theory of the Grassot fluxmeter, considers such questions as the back movement of the coil to the zero position, the non-synchronous movement of the coil with the flux changes, the time constant of the throw and its independence of reactance and resistance, and proves that the energy is proportional to the square of the throw.

The Grassot fluxmeter is a moving coil, permanent magnet instrument, with suspension control eliminated as far as possible by suspending the coil with unspun silk. The damping should be only electro-magnetic, other damping being negligible. If these conditions are fulfilled the following theory holds :

Let ϕ = Flux linkage in part of circuit under test.
„ ϕ_m = Permanent magnet flux linkage.
„ R = Total resistance in coil circuit.
„ I = Moment of inertia of moving coil system.
„ θ = Angular displacement of coil from zero position.

On changing ϕ, there is an E.M.F. in circuit $\frac{d\phi}{dt}$, and when the coil begins to move an E.M.F. in opposite direction $=-\frac{d\phi_m}{dt}$.

Therefore the current round coil circuit, neglecting reactance E.M.F.

$$=\frac{1}{R}\left(\frac{d\phi}{dt}-\frac{d\phi_m}{dt}\right)$$

So that, assuming flux to be uniformly distributed round annular air gap, we have :

$$\text{Deflecting torque}=\frac{k}{R}\left(\frac{d\phi}{dt}-\frac{d\phi_m}{dt}\right) \text{ where } k=\text{a constant.}$$

Hence we have :

$$\frac{k}{R}\left(\frac{d\phi}{dt}-\frac{d\phi_m}{dt}\right)=I\frac{d^2\theta}{dt^2}$$

Integrating over the period t_1 when coil begins to move till when it stops, we have :

$$\frac{k}{R}(\phi-\phi_m)=\int_o^{t_1} I\frac{d^2\theta}{dt^2}dt=O \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Hence $$\phi=\phi_m.$$

That is change of linkage ϕ is equal to the change of permanent magnet flux linkage in coil ϕ_m. With uniform flux distribution in air gap, in which coil moves ϕ_m is proportional to angular deflection θ, so that change of linkage ϕ is proportional to deflection and a uniform scale is obtained.

It will be noted that accelerating torque becomes a retarding torque when $\frac{d\phi}{dt}-\frac{d\phi_m}{dt}$ changes sign, $\frac{d^2\theta}{dt^2}$ also changing sign.

The throw θ is independent of rate of change of flux, being proportional to absolute change ϕ only, also proportional to quantity of electricity which has passed round circuit.

The energy used up due to resistance is, however, proportional to E.M.F. e or rate of change of flux. For example, if this were doubled, flux change remaining the same, e is doubled and, therefore, energy dissipated.

$\int 2eidt$ also doubled, where $i=\frac{e}{R}=\frac{1}{R}\frac{d\phi}{dt}$.

Back Movement of Coil to Zero Position.

The above explains why the coil will always return to its zero position in time, however small the restoring couple due to torsion of suspension ; for it has only to move back slowly enough to reduce the E.M.F. to any degree of smallness and consequently the energy also. When the coil returns to zero position exactly the same quantity of electricity passes round circuit as during its deflection, but it does so against an extremely small E.M.F. The energy given to the circuit as heat in this way is that due to the torsion of the suspension when in deflected position.

Movement of Coil Non-Synchronous with Flux Change.

If the coil could be imagined massless, so that $I=O$, then $\frac{d\phi}{dt}-\frac{d\phi_m}{dt}=O$ at all instants, that is, the movement of the coil would exactly synchronise with change of flux linkage, there being no resistance loss. Taking the other extreme case in which the whole of the flux change takes place before coil begins to move—that is, when acting as a ballistic galvanometer—it is of some interest to compare its action with that of an ordinary moving coil ballistic galvanometer, whose movement is controlled by the torsion of the suspension.

Taking the latter case first, the equation of motion is given by

$$I\frac{d^2\theta}{dt^2}+k\frac{d\theta}{dt}+T\theta=O$$

Where I = moment of inertia of moving system, $k\frac{d\theta}{dt}$ = damping couple, and $T\theta$ is the torsion couple of the suspension. This motion may or may not be oscillatory, according as $\frac{T}{I}-\frac{k^2}{4I^2}$ is positive or negative. If oscillatory, the solution is :

$$\theta=\theta_o e^{-\frac{k}{2I}t}\cos\left(\sqrt{\frac{T}{I}-\frac{k^2}{4I^2}}t+\epsilon\right)$$

Neglecting the damping couple $k\frac{d\theta}{dt}$, the equation reduces to :

$$I\frac{d^2\theta}{dt^2}=-T\theta$$

whence $$I\left(\frac{d\theta}{dt}\right)^2=-T\theta^2+c$$

where $c=I\omega_o^2$, ω_o = initial angular velocity of coil. At instant when $\theta=\theta_m$ or amplitude of throw, $\frac{d\theta}{dt}=O$, so that, substituting these values, we have :

$$O=-T\theta_m^2+I\omega_o^2 \text{ or } \theta_m=\sqrt{\frac{I}{T}}\,\omega_o \quad \ldots\ldots\ldots\ldots(2)$$

that is, the "throw" is directly proportional to initial angular velocity ω_o.

Now, taking the case of the Grassot instrument, in which the torsion couple $T\theta$ is negligible and the whole of the control due to the damping couple $k\frac{d\theta}{dt}$, the equation of motion reduces to :

$$I\frac{d^2\theta}{dt^2}+k\frac{d\theta}{dt}=O$$

whence $$k\theta=-I\frac{d\theta}{dt}+c$$

when $$t=O,\ \theta=O,\ \frac{d\theta}{dt}=\omega_o,\ \therefore c=I\omega_o$$

At the instant of maximum value of θ that is, when amplitude θ_m is attained, $\frac{d\theta}{dt}=O$ and $\theta_m=\frac{I}{k}\omega_o$ $\quad\ldots\ldots\ldots\ldots(3)$

So that in this case also the throw is directly proportional to initial angular velocity ω_o.

Time Constant of Throw.

With resistance R in circuit unchanged and instrument used in ballistic way, *i.e.*, with no movement till all flux

change has taken place, the time taken by the throw or swing is independent of amplitude. For equating rate at which kinetic energy is reduced to rate at which energy is used up in the circuit, we have :

$$\frac{d}{dt}\left\{\tfrac{1}{2}I\left(\frac{d\theta}{dt}\right)^2\right\}=ei$$

where $e=k\frac{d\theta}{dt}$, k=permanent magnet linkage with θ equal to unity.

$$i=\frac{k}{R}\frac{d\theta}{dt}, \text{ so that } ei=\frac{k^2}{R}\left(\frac{d\theta}{dt}\right)^2$$

and

$$\frac{d}{dt}\left\{\tfrac{1}{2}I\left(\frac{d\theta}{dt}\right)^2\right\}=\frac{k^2}{R}\left(\frac{d\theta}{dt}\right)^2$$

Integrating we have

$$e^{\frac{k^2}{RI}t}\frac{d\theta}{dt}=\omega_o, \text{ where } \omega_o=\text{initial angular velocity.}$$

$$d\theta=e^{-\frac{k^2}{RI}}\omega_o dt$$

Integrating again

$$\theta=\frac{RI}{k^2}\omega_o\left(1-e^{-\frac{k^2}{RI}t}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

$\frac{RI}{k^2}$ may be called the time constant of the throw, the amplitude of which is given by : $\theta_m=\frac{RI}{k^2}\omega_o$

This result has already been arrived at in (3) above, in which the k corresponds to $\frac{k^2}{R}$ in this.

Throw Independent of Reactance.

Used in the ballistic way, the equation of E.M.F.'s in circuit is :

$$\frac{d\phi}{dt}+L\frac{di}{dt}+Ri=O$$

where L = inductance. Integrating over period of flux change ϕ before motion begins we have :

$$\phi+Li+R\int idt=c=O.$$

Also $Li=O$. Therefore $\int idt=\frac{\phi}{R}$=quantity.

It will be noted that the energy due to electric momentum given to the circuit while current rises is given back again when current decreases, otherwise reactance E.M.F. $L\frac{di}{dt}$ first acts against current and then with it, having only the effect of delaying discharge through coil. This could be similarly proved with instrument used in non-ballistic way.

Throw Independent of Resistance.

This is shown by equation (1), ϕ being equal to ϕ_m independently of R. It is also shown by results (3) and (4). This latter is not quite so apparent at first till it is noted that initial angular velocity ω_o is inversely proportional to R, so that the R's cancel out.

Energy Proportional to Square of Throw.

This is evident at once from the relation $\theta_m=\frac{RI}{k^2}\omega_o$; for as kinetic energy is proportional to ω_o^2, electrical energy absorbed is proportional to θ_m^2. Otherwise, as both quantity and E.M.F. are proportional to throw θ_m, the time of throw being constant, see result (4), electrical energy absorbed is proportional to θ_m^2.

Wireless Design and Practice.*

By JOHN SCOTT-TAGGART.

The first chapter of this volume deals with oscillations, wave-lengths, frequency, inductance and capacity, mutual inductance, co-efficient of coupling. Tables are given showing the frequency which corresponds to different wave-lengths between 100 and 40 000 metres. This sort of thing is spoon-feeding in its worst form, and will deter the experimenter from making his own calculations. Methods of working out the ranges obtained with a variometer and the meaning of mutual inductance are explained. Co-efficients of coupling, capacities in series and parallel are next considered, and a table is given showing the different values of capacity produced by connecting condensers in series.

The second chapter deals with aerials. No methods are given of calculating aerial capacities, but a practical method is given and the formulæ for finding the inductance of coil antennæ are supplied.

Chapter III. is an important one, as it discusses the design of inductances. Various useful tables are given, including one showing the turns per inch of different gauges of wire with different coverings. As the wires are given in the B. and S. gauge as used in America (whence this book hails), this table is of no great use to British readers. Special coils are also described, and methods of calculating their inductance are given. Chapter IV. deals with condensers of both the variable and fixed types.

We now come to valve detector circuits and more descriptive matter. In the preliminary remarks we find the statement that it is advisable to connect a grid cell in the grid circuit of a valve fitted with a leaky grid condenser, "so that incoming positive charges will not be great enough to make the grid positive." To prevent the establishment of grid currents is to stop the cumulative rectification effect entirely, and to use a grid cell so as to make the grid negative is to do the worst thing possible. With reference to the grid condenser, the author states that "it is usually said that the grid condenser keeps the negative charge off the grid." A saying of this kind should be hushed up.

Oscillating valve circuits are dealt with in Chapter VI. Figs. 19 and 20 show no telephones. Figs. 21 and 22 show no grid leak (an omission which occurs in all subsequent valve circuits). Fig. 20 is quite impossible as it stands. The grid potential would be about + 30 volts, and the circuit would not oscillate. The second half of the book deals with transmitters for spark and C.W. signalling. In the chapter on valve telephone sets several circuits are given, but there is no attempt at proper explanation, or even at explaining practical details. A disappointing chapter!

Things brighten up when we come to Part II.—a description of some eighty circuits for wireless work. But all the valve receivers are bare of grid leaks. The choke-coil amplifier of circuit 52 is not a very practical arrangement for amateurs. Small variable resistances are inserted in the filament circuit "to give a slight negative voltage to the grid." The first one makes the first grid positive instead of negative, while the other two make no difference at all to the grid potentials of the second and third valves. The last few circuits deal with transmitters. The spark circuits are without blemish, but the valve transmitter circuits will puzzle the beginner. Circuit 67, for example, should have a choke coil across one of the condensers. Circuit 69 would be improved by various practical expedients, unnecessary batteries being eliminated. Circuit 71 will not work, as no choke is shown in the d.c. anode circuit.

The book as a whole is good as far as the elementary calculations are concerned, bad as far as practical instruction in circuit arrangement is concerned, and deplorable as far as care in drawing the circuits is concerned.

* "Wireless Design and Practice." By M. B. Sleeper. (London : Henry Frowde and Hodder & Stoughton.) Pp. 246. 7s. 6d.

THE LANCASTER-MORECAMBE-HEYSHAM ELECTRIC RAILWAY.

Some Experiences of Fourteen Years' Working with the Single-Phase Overhead System.

The Lancaster-Morecambe-Heysham branch of the Midland Railway was equipped with single-phase electric traction in 1908 to obtain experience which would be valuable in dealing with the wider problem of main line electrification. This article gives an account of the failures and modifications which have been shown to be necessary in various parts of the apparatus during fourteen years' working. The overhead work, insulators, bonding, generating plant and rolling stock are dealt with.

It was recently remarked in an engineering journal that one of the handicaps of electric traction was that to be tried at all it must be tried on a large scale, and that if it were possible to convert a system gradually from steam to electric traction we might see greater endeavours made to adopt this form of haulage. In this respect, the article continued, the electrical operation of our main line railways was especially handicapped, for to form a fair guide every experiment had to be undertaken on a scale which involved heavy capital expenditure.

This of course is true enough, but at the same time it must not be forgotten that the results and experience which have been obtained on the various railways now operated electrically are not without their uses in considering the wider problem of main line electrification. If this be not admitted we may add that there is at least one section of railway in this country which was definitely converted to electric traction as an experiment, that is with a view to obtaining not immediately improved results but data regarding operation and equipment which could be applied with confidence on a large scale. As we shall show in this article some interesting results of the highest value have been obtained.

Details of the Line.

The line to which we refer is on the Midland Railway and comprises the Lancaster-Morecambe-Heysham branch, that is the double roads between Heysham and Morecambe, and Morecambe and Lancaster, Green Ayre, certain interconnecting junctions, and the single line from Lancaster, Green Ayre Station to Lancaster, Castle, Station on the London and North-Western Railway. The total length of single road is about 21 miles. The general lay-out of this section with information regarding the curves and gradients is given in Fig. 1. Its electrification was decided upon in 1907, with the avowed intention of obtaining experience with electrical operation when applied to comparatively light traffic.

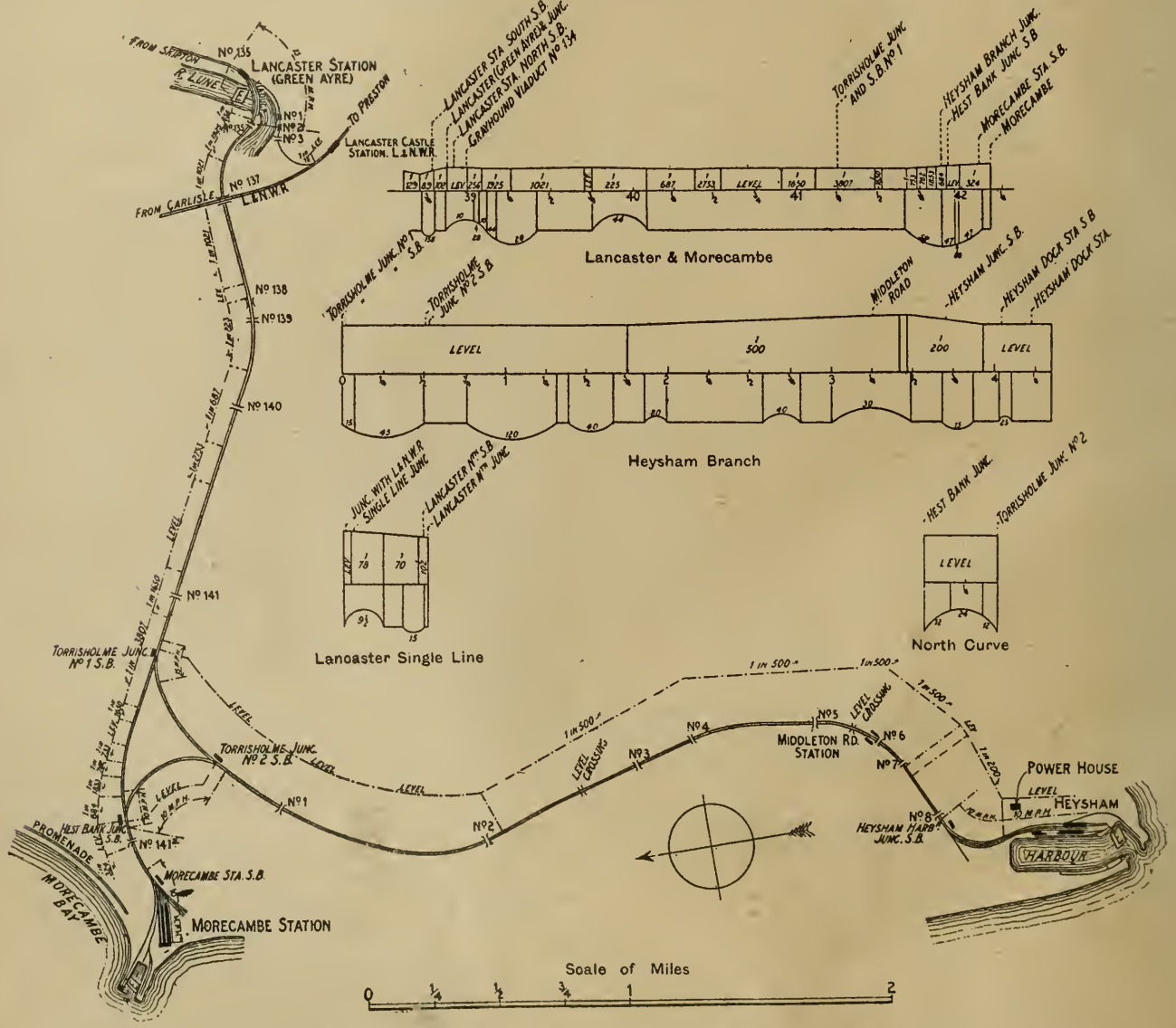

FIG. 1.—PLAN AND DIAGRAM OF GRADIENTS OF THE ELECTRIFIED PORTION OF THE MIDLAND RAILWAY SYSTEM.

An Interesting Prophecy

From the beginning there was no lack of optimism as to the result. And in this both the directorate and the officials of the Midland Railway were before their time. For in a Paper read before the Institution of Civil Engineers* a short time after the line was opened

* *See* THE ELECTRICIAN, Vol. LXIV., p. 222.

by Mr. J. Dalziel and Mr. J. Sayers, who were to a large extent responsible for the work of conversion, it was remarked that there was no reason why electric traction should not be equally successful for main line passenger and goods traffic as it had at that date been shown to be for suburban traffic. It was further argued that for heavy traffic working over long distances electrification even in 1908 offered a better solution of a problem than the only other alternative of extensive widening and regrading. These arguments are applicable *a fortiori* in 1922 and to that extent the Midland Railway built better than they knew.

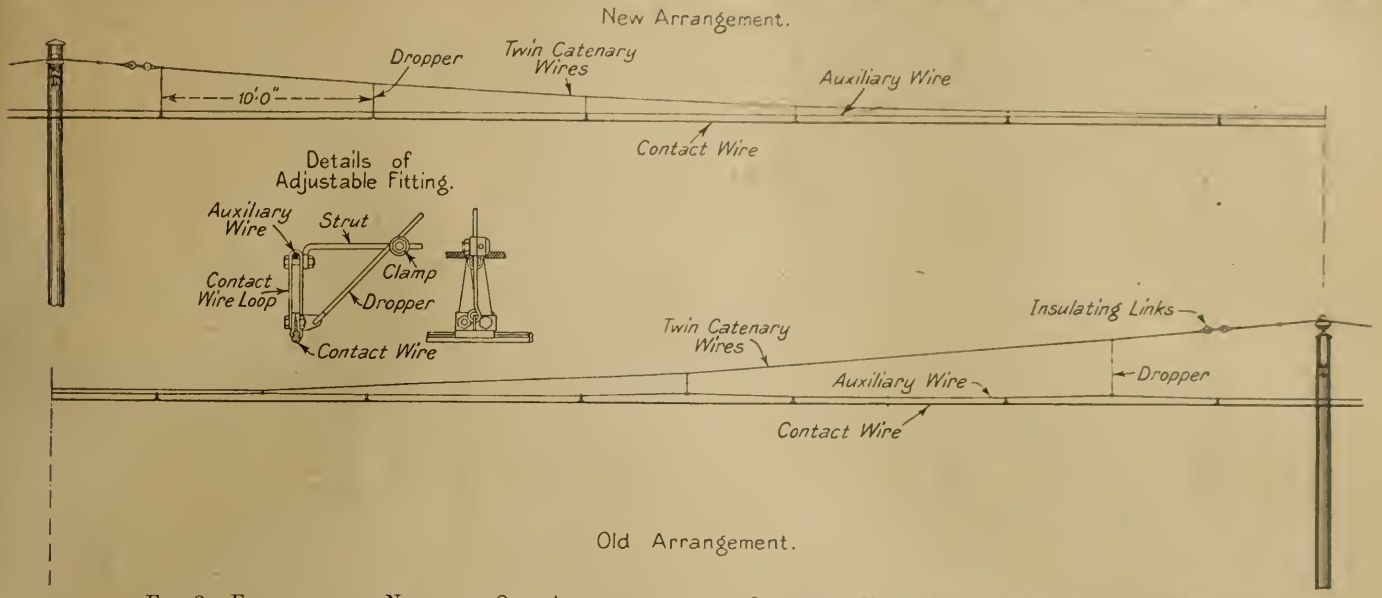

FIG. 2.—ELEVATION OF NEW AND OLD ARRANGEMENTS OF OVERHEAD EQUIPMENT ON A STRAIGHT STRETCH.

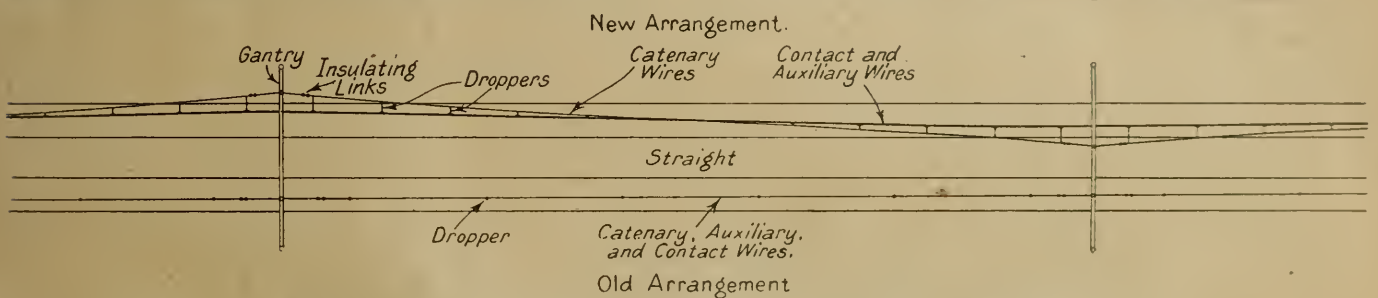

FIG. 3.—PLAN OF OLD AND NEW ARRANGEMENTS ON A STRAIGHT STRETCH.

Reasons for Adopting the Single-Phase System.

To carry out the electrification some form of overhead system was considered essential and as at that time the single-phase system was the only one available it was perforce adopted. This is one of the things that have changed, for not only have Messrs. Dalziel and Sayers a more open mind on this question but the experience they have obtained with the overhead equipment is equally applicable to the standard 1 500 V direct-current system, where overhead work is employed.

Traffic Conditions.

Before detailing the changes that have been found necessary in the equipment of the line something may be said about the nature of the traffic, as this is not without influence on the results obtained. The electric trains on this section provide a shuttle service between Morecambe and Heysham, and a similar shuttle service between Morecambe and Lancaster Green Ayre, with occasional trains between Lancaster Green Ayre and Lancaster Castle Station. The lines over which the electric trains run are also traversed by numerous steam goods trains and by a certain number of steam through passenger trains. Though the traffic is light in the winter it is spread over about seventeen hours out of the twenty-four and electric traction has therefore not only allowed of the release of a number of steam locomotives, but has prevented the waste due to the lengthy standing time inevitable under the old conditions. In the summer, on the other hand, the traffic is comparatively heavy and rather peaky owing to large numbers of passengers travelling at one time in connection with the steamers at Heysham. To deal with this traffic the electric trains have been found a great advantage, for the local passengers between Heysham and Morecambe can thereby be quickly carried off while the main line steam trains are being loaded up. There is also a considerable peak traffic on Saturday nights and at other special times between Lancaster and Morecambe, so that apart from other considerations the adoption of electric traction on this section has meant the elimination of a great deal of running round and shunting at these two stations.

Some Disadvantages.

From the traffic point of view it will be gathered that the service is not an easy one on which to obtain good results. The engineering difficulties in the way of conversion and maintenance are equally

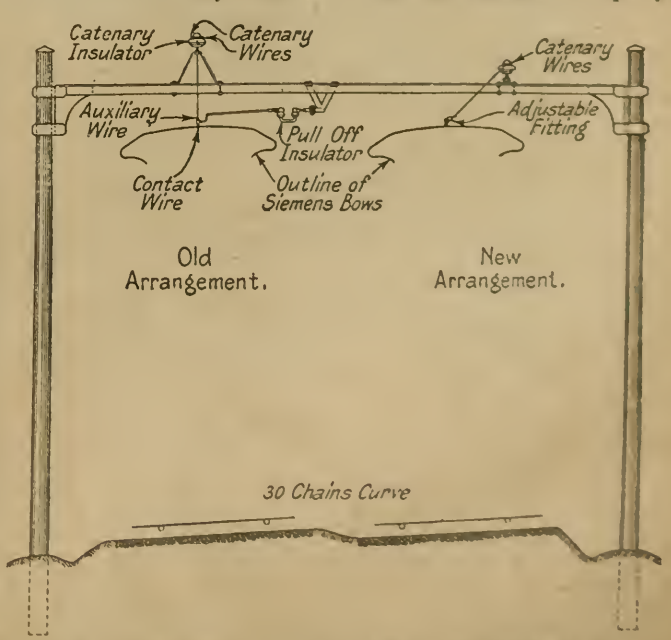

FIG. 4.—ELEVATION OF OLD AND NEW ARRANGEMENTS ON A 30 CHAIN CURVE.

great. Indeed, it may be said that there was every possible difficulty in the way of the erection of the overhead line, including severe gradients, sharp curves and low bridges. The line is situated in a country swept by violent gales and experiencing the worst of weathers, so that the equipment has been thoroughly tried out in every respect with the sole exception that it has not been possible to discover the effect on the overhead equipment of combined steam and electric traction through tunnels.

The Paper by Messrs. Dalziel and Sayers to which we have referred and the articles which we published in The Electrician of June 12, 19, and 26, 1908, give a detailed account of the original equipment of the line. It is the purpose of this article to indicate the changes which have since been found necessary in accordance with the experience of intervening years.

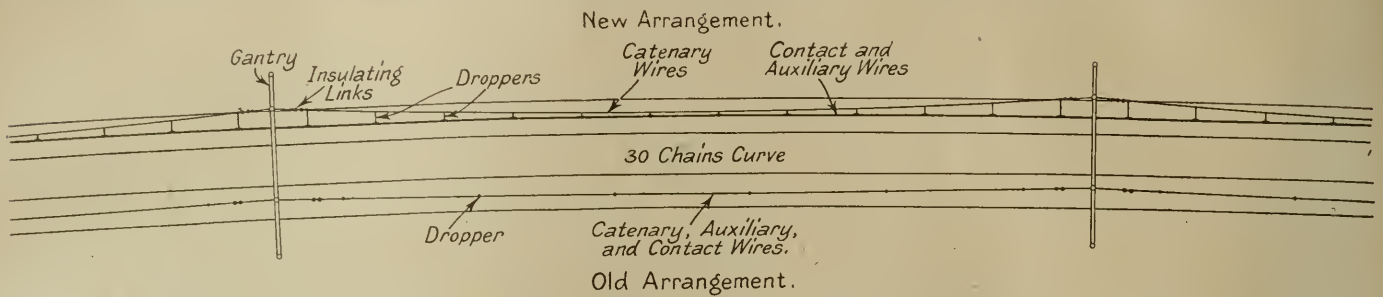

Fig. 5.—Plan of Old and New Arrangements of Overhead Equipment on a 30 Chain Curve.

Overhead Equipment.

The overhead construction originally used is shown in detail in the accompanying drawings and photographs (Figs. 2 to 7).

As regards collection, the employment of a single collecting bow for travelling in both directions necessitated the bow being symmetrical about the centre line of the coach and consequently only a very small clearance between the bow and the structure of the bridge was permissible. In fact, to obtain sufficient clearance it was necessary to take the contact wire well out towards the centre of the bridge arches, so that it came down quite low, though clear of the loading gauge, in order that the other side of the bow might clear the structure properly. It is interesting to note that the clearances actually used are less than those recommended by the Advisory Committee on Electric Traction on Railways, and no trouble has been experienced. Such practice is not of course recommended as one to be followed, but where there are numerous low bridges it is inevitable (see Fig. 6).

Contact Wire.

Turning to the overhead equipment, the contact wire originally used was of figure 8 section and was run in lengths of from 800 to 1 000 yds. It consisted of the equivalent of a 000 SWG copper conductor and was of 70 sq. mm. sectional area. One end of each length of the contact wire was fixed through insulators to a terminal gantry, the other being attached through pulleys and other gear to a weight equal to about 1 200 lb. The fixed end of this arrangement was always that at which the train entered the section and the weighted end that at which the train left, the idea being that the tendency of the bow would be to straighten the contact wire. The original weight used was equal to about 800 lb. with a horizontal stagger of 4 ft., *i.e.*, 2 ft. from the centre line of the coach, but in the experimental trials which were made for a period of some months before the line was opened it was found necessary to increase the tension to that mentioned above for lengths of trolley wire up to 1 000 yds. in length and to reduce the stagger to 2 ft. The latter reduction was principally necessary owing to the exposure of the line to the worst of weathers, and even with the reduced stagger there have been occasions when the line has been blown out and kept some distance from its position of repose by the violence of the gale. Another reason for increasing the tension was to remove the numerous small kinks which occurred in the trolley wire, especially on the more exposed sections between Heysham and Morecambe.

Fig. 6.—The Old (Left) and New (Right) Construction compared at an Overbridge Crossing.

Tightening Arrangements Abandoned.

Generally speaking, however, the tightening arrangements were found to be unsatisfactory. For weighting the contact wire in the way described gives a pull all in one direction, tending both to tighten and elongate it. The friction over the pulleys and at the auxiliary loops and pull-off fittings also overcame any tendency of the weights to rise with a decrease in temperature,

while as the contact wire wore the tension of course increased instead of decreasing, as would have been more desirable.

To overcome these difficulties, in April, 1910 an improved pulley arrangement was fixed at the weighted end of one section, and all the auxiliary loops and pull off fittings in that section were lubricated with vaseline. With this arrangement the weights did actually rise and fall with temperature variations, but it soon became evident that to maintain the movement satisfactorily all points where friction occurred would have to be lubricated periodically. For labour and other reasons this was considered impracticable, and it was therefore decided to abolish the weighting apparatus and to anchor the contact wire at both ends, an operation which was successfully carried out between June and October, 1913.

It may be mentioned that only a very small wear of the contact wire has been observed, and though it has been in use over fourteen years it has apparently still several years of life. The only trouble, a minor one, that has been experienced with this part of the installation is an accumulation of rust at the contact wire clips, though this has not accumulated in sufficient quantity to prevent smooth running.

Pull-Off Difficulties.

As mentioned above, it was soon found that the 4 ft. stagger of the contact wire over the track was too great, for even during the experimental runs several cases occurred of the bow running off the wire owing to the oscillation of the cars and the wind pressure. It was also found that the arrangement of the pull-offs on alternate gantries did not counteract these factors sufficiently to allow the wiring to be adequately held. The stagger was therefore reduced, as mentioned above, and as an additional precaution the pull-off insulators were fixed at every gantry in the manner shown in Fig. 7. Since this modified arrangement has been in use there has only been one instance of the bow running off the wire, and this was due to the combined effect of a gale and a loose joint. Experience, in fact, shows that with a stagger not exceeding 2 ft. and the upward tension of the bow limited, the line is held by the pull-offs sufficiently satisfactorily to eliminate such occurrences entirely. The height of the contact wire from rail level varies from 18 ft. 3 in. in the open to 13 ft. 3 in. under the bridges. It is suspended by short loops about 4 in. long from a steel cable, known as the auxiliary wire. These loops are rigidly fixed to the contact wire, but are movable along the auxiliary wire.

Catenary Details.

The auxiliary wire, which consists of a 7/13 steel flexible cable, is hung from two main catenary cables, of which there are two, at five points in each span, as can be seen from the illustrations reproduced herewith. These catenary cables, which each consist of 7/13 steel wires, are clipped together throughout their whole length except for about 3 ft. on either side of the insulator, where they divide to pass through the grooves of a ring on opposite sides of the insulators. The catenary is, therefore, free to move for this distance, so equalising the stresses in the spans due to unequal loading. At the same time everything is secure should a wire break. All these wires were treated with hot red paint before erection and no trouble has been experienced from corrosion. Section switches are provided so as to isolate the lengths into which the up and down lines are divided. These switches are of the double-break air pattern, and are fixed on the top of the poles supporting the gantries. Each section switch is in addition duplicated, the connection from one contact wire to the section ahead of it being accomplished through a short section of switch wire which is connected by a choke coil and lightning arrester with a $\frac{3}{4}$ in. gap to the two contact wires (one in each section) before the line is switched through at this point. This arrangement was adopted to obtain a duplicate break as well as a short length of line into which the car could run without thereby bridging the two sections which it was required to isolate. The run-off from one section to the other is accomplished in a "three-pole" length of track by gradually curving away and raising the old wire and at the same curving in and lowering the new wire.

The section switches are provided with padlocks, as are the switches at the station, which enable the contact wire to be earthed in case of emergency. A certain amount of trouble has been caused by the air break insulators used on these switches. The first failure of the insulators occurred in April, 1909, about a year after the line opened, and since then there has been a number of others. The trouble in every case has been due to the cement used for fastening the caps on to the insulators. This cement consisted of a mixture of sulphur and ground glass. A further weak point that soon became apparent in the design of these insulators was that owing to the

Fig. 7.—The Old (Left) and New (Right) Construction compared on a Straight Stretch with Normal Height Poles.

blow caused by opening and shutting the switch falling upon the neck of the insulator the porcelain soon fractured. These difficulties were overcome by providing additional insulators so as to obtain a double insulation, and by giving a greater strength to the parts. There have been no failures since this was done twelve years ago.

Insulator Troubles.

As might be expected, the principal trouble experienced with the line equipment has been in connection with the various insulators employed. The insulators originally used were specially manufactured for the company and were tested very severely, but even before installation they were not found entirely satisfactory. The steel bolts supporting these insulators were incased with ebonite, the idea being to obtain practically double insulation with one insulator. The insulators themselves were also made in two portions so as to give as massive construction as possible. It was claimed for this design and its use with a twin catenary cable, that it would bring the side strain of the overhead gear below the level of the inside bolt and that as there was no bend at which the catenary cable up to the present time, *i.e.*, for twelve years. Experience in this connection goes to show that a small quantity of really sound porcelain, combined with a robust construction of the supports and fastenings, forms the best insulator for a high tension line.

An alternative means of improving the insulation was tried on the Lancaster-Morecambe section of the line, where the arrangement was adopted of replacing the original insulators by those of the Diabolo type, as clearly shown in Fig. 8. These, too, have given very satisfactory results, and there have been no troubles or failures of any kind with them since their erection in August, 1910.

Pull-Off Failures.

Perhaps, however, the greatest trouble, and certainly the most interesting way of overcoming it, has been in connection with the pull-off insulators. The first failure with these insulators occurred in February, 1911, when one of them broke down electrically during a heavy rain storm. This failure has been followed by many others. Experience indicates that the bursting, which has frequently occurred, is due to the absorbent nature of the litharge and glycerine

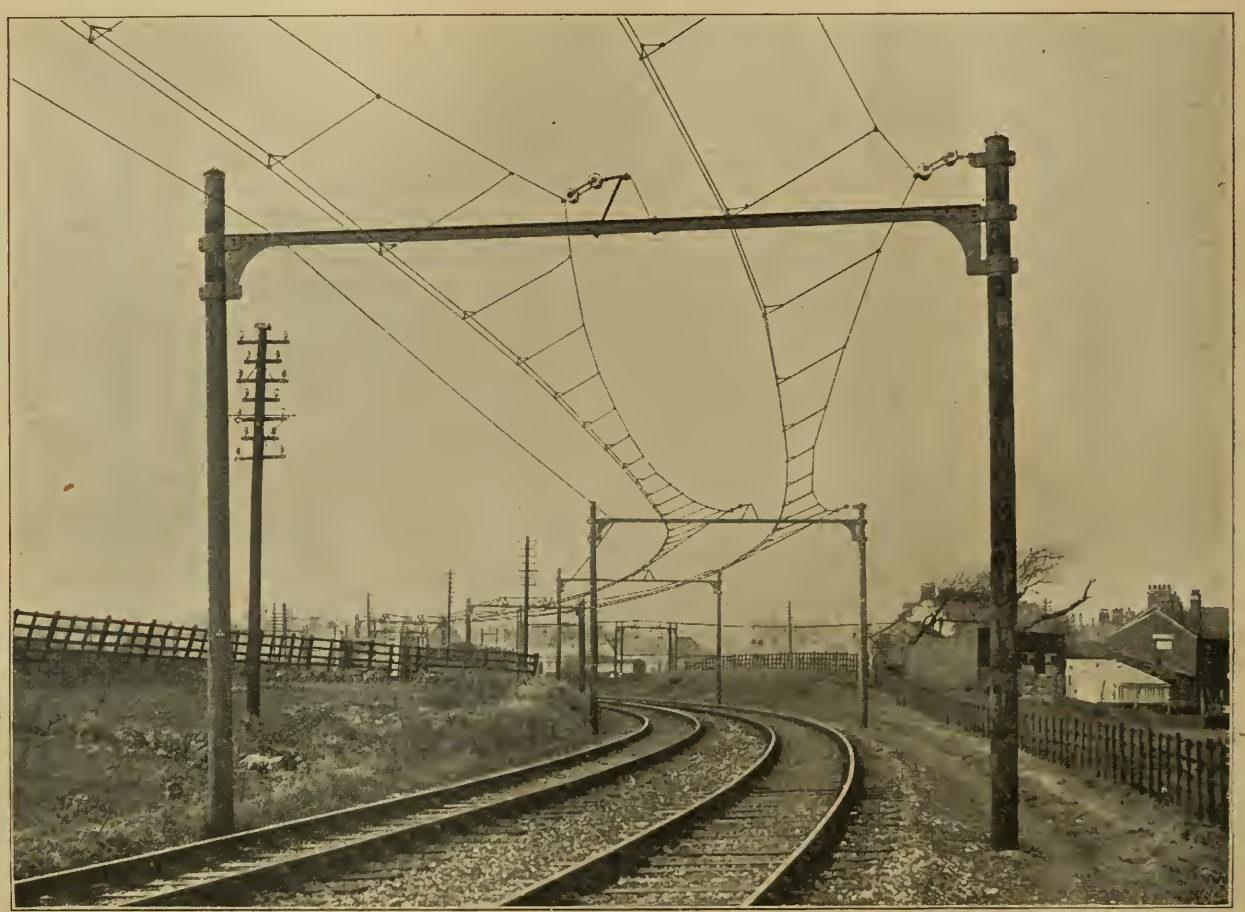

Fig. 8.—The New Construction on a 24 Chain Curve.

itself was deformed by the pressure of any clamp there was no point at which the mechanical waves would tend to break the wire at a point of reflection. In other words, the idea of eliminating to the fullest possible extent anything in the way of hard spots on the contact wire was carefully kept in view.

In spite, however, of the care taken in the choice and manufacture of these catenary insulators, trouble soon began to occur. In December, 1908, the first insulator failure took place with one of these insulators breaking down electrically and earthing the line. During the two following months four similar failures occurred. In every case these faults were found to be due to the absorbent nature of the litharge cement employed by the manufacturers for fastening the crown on to the main insulator. With a view to overcoming this trouble, as much as possible of the litharge was removed. The insulator was then halved and bitumen poured in. The whole of the catenary insulators on the line had been so treated in this way by the end of 1909.

In spite of this, however, the failures continued, until between May and September, 1910, steps were taken to improve matters on the Heysham-Morecambe section by providing additional insulators, known as catenary insulating links, on each side of all the main insulators. This arrangement proved successful, and there have been no further failures in connection with these insulators cement employed for fastening the metal caps on to the insulators, owing to the expansion of the cement causing a fracture of the porcelain.

Here, again, great success was obtained with two insulators of the Diabolo type which were fixed on poles near Morecambe as early as 1909. These are still in use, and have given no trouble whatever. In August, 1914, a white spool and strain pull-off insulator was fixed as an experiment on the up line near Morecambe. As this experiment proved successful, similar insulators were fixed on a number of other gantries.

In February, 1916, experiments were also made with a loop type of insulator. This insulator also behaved satisfactorily for some time, but in March, 1918, a heavy discharge was observed across it, at a time when it was covered with snow. It was then found that though three of the insulators forming it were broken there was still sufficient insulation available to prevent a breakdown of the line. The faulty insulators were replaced by others of the same pattern, but since then further failures have occurred and in 1920 the use of this pattern of insulator was abandoned.

Mechanical Failures.

In connection with the type of pull-off insulator originally installed there have been four cases of the shank becoming detached

from the back of the insulator and hanging foul of the loading gauge, being suspended from the contact wire by means of the pull-off pipe. The shanks of these insulators were fastened by means of red lead, raw linseed oil and tow, and it seems that the faults were caused by the leakage current burning the tow and so loosening the holding.

A Bold Step.

To overcome this trouble the shanks of a number of pull-offs were fixed into the insulators by a black cement, consisting of smithy ashes, resin and sand. This cement has proved quite satisfactory. Nevertheless, it has not been entirely tried out as the constant trouble caused by these pull-off insulators encouraged the bold step of dispensing with them entirely and of regulating the position of the contact wire over the track by staggering the catenary insulator positions as shown in Figs. 2 to 8 which give an interesting comparison of the old and new methods of suspension. In the new arrangement the contact wire is held upright by means of adjustable struts attached to special auxiliary loops and contact wire clips. This method of suspension was first introduced on the down line between Morecambe and Heysham at a time when it was temporarily out of use during the war. Since it has been in operation the numerous tension tests that have been made show that it compares favourably with the old methods in all conditions of weather. Trouble due to pull-off insulators is entirely eliminated; in appearance the new suspension is preferable as the contact wire follows the curvature of the line and hard spots are non-existent. This type of suspension is now in use throughout on the down line between Torrisholme Junction and Heysham, and on the up and down lines between Heysham and Torrisholme, as well as between Lancaster Green Ayre Station and Lancaster Castle. It has given entire satisfaction. It may be added that with this type of suspension there is very little tension, as even on the curves pull does not exceed 10 lb., there is no danger of running off and smooth running is ensured.

Figs. 4, 5, 6, 7, and 8 show the type of construction employed on curves and under bridges respectively. These are mainly self-explanatory. Under bridges the change in height of the trolley wire from the standard to that necessary to permit the passage of the bridge is effected in a "four pole" length, the gradient of the wire being usually about 1 in 100. The contact wires under steel bridges are protected by fire-proofed wood shields which extend 2 ft. beyond the bridge structure and slide into fire-proofed soft wood runners. This prevents damage from articles being dropped on the equipment from above, though as an experience at Lancaster showed, it is possible for a weighty human being to fall on the overhead equipment without the latter being injured.

It may be added that the original pull-offs are still used under the bridges and on curves, where special endeavours have been made to render the change in direction as easy as possible. As a means of protection from damage, gauges 16 ft. 9 in. high are provided at all the level crossings, of which there are a number on the line, to prevent loads which would otherwise come in contact with the overhead equipment being taken across the line.

(To be concluded.)

Progress in Industrial Research.

The Quarterly Review issued by the British Electrical and Allied Industries Research Association contains a record of the progress made during the past few months in the important research work conducted by this body. The work of the Association is carried out by Committees, each dealing with a different section of the work; these sections now number eleven.

Fibrous Insulating Materials.

Section A (Fibrous Insulating Materials) covers research on fabrics (untreated and treated), papers, fibres and boards, varnishes, &c. Specifications of the methods to be adopted in investigating varnished fabrics have been drafted. The clauses covering mechanical tests are now under experimental proof; but the development of tests for electric strength has indicated the desirability of a wider series of tests applicable to all materials with a fibrous base, and even of a series of tests standardised for every kind of insulating material. The study of untreated papers has yielded results shortly to be published as a document covering the methods of examination and the definitions of the materials and terms employed. Specifications have also been drafted for the study of pressboard, vulcanised fibre, varnish board, etc., and are undergoing experimental verification; a full report of these researches is in preparation.

New work in section B (Composite Insulating Materials) includes the formation of a committee for research in varnishes; the co-operation of all having special knowledge of this subject is invited. A comprehensive publication has been prepared of the test methods developed by the Association for the investigation and improvement of composite insulating materials. The publication includes a complete series of mechanical (*e.g.* tool wear and chipping tests) and electrical tests, with the exception of tests for inflammability, flash point, fire resistance, dielectric losses, action of solvents, and surface breakdown. These are still under consideration, though in some cases the researches have reached the report stage. The Committee of Section C (Porcelain) reports the completion of arrangements for porcelain research at Manchester University and the National Physical Laboratory.

Mica and Micanite.

The results of the work done by Section D on Mica and Micanite for commutators and condensers will shortly be available as a report. In the course of this work there has been found a general lack of physical data concerning certain features, and this led to the institution of a research on fundamental constants, and the examination of the particular characteristics of certain micas. Arrangements have also been made for the publication of data obtained by the E.R.C. The manufacture of micanite is under consideration, and co-operation is invited from manufacturers and users.

Insulating Oils.

The specification for insulating oils, prepared by section E and already submitted to the B.E.S.A., has met with substantial approval, and a final draft is under consideration. The researches on the electric strength and resistivity of insulating oils include the deterioration of oils by foreign matter, water, and products of arcing; particular interest is involved in the use of centrifugal apparatus in this research. Work still continues on thermal transference, specific and latent heats, &c. (at the N.P.L.), and on the action of catalysers and the analysis of deposits.

In Section F (conductors) the intermittent and overload ratings of buried cables continue to receive attention, the data collected from power-station engineers being included for analysis. Recommendations have been drafted dealing with the ratings of cable used on ships. The research on overhead lines has progressed as far as deflection and performance tests of standard "A" and "H" poles, inserted to various depths. In this research, the records were made with the aid of a cinema camera, which enabled a detailed examination of the behaviour of the poles to be made at leisure. This research is in the report stage, and the tests of long overhead lines are being pushed.

Electric Control Apparatus.

Section G (Electric Control Apparatus) deals with the phenomena of switching and arcing, mining switchgear, heavy-duty fuses, d.c. circuit breakers, and the resistivity of joints and contracts. The investigation of the phenomena of switching and arcing has involved as a preliminary the determination of the short-circuit characteristics of a large alternator at Carville Power Station, the development of devices for predetermining the instant at which a circuit is made or broken, and special apparatus for control of the power factor and energy flow. An adjustable switch has been designed and constructed. Pending the completion of arrangements on the site of the test, there has been made a survey of all available data on switching and arcing.

The tests on mining switchgear deal chiefly with the pressures developed in closed chambers; satisfactory workshop tests have been devised. The investigations on heavy-duty fuses have progressed, with the aid of tests on a large battery under short circuit conditions, to a point where test methods can be formulated. It yet remains to test makers' samples, of which a complete set has been collected. Preliminary tests of d.c. circuit breakers have disclosed unexpected difficulties in the determination of the physical constants of shorted circuits. When these have been overcome, it is hoped to secure the loan of apparatus suitable for large-scale tests, failing which it will be necessary to fall back upon the special apparatus built for the researches on switching and arcing.

Synthetic Resins.

A close study has been made by the committee of Section K of the whole question of the production in this country of synthetic resins. The scope of this work includes plans for the supply and production of raw materials, for test methods, and the collection of samples for tests. A report is expected shortly.

The activities of Section L, formed to deal with dielectrics in general, have resulted in an extensive programme of research on dielectric losses to be carried out in co-operation with the N.P.L. This will commence with observations at low voltages and at low and audio frequencies, and will later proceed to the development of test methods for high voltages and radio frequencies. The experimental work on the thermal resistivity of dielectrics in sheet form is proceeding; test methods for built-up insulation have been developed and are to be used in investigating various methods of construction.

The researches on condenser corrosion and on turbines, carried out in co-operation with other research associations, have reached the report stage. The report on the corrosion of metals is a most valuable *résumé* of the several years' investigations, and should go far to remove much of the guess-work hitherto inevitable in condenser maintenance and design.

Imperial Wireless Telegraphy—A Technical Report.

The report of the Wireless Telegraphy Commission which, in accordance with the suggestion of the Imperial Wireless Telegraphy Committee, was appointed in 1920 to make recommendations regarding the sites and apparatus for the stations of the Imperial Wireless Chain, contains a great deal of interesting information on technical wireless matters. It includes a discussion of the development of high-power thermionic sets, the cost of valve renewals, the choice of wave length, transmitting antennæ, masts and towers, the methods of reception and the design of receiving stations. Detailed recommendations for the equipment of the various stations in the Imperial Chain are also given.

The Wireless Telegraphy Commission, which was appointed by the Cabinet on Dec. 23, 1920, has issued its report (Cmd. 1 572). The Commission consisted of Lord Milner (chairman), Dr. W. H. Eccles (vice-chairman), Mr. L. B. Turner and Mr. E. H. Shaughnessy, with Lieut.-Col. C. G. Crawley as secretary. It was appointed as the result of a recommendation by the Imperial Wireless Telegraphy Committee, 1919-20, that the stations of the Imperial wireless chain should be planned by a wireless Commission of four members, and its terms of reference were to decide on the wireless plant most suitable for carrying out the scheme of Imperial wireless communications recommended by the Imperial Wireless Telegraphy Committee, 1919-20,* to make recommendations regarding the actual sites for the stations proposed by that committee, and to advise generally on the preparation of specifications for machinery and apparatus, the making of contracts, and the construction of the stations. Its contents are of the highest technical interest.

Development of High-Power Thermionic Sets.

The report begins by pointing out that the Imperial Wireless Telegraphy Committee recommended that the thermionic transmitter should be capable of delivering at least 120 kW to the antenna and that double this power appears to be within the bounds of possibility at an early date. As regards progress in these matters at home, the work of the Admiralty is especially notable; at the Signal School, Portsmouth, very large silica valves have been constructed and used. Every effort has been made by the Admiralty to hasten the establishment of an industry for the manufacture of these valves. At the present date the 2½ kW silica valves are being produced at the rate of about four or five per week.

In order to equip a typical Chain station with silica valves, about twenty-four would be required to deliver 120 kW to the aerial. The annual consumption of valves by such a set working twenty-four hours every day without cessation would be between 36 and 108 per station. Thus, on the basis of incessant operation, eight Chain stations would consume between 288 and 864 valves per annum. The silica valve industry is only gradually approaching the condition of being able to cope with the possible demands of the Chain stations over and above those of the Admiralty and other services.

If glass valves be used instead of silica about four times as many would be needed for equipment and renewals. In round numbers, between 1 080 and 3 240 glass valves would probably be required per annum by the Chain stations if all were to operate continuously. There is reason to believe that this demand could be met.

Cost of Valve Renewals.

The most important aspect of this question is the cost of valve renewals. Glass valves cost about £15 each. The above rates of renewal of glass valves may cost, therefore, between £2 025 and £6 075 per annum per station. The silica valves cost about £60 each, and the expenditure upon renewals would therefore be between £2 160 and £6 480 per annum per station. It is claimed, however, that burnt filaments can be renewed in either glass or silica valves at small cost, and that the above estimates of costs of renewal of silica valves can thus be materially reduced. These claims have not yet been tested practically by any large user. In all cases, it should be emphasised, estimates of the consumption of valves will be profoundly affected by the care taken in manufacture, and by the absence or presence of skilled attention during use.

The above estimates of the cost of renewals relate to the method of operation in which high voltage direct-current generators are employed. If alternating current were used the initial capital outlay on machinery would be greatly reduced, but the cost of valve renewals would be increased by 50 per cent. for the silica valves and by about 66 per cent. for the glass valves. The estimates are based upon an average filament life of from 6 000 to 2 000 hours, which can reasonably be expected to be achieved in the course of valve development.

Apart from the problem of manufacture of the valves, the problem of assembling them as thoroughly practical telegraphic transmitters remains. The Commission is collaborating with the Admiralty upon this problem. A set of valves which is designed to utilise 67 kW is now being erected at Signal School on the Commission's responsibility.

The Work of the Marconi Company.

Besides the Admiralty, the Marconi Company have in this country been very active in the development of large thermionic sets. They have established commercial traffic across the Atlantic by means of thermionic stations of less than 30 kW input at Clifden, Ireland, and at Glace Bay, Canada. In Central Europe the Telefunken Company have erected plants of about the same power at two stations. In the United States of America the development appears to have been confined principally to the laboratories, and the Commission have no information regarding the commercial working of large thermionic stations.

The Commission visited the Carnarvon station of the Marconi Company and took part in trials of the largest thermionic set yet constructed.† It is an assemblage of forty-eight glass valves and is capable of working with an input of about 100 kW. This is approaching the order of magnitude laid down by the Imperial Wireless Telegraphy Committee. The set was overloaded at the trials until the input was about 150 kW. The trials, which were of short duration, were very successful and included the transmission of messages across the Atlantic (of which receipt was acknowledged by wireless) and the transmission of messages to Australia and India during what are known to be the best hours of the day for reception in those parts of the globe. The engineers of the Marconi Company have spent much time and great ingenuity in building up this set, and the Commission are confident that they would now be able to erect a set fulfilling the minimum requirements laid down by the Imperial Wireless Telegraphy Committee.

Choice of Wavelength.

Into the problems of choice of wavelength two factors enter, the international and the physical. The former factor was discussed in Paris at a meeting of the representatives of the Governments of the Allied and Associated Powers. This international aspect of the matter has been borne in mind by the Commission in the formulation of their recommendations.

The physical factors in the choice of wavelength have been closely studied, both theoretically and experimentally, and by means of accumulated records. Mr. Turner spent September in Egypt observing the legibility of prearranged signals despatched from the Admiralty station at Horsea. For this purpose a thermionic set of about 30 kW input was used to emit a series of signals at various wavelengths at all hours of the day and night upon selected days. The conclusion is that for distances such as those in the links of the Imperial Chain the best signals are those obtained at night by the use of relatively short waves, while the best day signals are those using long waves. The month of the trials is one of the worst months of the year for atmospheric disturbances in Egypt.

Transmitting Antennæ, Masts and Towers.

The choice of an antenna for a new type of transmitter lies between low antennæ of great area and high antennæ of smaller area. In the case of thermionic oscillators, where plant large enough for the task is being made with difficulty, the high antenna of relatively small area is preferable. The preference is independently supported by a deeper study of the better wave-making properties of high as compared with low antennæ. From the nature of the thermionic oscillator, moreover, it can be shown that a symmetrical antenna is more suitable than an unsymmetrical one, whether a low or a high antenna is concerned.

The masts or towers used for supporting the antenna constitute the most costly item of a wireless station, and unless properly designed they affect and cause great loss of oscillatory energy generated. The ideal mast would be built of insulating material; wooden structures are an approximation to the ideal, but are unsuitable for the tropics. Steel structures are conductors, and cause considerable electrical loss. A great deal of this loss can be avoided by making the mast or tower in sections with insulating portions and standing the mast on an insulating base. There are some mechanical difficulties in this mode of construction, but they do not greatly affect the capital cost, and may be regarded as subsidiary detail. The above remarks apply alike to self-supporting towers and to masts supported by guys, the guys also being segmented by insulators in the latter case. The cost of masts is much less than that of towers.

It is recommended that earth screens and emergency receiving gear and operating apparatus should be installed at all stations.

Method of Reception and Design of Receiving Stations.

A number of alternative types of apparatus and several types of receiving antennæ were tested in Egypt by signals from Horsea, Leafield and other European stations. The Commission visited the Towyn receiving station of the Marconi Company and saw a demonstration of Mr. Franklin's double directional antenna. The demonstration proved nothing as regards the performance of this

* *See* The Electrician, Vol. LXXXV., p. 42, July 2nd, 1920.

† *See* The Electrician, Vol. LXXXVII., p. 714.

apparatus under the tropical conditions of many of the Chain stations, and an examination of the apparatus tends to confirm the opinion that it has no anti-atmospheric merits other than those possessed by various forms of directive apparatus.

The Arrangement of Receiving Posts.

The Imperial Wireless Telegraphy Committee recommended that each station of the Chain should be one-way duplex, but it would seem that better use of the plant could be made if each station were provided with as many receiving posts as there are stations with which it will communicate; and, further, that each of the Egyptian stations should be assumed to communicate with both East Africa and India. Such an arrangement is quite feasible and offers the following advantages:—(1) Until the routes are fully loaded it allows of improved working during periods when the flow of traffic in one direction is greater than in the other direction; (2) during periods when bad atmospheric conditions prevail at one station and not at the adjacent stations the one station can be sending to either of the others, and when the good reception period at the one station comes the time lost can to some extent be made up by receiving from all adjacent stations at once.

For economy of staffing and for traffic reasons it is highly desirable that all the receiving posts of one station shall be situated together. At each of the non-terminal stations, therefore (Egypt, East Africa, India, Singapore), the receiving posts should be grouped together at one spot, distant 20 to 40 miles from the transmitting station. In Egypt, East Africa and India, where the routes diverge through much less than a right angle, the line joining the transmitting site to the receiving site should be approximately perpendicular to the average direction of the signalling routes at the station; but at Singapore, where the branch to Hong Kong is nearly perpendicular to the average India-Singapore-Australia route, the receiving site should be situated approximately on the line joining Singapore to Hong Kong. In South Africa and Hong Kong the receiving site should preferably be situated 20 to 40 miles from the transmitting site approximately on the signalling route. In England the receiving post of the new station should preferably be placed with the existing receiving post at Banbury. In general the receiving site should be chosen so as to comprise a central plot, 250 yds. by 50 yds. for the operating building, and two other plots, 220 yds. square, each suitable for containing a mast 300 ft. high, about 550 yds. from the central plot and on opposite sides of it. The general direction of the three plots should lie along the average direction of the signalling route.

Atmospheric Disturbance.

Experience recently gained in England and Egypt has shown that atmospheric interference may be markedly reduced by each of three distinct methods, which may be referred to as: (*a*) Atmospheric balancing, (*b*) limiting, (*c*) barraging. Designs are in progress for applying all these simultaneously in Egypt. If the benefits obtainable justify the expenditure, the other stations of the Chain can be similarly equipped in due course.

The Windhuk Station.

The Imperial Wireless Telegraphy Committee recommended (1920) the use of the ex-German Windhuk station as the South African terminal station of the Chain, being under the impression that Windhuk was adequately connected by land lines with the political and commercial centres of the Union. Later information put before the Commission has shown that new land lines would be required, and that the maintenance of these lines would be costly. Under these circumstances, the Commission drew up a memorandum upon the possibility of erecting an entirely new station near Johannesburg as the terminal station of the African chain. The capital outlay would be greater than that needed for the adaptation of Windhuk, but the cost of maintenance would be less, much retransmission of messages would be avoided, and better conditions for the staff could be provided.

Buildings.

The advantages of a symmetrical antenna have been referred to above. In order to ensure symmetry, the buildings for housing the transmitting plant should be placed at the centre of the transmitting site. In general, there will be a boiler house, an engine room and a high frequency room, together with workshops and an emergency operating room; but when power can be drawn from an outside supply the boiler house is not required. In view of the recommendations of the Imperial Wireless Telegraphy Committee it is important to plan the buildings in such a way that the boiler house, engine room and high frequency room can each be extended easily. The form adopted in this Report is a very economical one; it consists of two or three equal bays, as the case may be, in parallel formation, with panelled ends, each lighted from the roof, which may be of sawtooth type. The buildings may be oriented in any direction appropriate to the locality.

General Recommendations.

The Commission recommend that:—

(1) The transmitting stations in England, Canada, Australia, the Union of South Africa, India and Egypt be equipped with thermionic valve plant in the manner described in detail below. But in view of the amount of skilled attention demanded by this plant in its present stage of development, and having regard to the isolated nature of the stations in East Africa, Singapore and Hong Kong, these three stations should be equipped for combined arc-valve transmission; the arcs alone should be installed immediately and the thermionic valve plant should be added after practice has become standardised.

(2) Each transmitting station should be capable of working with either of two wavelengths as may be appropriate to the time of day and the atmospheric conditions.

(3) Each receiving centre should be provided with antennæ and apparatus sufficient for working simultaneously with the other stations normally communicating with it, and all the receiving and operating apparatus should be in one and the same building.

DETAILED TECHNICAL RECOMMENDATIONS.

England: Transmitting Station.

(4) *Masts.*—The masts should be of steel, each 250 m high, guyed three ways with six concrete anchorages, both masts and guys insulated in sections, and designed to take a horizontal pull of 10 tons at the top and a wind load of 60 lb. per sq. ft. with a factor of safety of 3. Four masts should be erected, one at each corner of a square not exceeding 400 m. side. The site should allow of extension of the antenna by the addition of two masts at each end, and the whole area available should therefore be about 1 mile by $\frac{1}{2}$ mile.

(5) *Antenna.*—The antenna should be designed so as to reduce corona to a minimum, and should be especially highly insulated. Its electrical capacity should be about one-fortieth of a microfarad.

(6) *Earth Screen.*—The earth screen should be a series of copper wires radiating from the centre of the site to its edges, and supported at not less than 8 ft. from the ground by insulators.

(7) *Antenna Tuning Coil.*—The tuning coil should be designed for an antenna current of 500 A, provided with tappings for tuning the antenna to wavelengths between 3 000 m and 16 000 m. The high frequency resistance of the part in use should not exceed $\frac{1}{3}$ ohm at the corresponding frequency.

(8) *Thermionic Valve Set* (provided in duplicate).—A thermionic valve set capable of delivering at least 120 kW of high-frequency power to the antenna, with the necessary connexions to the antenna coil, with control gear and protective devices in the anode and filament circuits, with grid leaks and condensers, relay and hand keys, air-piping for valves and keys, compressor and instruments, all connected up. The set should be capable of sub-division in stages so that a convenient fraction of the total power may be taken to the antenna at will. It should also be capable of extension until 240 kW can be delivered to the antenna. Current may be supplied either from high voltage d.c. machines (10 000 to 12 000 V) or by rectifying alternating current; tenders will show which is preferable from the point of view of economy.

The set should be guaranteed with respect to constancy of wavelength, purity of wave, overall efficiency at each wavelength and average cost of renewals. It must be capable of transmitting continuously at hand speed and at ninety words per min. at full power, for reception at 2 500 miles.

The Marconi Company to Tender.

It is suggested that the Marconi Company be invited to tender for the apparatus recommended under the headings "earth screen," "Antenna Tuning coil" and "thermionic valve set." If their quotation should not be acceptable, thermionic plant, &c., could be designed by the Commission after the conclusion of the work now being undertaken at Horsea, erected in England, tested, and proved designs recommended to the Dominions and to India.

(9) *Power Supply and Electrical Machinery.*—For the generation of the electrical power supply water-tube boilers, burning oil or coal, should be used. The requirements are:—Three water-tube boilers, each evaporating 7 000 lb. or two each evaporating 10 000 lb. of water per hour, with superheaters and economisers, pipe work, water softeners, feed-pump, together with condensers and cooling plant; *two 250 kW turbo alternators, three-phase, 50 cycles, 3 000 V between phases; *two 250 kW three-phase transformers, giving 15 000 V; two turbines, each driving one 50 kW d.c. machine, 220 V, and *one 30 kW d.c. machine, 20 V, and high and low tension switch gear. The alternative mentioned in Recommendation (8) would require the substitution of the following two items for the three items marked with an asterisk: Two 200 kW steam-driven sets giving 10 000 to 12 000 V d.c., and two 20 kW sets giving 20 V d.c. Later extensions would be one boiler, one turbo-alternator (or one 200 kW, 10 000 to 12 000 V d.c. set), one transformer, one 20 kW 20 V d.c. set, one d.c. turbo-generator, switch gear, &c.

(10) *Buildings.*—The transmitting station buildings should be at the centre of the site. They comprise the sections mentioned in paragraph 28. A travelling crane is required in the boiler-house and the engine-room.

(11) *Emergency Receiving Gear and Operating Apparatus.*—

The emergency arrangements should comprise a small aerial, a receiving set of the Post Office pattern, perforators, automatic transmitters and recording apparatus.

Receiving Station for Duplex.

(12) The receiving station should be situated at Banbury, and be provided with two sets of apparatus similar to that being installed at Banbury for the Leafield-Abu Zabal link of the Chain, but supplemented by limiting apparatus. Details appear in paragraph 19. As soon as Canada enters the Chain scheme an additional aerial system and set of receiving apparatus will be needed. Telegraph lines in duplicate connecting Banbury to the transmitting station will be required.

Canada.

(13) Should the Canadian Government decide to have stations at Montreal and Vancouver, the former could maintain a good service with the station in England, and the latter would be able to communicate during part of the day with England and with Australia. Both stations might be as described above.

Australia.

(14) The transmitting station should be as described in Recommendations (4) to (11), unless an ample public supply of electricity is available. In this latter event the transmitting station might be similar to that described in Recommendation (16).

(15) The receiving station should have two aerial systems and three sets of receiving apparatus, with accommodation for a third outfit for direct communication with South Africa when desired. The aerial for this receiving station consists of a pair of horizontal wires each about 250 ft. long supported upon two 75 ft. poles. The site required is as indicated in paragraph 19. When a station is built in Vancouver additional receiving equipment will be required. Apart from this, additional receiving equipment will be necessary if the Chain station is required to work across Australia.

A 12 kW d.c. supply (public or oil engine) will be required for lighting, charging batteries, and running telegraphic apparatus.

Telegraph lines in duplicate connecting the transmitting station to the receiving station will be required.

The Commission have been informed that the Australian Government prefer to have the Chain station situated at Perth rather than at Port Darwin.

South Africa and India: Transmitting Stations.

(16 and 18) If the transmitting station is placed near Johannesburg the masts, the antenna, the earth screen, the tuning coil, the thermionic valve set and the emergency gear should be as described in Recommendations (4) to (8) and (11). The power supply and electric machinery should be: *Two 250 kW three-phase transformers, 15 000 V; *two 30 kW three-phase transformers, 20 V; two 10 kW lighting transformers, 220 V; two transformers supplying two 40 kW rotary converters giving 220 V d.c.; high and low tension switch gear; and overhead transmission lines in duplicate. Later extensions would be one single set of transformers and gear as scheduled.

The alternative mentioned in Recommendation (8) would require the substitution of the following two items for the two items marked with an asterisk:—Two 200 kW motor generators, 10 000 to 12 000 V d.c.; two 20 kW three-phase transformers, 20 V. In each of the above schedules a mercury rectifier may be substituted for each rotary converter.

Receiving Stations.

(17) The receiving station should have one aerial system and two sets of receiving apparatus in the first instance, with accommodation for a second outfit for direct communication with Australia when desired. Lighting and telegraph lines will be required as in Australia. For India the same recommendations are made as for South Africa.

Egypt.

(19) The transmitting station, unless placed at Abu Zabal, should be of the type described in Recommendations (4) to (11).

The receiving station should have four aerial systems and five sets of receiving apparatus.

The site should consist of a central plot 200 yds. by 50 yds., containing the operating building, &c., and two other plots 220 yds. square, each containing a 300 ft. mast 550 yds. away in opposite directions from the central plot. The three plots should be connected by cable.

East Africa: Transmitting Station.

(20) The masts, antennæ, earth screen, tuning coil and emergency gear should be as described in Recommendations (4) to (7) and (11).

(21) *Arc Converter.*—Two 250 kW arcs should be installed, each provided with chokes, condensers, contactors, resistances, instruments, keying inductances, keys and auxiliaries, similar to those at Leafield.†

(22) *Power Supply and Electrical Machinery.*—The hydroelectric project at Thika, reported upon by the Public Works Department, Nairobi, on March 30, 1914, should be carried into effect, at least in part, if, as seems probable, the wireless transmitting site can be near the Falls. For the purposes of the wireless station the water of the Thika is sufficient, and the proposed simultaneous utilisation of the Chania might therefore be reserved for any eventual enlargement of the wireless station. The electrical machinery should consist of two 250 kW water turbine-dynamo d.c. sets, delivering 350 A, with voltage regulation between 500 and 1 000 V; two 60 kW water turbine-dynamo d.c. sets, 220 V; switch gear; and two overhead transmission lines from the hydroelectric house to the wireless transmitting station.

(23) Should the hydroelectric project be for any reason impracticable, the electrical supply should be generated by steam, as described in Recommendation (27).

(24.) *Buildings.*—A hydroelectric building should be provided at Thika River.

Receiving Station.

(25) The receiving station should have three aerial systems and four receiving sets, with accommodation for the addition of a fourth outfit for direct communication with England.

The site should be so chosen as to permit of the erection of a pole line 250 yds. long across the central plot, but otherwise conforming to the description in paragraph 19.

Singapore: Transmitting Station.

(26) The masts, antenna, earth screen, tuning coil and emergency gear should be as described in Recommendations (4) to (7) and (11). The arc equipment should be as described in Recommendation (21).

(27) *Power Supply and Electrical Machinery.*—Three boilers, each evaporating 7 000 lb., or two each evaporating 10 000 lb. of water per hour, with superheaters, economisers, water softeners, feed pump, together with condensers and cooling plant.

Two 250 kW reciprocating-engine and dynamo sets, 350 A d.c., with voltage regulation between 500 and 1 000 V. Two 60 kW reciprocating-engine and dynamo sets, 220 V d.c., and switch gear.

(28) The buildings at the transmitting and receiving stations should be as indicated in the diagrams in Report.

Receiving Station.

(29) The receiving station should have three aerial systems and four sets of receiving apparatus. The site should be 250 yds. by 50 yds., with facilities for a pole line 250 yds. long running across it, and conform to paragraph 23.

Hong Kong: Transmitting Station.

(30) The masts should be of steel, 200 m. high, guyed three ways with six concrete anchorages, both masts and guys insulated in sections, and designed to take a horizontal pull of 10 tons at the top and a wind load of 60 lb. per square foot, with a factor of safety of three. Four masts should be erected, one at each corner of a square not exceeding 400 m. side.

The site should allow of extension of the antenna by the addition of two masts at each end, and therefore the whole area available should be about 1 mile by ½ mile. The antenna, earth screen, tuning coil, and emergency gear should be as described in Recommendations (5) to (7) and (11). The arc equipment should be as described in Recommendation (21). The power supply and electrical machinery should be as described in Recommendation (27). The buildings should be as described in Recommendation (28).

(31) The receiving station should be generally the same as that described in Recommendation (17).

Financial Details.

In the course of an explanatory foreword pointing out the severely technical nature of the report, Dr. Eccles remarks that the structural work and machinery at each station have been planned with the endeavour of keeping the probable cost within the approximate estimates submitted by the Imperial Wireless Telegraphy Committee in their report. That is to say, the average cost of the overseas stations will not exceed £160 000, exclusive of the cost of erecting residences for the staffs at some of the stations. The stations in England, Egypt, East Africa, Singapore and Hong Kong, for which the Imperial Government is presumably responsible, should not exceed in the aggregate the sum of £853 000.

Looked at as a whole, the report provides specifications sufficiently full for the immediate preparation of estimates. A later report will give detailed specifications. All the stations are planned to permit of easy extension of antenna, buildings and plant.

The Traffic Question.

It should be emphasised that during portions of each day much of the Imperial strategic, official and news traffic could be carried on by direct communication between any pair of principal centres, the intermediate stations being omitted; but the intermediate stations would be necessary for relay work during the less clear portions of the day, and also for handling their own local traffic. The news messages transmitted from the principal centres could be received at many stations in the Empire, for example in New Zealand, at the cost of an inexpensive addition to their existing receiving equipment. Foreign stations in many parts of the world would be able to pick up news and propaganda from one or other of the principal centres.

† *See* The Electrician, Vol. LXXXVII., p. 266.

The Electrification of Main Line Railways.

An important joint meeting of the Midland branches of the Institutions of Electrical, Civil and Mechanical Engineers was recently held in Birmingham, when the subject for discussion was "The Electrification of Main Line Railways." By kind permission of the Lord Mayor of Birmingham the meeting took place in the Council House under the chairmanship of Sir Henry Fowler, chief mechanical engineer of the Midland Railway. Sir Henry was supported by Mr. R. A. Chattock, Mr. E. C. R. Marks, Chairman of the Midland branch of the Institution of Mechanical Engineers, and Mr. A. W. Willett, President of the Birmingham Association of Civil Engineers.

Electricity Supply and Electric Traction.

Sir Henry Fowler, in opening the discussion, said that all over the country enquiries were being held as to the future arrangements for the supply of electrical energy. If a clear lead could be given as to transport demands, it would be of the greatest advantage. Apart from questions of expense, the difficulties which prevented electrification were few. Finance was especially the difficulty on lines with a low density of traffic, and the cost of the change over needed grave consideration.

No Engineering Difficulties.

Mr. W. Willox, ex-chief engineer of the Metropolitan Railway, referred to the successful results of electric traction on suburban lines in this country, and called attention to the number of cases in the United States where main line working had been conducted by the same means with the most favourable results, especially where there were heavy gradients and tunnels. The electric locomotive had proved itself superior to the steam locomotive, and there were no engineering difficulties in electrifying existing steam railways, even when the traffic was dense, by either the contact rail system or overhead equipment. It was thought that at points and crossings the contact rail system was dangerous to the maintenance gangs. His experience was that there was no special danger, and there had been no cases on the Metropolitan Railway where men had been killed or injured when ordinary care was taken. He emphasised this by referring to the rebuilding of Baker Street Station, where the position of every line in the station had been altered without stopping the traffic. Incidental advantages of electric traction was that power was available for lighting purposes and for operating both the semaphore and fog signals.

Overhead v. Contact Rail.

Mr. C. F. Bengough, chief engineer of the North-Eastern Railway, said that a consideration of the relative advantages of the overhead wire, and the third rail was important in connection with main line working, where the problem was quite different from that of suburban lines. In the case of a line electrified on the third rail system in order to make the sidings safe for shunters, the third rail would have to be fully protected and would form a serious obstruction, so that overhead equipment would appear to be the only practical form to use. The use of the third rail meant increased difficulty in maintaining the track, and this would be emphasised with high pressures. In case of derailment a very slight displacement of the vehicle would wreck the third rail, and when the train was worked with a single electric locomotive the long gaps necessary at level crossings or at junctions would have to be bridged by the erection of short lengths of overhead equipment. The great advantage of the third rail was its accessibility, and in the case of accidents, there was no obstruction to the working of the breakdown cranes. On the other hand, the overhead equipment formed an obstruction to the breakdown cranes; it was likely to be displaced from the engine bows during heavy gales, and inspection necessitated the use of tower wagons. On the other hand, the maintenance of the track was not interfered with in any way, and in the case of derailment a considerable displacement of a vehicle would take place before it would foul the supports. The balance of advantage was therefore with the overhead equipment and the question therefore arose as to which was the most economical form. Where only one contact wire was used as on part of the Shildon-Newport line, overhead equipment should be quite as cheap as the third rail, while experience in the Tyneside area showed that the maintenance costs were considerably in its favour.

Mr. Roger T. Smith, chief electrical engineer of the Great Western Railway, summed up the advantages of electric traction as being greater haulage power per ton as compared with steam, no stops for coaling or water and a longer period of usefulness per day.

Comparisons—A Word of Warning.

Mr. F. W. Carter, B.T.-H. Co., said that in making a comparison between steam and electrical operation it should not be forgotten that the methods of working the traffic would not be the same in the two cases. It might, therefore, be concluded that if an estimate of the performance and expense of electrical operation were based on the existing methods, better results would be obtained when the methods of working were more closely adapted to the new requirements. It was necessary to ensure that the data derived from electrical considerations and the data derived from traffic considerations should not be combined in such a manner as to lead to inconsistency. Electrical operation would modify the existing railway organisation from the fact that the electric locomotive was capable of much more continuous service than the steam locomotive and that closer co-operation would be possible between the traffic and operating departments. On a steam railway the trains were independent units, while on the electric railway they were tied in groups to sub-stations. The amount of plant that must be held at the disposal of the railway in generating stations and sub-stations depended on the maximum demand for power. The work done by it depended on the average demand, and the greater the load factor the more efficiently was the plant used. The economy in operation was therefore the greater the more uniformly the load could be distributed both in time and space. Mr. Carter gave some figures of the working on the Chicago, Milwaukee and St. Paul Railroad, which have already appeared in The Electrician, to emphasise this point.

Suburban and Main Line Electrification—A Difference.

Mr. H. N. Gresley, Locomotive Engineer of the Great Northern Railway, said that the electrification of railways had been strongly urged as a means of enabling railways to pay their way and to reduce their working expenses. This it had undoubtedly been successful in doing on suburban railways, not because it saved expense in working, but because it made money by creating new traffic. The problem of main line electrification was a totally different matter. The main lines of the country were not congested at the moment and much greater tonnage could be carried without doubling the lines. The electrification of main lines was, therefore, largely contingent on the price at which current could be obtained, and this price would have to be more attractive than it was at present before electrification could be favourably considered. There had been a tendency during the past twelve months to compare the best results that could be expected from electrification with the average results now being obtained by steam traction. No mention was made of the extra cost of the maintenance involved owing to third rails or overhead wires. Nevertheless, the electrification of suburban railways and of heavy terminal railways should be undertaken as soon as the necessary money could be raised at a sufficiently low rate.

No Savings in Maintenance.

Mr. J. A. Hickley, locomotive engineer of the North Staffordshire Railway, said that it was probably true that electric locomotive required little inspection and few repairs. But its first cost was greater and its life probably less than the steam locomotive, for which thirty years was quite a reasonable average. When the cost of repairs and power station and sub-station plant and the maintenance of the conductors were taken into account it was doubtful whether experience would show any saving on the maintenance side. Many of the advantages claimed for electrification, such as higher acceleration, and saving of time at terminals, hardly applied to main line traction, though the saving of time on plant and engine duties and on repairs and maintenance costs were equally applicable in the two cases. The objection against electrification that whole sections of the lines might be thrown out of use was more or less of a bogey, and if arrangement could be made to use water power where it was available the cost of energy would be much reduced. There was no doubt that where a new line was projected the case for electrification was very strong. One great advantage of electrification was the possibility of using regenerative breaking. It also would be justified owing to the increased average speed possible where the traffic was dense and where widening or doubling would have to be resorted to to cope with development. It was possible that further improvements in steam locomotives would alter the whole aspect of affairs before many years were passed, and in this connection the combination of the semi-Diesel engine with electric transmission would form an intermediate step by rendering possible the gradual electrification of a railway.

Electrification an Aid to the Civil Engineer.

Dr. F. C. Lea said the development of the steam locomotive was limited by the requirements of the civil engineer at the bridges, but these demands for load limitation would be very easily met while the train drawing capacity could be considerably increased by the electrification of main lines. Many of the civil engineers' most serious maintenance problems would be considerably diminished by the adoption of electric traction.

Electrification Means Altered Traffic Conditions.

Prof. W. Cramp said that it had been taken for granted that traffic on our main lines would be similar under electrification

schemes to what it was to-day, but if the conditions which had been an advantage to suburban traffic could be applied to main lines, the result would be a great increase in travelling. There was an enormous demand for short trains of high acceleration and high frequency from places like Birmingham and Oxford to London. The present long train was due to the steam locomotive, and the way to make a success of electric traction was to use shorter trains, of high acceleration and greater frequency. Some of them were dismayed at the decisions which had been arrived at by the Advisory Committee on Electric Traction. The 1 500 V direct current system might be a success, but this was not the time to lay down hard-and-fast regulations.

The Railway Load and the Supply Engineer.

Mr. R. A. Chattock said the railway load was valuable to the supply engineer owing to its high load factor, and if a power station could be operated with a high load factor it should be able to supply current at a low figure. Electric traction had meant more traffic on suburban lines and he did not see why the same thing should not happen on main lines. This applied equally to passenger and goods traffic.

A Single-Phase Advocate.

Dr. Gisbert Kapp, pointed out that it had been possible to adopt electric traction on certain lines in Italy during the war without any extra cost for strengthening bridges. He called attention to the use of the single-phase system in Switzerland and in Germany. The overhead system was preferable for several reasons, and 1 500 V direct current would not take us far. 3 000 V direct current could be employed, but even that meant numerous sub-stations; 3 000V on an overhead wire instead of 1 500 V meant half the cross section, but the sub-stations could be ten times as far apart. For direct-current working they required three-phase transmission with transformers and converters and a considerable staff. To some extent this had been overcome in America by the use of automatic apparatus, but he did not think they would trust such equipment in this country. The 15 000 V transmission system, such as was being used in Switzerland, would be no danger for a railway because it could be placed in the company's own ground. He hoped that, therefore, whatever system was chosen it would only be after careful consideration, because it could not be changed, and it was highly necessary that each railway should use the same system.

The Chairman, in summing up the discussion, said that Prof. Cramp's idea of smaller train units would mean an increase in labour charges. He did not look upon the Diesel locomotive as a competitor of the electrified main lines.

Gas Works and the Production of Light, Heat, and Power.

In an address delivered to the London and Southern District Junior Gas Association on "Gas Works and the Production of Light, Heat, and Power," Mr. A. H. Seabrook emphasised the value of versatility in engineering practice. A man who had spent a number of years in one branch of engineering, and then became associated with another, could often bring a new outlook to bear on existing methods. In his own case he had been associated with electrical engineering for twenty-five years, and during the last few years he had been connected with gas engineering. There were many advantages to be derived from closer relations between these branches. Both were primary public services of unlimited importance. Ultimately light and power stations should become as neutral, so far as the form of the light, heat, or power was concerned. The centre at which coal could be best dealt with was also the most suitable place for the joint production of gas and electricity. In travelling about the country he had been struck by the facts that gas works were found in the smallest towns, and that the engineers responsible had usually been happier in their choice of a site than those who settled the positions of electricity generating stations. Gas works almost invariably had a railway siding and plenty of water available.

Coke in Electrical Generation.

An important point, that was apt to be overlooked, was that the generation of electricity at a gas works permitted the use of coke as fuel, at a minimum transportation cost. The burning of coal in a raw state was generally admitted to be uneconomical; yet the Government was actively encouraging the installation of huge stations where raw coal was to be burned for the production of electricity. There were varieties of coal so poor in the yield of bye-products that they could be suitably used direct without an attempt at by-product recovery. But the use of coal rich in by-products direct should be eliminated so far as possible.

He was glad to note the growing practice of sandwiching coal and coke as boiler fuel. The proposal of some of the London electricity supply companies and the Gas Light & Coke Company to supply a portion of the electricity required for London from works at Beckton, was an important step. The arguments in favour of the arrangement seemed irresistible. There were ample storing facilities, plenty of space, ample water supply and a distinct inducement for the gas and electricity people to work together. The fuel used would have been coke, and the destruction of raw coal for the purpose would have been avoided. Electricity would doubtless have been produced more cheaply at Beckton than at the new super-station approved by the Government, lower down the Thames.

Generating Station Fuel as a By-Product.

Col. Woodhall, in November, 1919, had pointed out that the by-products of the gas works were more than ample to keep the ordinary town electricity stations provided with fuel. He (Mr. Seabrook) was, he believed, the first electrical engineer to fit suitable automatic stokers to large station boilers for the express purpose of burning coke breeze. This was done at Marylebone during the war. Various difficulties had been overcome. At one time the boiler house was unbearable owing to sulphur fumes, and motor goggles had to be used by the men to keep the coke dust out of their eyes. But by sheer persistence all difficulties had been mastered, and ultimately they got the same boiler evaporation with neat coke breeze as with the coal previously used, while boiler house conditions became normal. The experiment resulted in a material reduction in the cost of generating electrical energy, apart from the valuable conservation of coal. It was on such experience he had based his advocacy of the Beckton scheme, and it was difficult to understand why it had been turned down.

Advantages of Combination.

In many cases where the possibility of combining the generation of gas and electricity was being considered there were other advantages, such as the existence of buildings that could be readily adapted for a generating station. In some cases the electricity supply could be handled by coke gas producers and gas engines driving electric generators, but above a certain capacity coke-fired boilers and steam plant must be used. Mr. Bostock had recently expressed the opinion that the cost of producer gas per therm was about half that of town gas. In one or two combined works the use of blue water gas direct to the gas engine driving electric generators, was contemplated.

Municipal Control and Combination.

Under municipal control the creation of a combined power works entirely neutral as regards the merits of gas and electricity, should be fairly easy; even under company control the gas company and electricity company operating in a small works should be able to combine and pool their resources. He did not believe that huge undertakings, whether for gas or electricity, had necessarily an advantage over those of medium size. What was needed was such a size as would supply the entire light, heat and power requirements of a district. In addition to the Electricity Commissioners, a Government Department engaged in developing electricity supply, there should be a Gas Commission working on similar lines, followed by an amalgamation of the two as a Light, Heat and Power Commission.

Battery Vehicles and Coal Supply.

In a Paper read before the North of England Section of the Association of Mining Electrical Engineers on "Coal Loading by Road, with special reference to Electric Battery Vehicles," Mr. I. S. Mackenzie said that his main object was to draw attention to the fact that for short distance road haulage the modern electric vehicle was so reliable and economical that its adoption was a paying proposition. One particularly useful field was the transport of coal to the colliery workmen's houses.

The advantages and disadvantages of battery vehicles were dealt with at some length, and it was pointed out that a judicious selection of the battery size caused such disadvantages as limited mileage per charge to disappear. Battery charging should present no difficulties if suitable plant was installed, particularly at a colliery where skilled engineers were in attendance. Where an alternating-current supply was available, as at most collieries, there was no necessity for the installation of rotary plant, as mercury arc rectifiers could be used with advantage.

General experience tended to show that the single motor, chain-driven type of vehicle was the most satisfactory, and certainly had the fewest moving parts.

Working out the cost of delivering coals to workmen's houses by electric vehicles, including all standing and running charges, plus interest on capital outlay, &c., the author showed this to be of the order of 9·5d. per load of 15 cwt. delivered to a distance of half a mile from the colliery, and suggested that colliery managers should seriously endeavour to ascertain what it actually cost them to do the same work by the present methods.

Correspondence.

THE REVO ELECTRIC IRON.

To the Editor of THE ELECTRICIAN.

SIR,—I have read with interest the letter appearing in your last issue regarding the performance of a 100 V electric iron which was used on a 200 V circuit for twelve months. The result is, to say the least of it, unique, and although not wishing to doubt the good faith of your correspondent, calm consideration of some elementary facts leads one to doubt whether, after all, the iron was not incorrectly rated originally.

Presuming, however, that the article in question was an ordinary 4 or 5 lb. domestic iron rated to consume 400 W, at 100 V, and that it had a face area of 25 sq. ins. when 200 V were applied, the current consumption would rise to 1 600 W, or about 64 W per sq. in., a result which all the heating and cooking appliance manufacturers of the world, aided by all the resources of modern science, have striven for, and failed to achieve.

That the nichrome wire would stand up to the doubled voltage for a few minutes is understandable, but that it should survive regular use for a whole year is amazing, and one is tempted to enquire what the thermal efficiency of the iron would be if used on its rated voltage.

I would also submit that cheap advertisement of this description is not conducive to happy relationship between manufacturers and the trade, as it is likely to mislead the lay user of electric irons as to their adaptability to *any* circuit, no matter what voltage.—

I am, &c.

London, W. 9., February 1. WM. B. SCOURFIELD.

A Large Electrical Contract.

It is a matter for congratulation that, as we announced last week, the first order placed for the electrification of the Glencoe-Maritzburg section of the Natal Railway has, in the face of keen European and American competition, been secured by a British manufacturer, the METROPOLITAN-VICKERS ELECTRICAL COMPANY. The whole of the mineral traffic of the important Natal coalfields, for which Glencoe is a collecting centre, passes over this line on its way to the coast at Durban, and for many years the mountainous stretches of country between Glencoe and Maritzburg have been a bottle neck, with the limit of steam traction possibilities reached. Important economies will be effected by the introduction of electric locomotives; assuming a loaded traffic of 20 000 tons per day in one direction on a 1 per cent. up grade, eleven electric trains, each of about 1 800 tons, would be capable of this duty, for which fourteen steam trains would have to be employed. A valuable feature of electrification in these hilly districts will be the possibility of employing regenerative braking on the down grades, as obviating all the wear and tear on wheels and brake shoes inevitable with steam traction. This electrification will be one of the most important hitherto undertaken, comparing in this respect with the Chicago, Milwaukee and St. Paul undertaking. The locomotives will be designed to take a direct current supply of energy at a pressure of 3 000 V on the trolley.

A Press Association "Times" telegram from Bloemfontein states that a letter to the local Press from a prominent Nationalist alleges that the Union Government rejected a German tender for the locomotives, which was £425 000, or £5 000 per locomotive cheaper than the tender of the Metropolitan-Vickers Company.

Domestic Electric Appliances.

Mr. S. J. SEWELL, writing on the action against Harrods, Ltd., reported in our issue last week, states :—

"I have been for some years of opinion that it is essential that washing and sewing machines should be driven by fractional electric motors, and have, in my 'Sewing and Washing Machines Gazette,' preached this reform, but the action against Harrods, Ltd., which was a claim for damage to a lady's fingers through being caught in the wringer used as an adjunct to the 'Thor' washing machine, is, I fear, likely to give a set-back to electric washers, also to electric-driven sewing machines. I would like you to make public the fact that a similar result might have occurred had the washer been manual driven. The wringer was fitted with the latest safety devices, but the 'release,' fitted to both hand and power wringers, appears to have been utterly ignored.

"As with washing machines, so with sewing machines, it is impossible to make them 'fool-proof,' no matter whether they be driven by the hand or by an electric motor.

"The sales of electric washing machines during the past two years have been ever increasing. Up to the present they have been confined to those of American or Canadian manufacture, but many British manufacturers of washing machines have for some months been experimenting with electric motors, and last week Whittaker Brothers, of Accrington, completed arrangements for producing an English electric washer. As regards the use of electrical motors for driving domestic sewing machines, this country is far behind the United States. But I understand that there are a dozen British firms who are experimenting in the construction of these motors."

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The Supervising Electricians' Dinner.

There was a large gathering at the annual dinner of the NATIONAL ASSOCIATION OF SUPERVISING ELECTRICIANS at Frascati's Restaurant, London, on Saturday evening last.

Major T. VINCENT SMITH, M.C. (President), occupied the chair, and was supported, "aregollically" (to use an expression of the late Willie Edouin's) by two old personal friends, Mr. J. S. Highfield, the popular Past-President, and Sir R. Burton Chadwick, M.P.

The GENERAL SECRETARY (Mr. A. Bramming) and the Entertainment Committee are to be congratulated upon the excellent repast which was provided, and also the musical entertainment.

In proposing the toast of "The President," Mr. F. W. SMITH said Major Smith had fully justified the confidence the Association had placed in him, and he was a very valuable asset to them. The Association had been through trying times during the past year, but it had achieved great things, and had won the respect of the whole electrical industry.

The PRESIDENT, replying to the toast, expressed his appreciation of the loyalty of the members, and of the way they turned up at the meetings and bombarded the authors of Papers with questions. Members of the Association hoped the parent Institution would look with favour on its children and regard with interest their activities.

Major E. J. HOGAN (Hogan and Wardrop), proposing the toast of "The Association," said he thought every branch and every shade of opinion in the profession had its own association, and there were also hybrids. He sometimes thought it would be better if all these were grouped in one big association, each branch having its own sub-section. No association had the right to exist unless it set out with the purpose of improving the status of its members. In their Association the educational side received the most careful study, and therefore it was an organisation everyone should support. The special educational facilities given to associates, and the low subscription demanded from them, were worthy of the highest praise. The benevolent side of the Association's work was also very valuable, as was the sense of mutual protection afforded by membership.

The Association's Progress.

Mr. C. G. WRIGHT, in responding, said the Association had passed through troubled waters with success. They had now a full-time secretary, who was looking forward to the presentation of a report at the meeting on Feb. 14 which would show great progress during the past year. If the Association continued to progress at the present rate, he thought they would have to enlarge their premises. They were now establishing branches in the provinces, which would help the Association very much. A start had been made with branches at Manchester and Ipswich. The branches would also occupy themselves with the provision of educational facilities. They hoped to enrol in the Association every foreman in the industry, and it would be well if every employer could assist by becoming an honorary member. Every full member of the Association was fully qualified to do the work he undertook.

Mr. J. S. HIGHFIELD proposed the toast of "The Visitors," and referred to the fact that Mr. Banister, the former hon. secretary, had done a great deal for the Association, and he and others who had helped him had laid the foundation for a real Association, based on the principle of service and proper efficiency amongst its members. He (Mr. Highfield) did not hold with the view that associations should coalesce into one gigantic body. There were present members of the technical Press, which had served the electrical industry extraordinarily well. They should also have had with them Mr. Beauchamp, of the Electrical Development Association, and he was sorry he was not there. The E.D.A. had not very much money, but had an immense amount of energy, and had now established itself on a firm foundation.

Sir R. BURTON CHADWICK, M.P., in reply, regretted that there were so few men in the House of Commons who were capable of speaking authoritatively on the subjects with which the electrical industry was bound up. It was left to members like himself, without any electrical knowledge, to criticise and discuss matters connected with the new electricity districts.

The Progressiveness of the Press.

Mr. T. H. WINDIBANK, in proposing the toast of "The Press," said there were no more retiring or modest men, nor men who sought less advertisement, than those connected with the Press. The progressiveness of the trade Press was always reflected in the industry it represented. It was the proud boast of the electrical industry that it had a free Press which never hesitated to speak its mind, either to criticise or to encourage those things which appeared to be for the good of the industry.

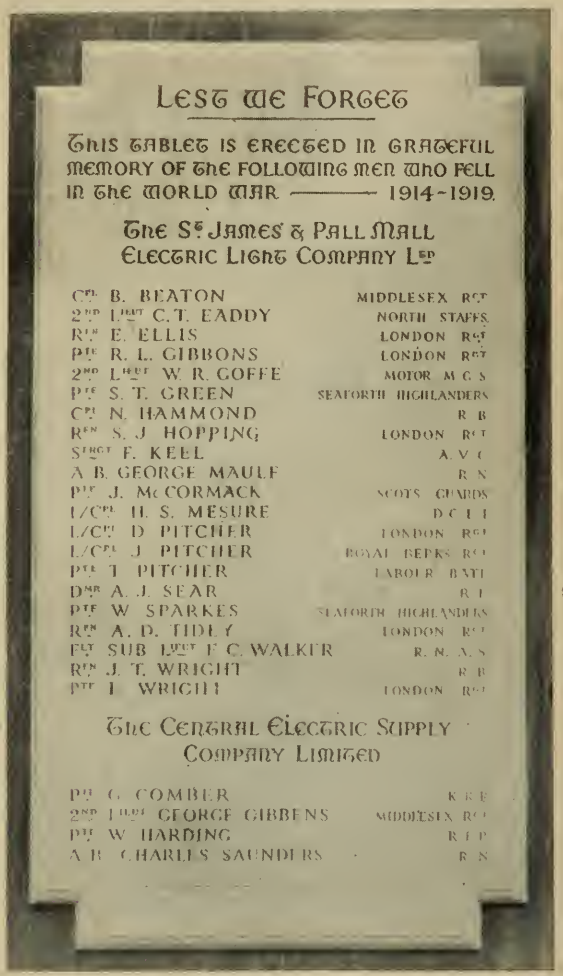
Mr. A. H. ALLEN, in replying to the toast, said over thirty years ago he nearly became a supervising electrician. He passed his apprenticeship in wiring, and was asked to supervise a squad of wiremen. He did not take it on, because the pay was not good enough, because there was no Association of Supervising Electricians in existence then. The Press noted with satisfaction the progress of the Association, and the movement for extending its activities to the provinces. As the Association sought to serve the industry, the Press sought to serve the Association in every possible way.

One of the features of Drury Lane's rebuilt theatre, which is to be reopened early next month, is an entirely NEW SYSTEM OF STAGE LIGHTING, which, though of British conception, will be capable of giving the same effects as the Continental methods.

Electricity Supply—War Memorial.

We reproduce herewith a photograph of a memorial tablet which has recently been erected in an imposing position on the wall of the main entrance to the offices of the St. James and Pall Mall Electric Light Company, Carnaby-street, Golden-square, W. 1.

The tablet is of Carrara marble mounted on a dove-coloured marble base—with blue lettering—and is erected in grateful remembrance of



Memorial Tablet erected by the St. James' and Pall Mall Electric Light Company.

twenty-one employees of the St. James' Company and four employees of its ally, the Central Electric Supply Company, who fell in the World War.

The memorial was unveiled on Tuesday, Jan. 24, in the presence of a large number of employees, by the Chairman of the St. James' and Central Companies, Mr. Walter Leaf, who, in fitting terms, referred to the honour and reverence in which the twenty-five men whose names are recorded on the tablet are held by the directors and employees, and said that the memorial would stand for all times as a monument of gratitude and appreciation.

North Lancashire Electricity District.

Only two of the Electricity Commissioners (Sir John Snell and Mr. H. Booth) attended the inquiry, which opened at Barrow on Tuesday, into the scheme for the reorganisation of electricity supply in the North Lancashire and South Cumberland Electricity District.

Mr. W. S. Kennedy, who appeared for the Committee who prepared the scheme, stated that when it was drawn up there was general agreement, but since then several of the local authorities had made objections as to area and other matters. If these authorities could supply electricity by better means they would be allowed to do so, and any scheme would be considered. It was proposed to make the fullest use of the Vickers plant in Cavendish Park, and negotiations had been opened, although for the time being they were in suspension. There was also a proposal to use water power from the River Leven at Backbarrow. If the Vickers Company required the plant for their own works in the future, then a new station would be erected at Barrow. If carried out, the scheme would cost £217 000 by 1925, and the supply would represent just over 20 000 000 units at a cost of a little over a penny per unit, compared with the 1920 supply of a little over 8 000 000 units costing slightly over 3d. per unit. Barrow Corporation claimed an increase of representation, based on the rateable value and units required.

Mr. Woolf, for Barrow Corporation, announced that on the previous day their General Purposes Committee decided not to come into the scheme, though they were anxious to assist the Commissioners in carrying out their duties under the Electricity Supply Act.

Mr. Hibbert, of Ulverston, put forward an alternative area, which would include Barrow, Ulverston, Dalton, North Lonsdale and Millom, and in reply Mr. Entwistle, Town Clerk of Morecambe (who also represented Lancaster and Heysham) admitted there was no chance of industrial development in the area. With Barrow out of the scheme they had no bulk-supply source in prospect. Special arrangements would have to be made to deal with Windermere and Kendal.

Sir John Snell said the Commissioners would want expert evidence on the proposal to include Millom in the area.

The inquiry had not concluded when we went to press.

Extensions at Loughborough.

At a meeting last week of the East Midland Sub-Centre of the Institution of Electrical Engineers, Mr. R. B. Leach, Borough Electrical Engineer, of Loughborough, delivered an address on the history and progress of the local electricity undertaking. The present generating capacity of the plant, he stated, was 2 850 kW. The maximum demand had increased to 1 950 kW. The capacity of the original plant was 500 kW, and this was found to be sufficient to meet all requirements for a period of seven years. The speaker described the additions and developments which had been made from time to time, and went into technical details of the production costs and selling price of the electricity supplied. In regard to the total costs, Loughborough tied with the Glasgow undertaking for twelfth place, with a total of 1·37d. per unit. In the cost of coal Loughborough tied for third place with Leeds, which was many times larger, the cost being 0·65d. per unit sold.

The scheme for a further extension of the undertaking included the installation of two turbo-alternators of 3 000 kW capacity each. The Electricity Commissioners, however, only sanctioned one 3 000 kW turbo-alternator, as they were of opinion that, by the time the second set would be required, all the needs of the undertaking could be met by taking a supply from the joint authority. Mr. Leach gave a clear description of the methods which had led to the successful results obtained at Loughborough, and showed numerous slides and portions of machinery.

The I.E.E. Commemoration.

The official programme of the meetings of the Institution of Electrical Engineers, which, as already announced in The Electrician, will be held on Feb. 21, 22, and 23, to commemorate the first meeting of the Society of Telegraph Engineers on Feb. 28, 1872, has now been issued.

On Tuesday, Feb. 21, at 3 p.m., an experimental lecture will be given by Prof. J. A. Fleming, M.A., D.Sc., F.R.S., on "Michael Faraday and the Foundations of Electrical Engineering." Note.—The annual dinner of the Institution will be held this day at the Hotel Cecil, Strand, W.C., at 7 p.m. for 7.30 p.m.

On Wednesday, Feb. 22, from 3.30 to 6 p.m., short discourses will be given on "Reminiscences and Experiences of Electrical Engineering in Both its Technical and Legislative Aspects," and at 8.30 p.m. Professor Fleming will repeat his lecture of the previous day.

On Thursday, Feb. 23, from 3.30 to 6 p.m., and from 8 to 10 p.m., the discourses on electrical engineering will be continued and concluded.

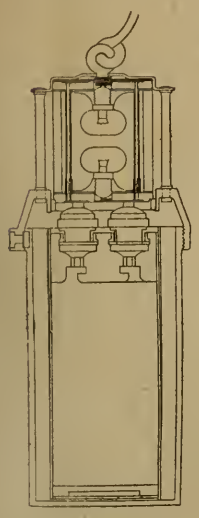
It is hoped that the contributors on the Wednesday evening, and on the afternoon and evening of the Thursday, will include the following:—Mr. Ll. B. Atkinson, Mr. Frank Bailey, Mr. O. H. Baldwin, Mr. G. Balfour, Sir T. O. Callender, Mr. R. A. Chattock, Col. R. E. Crompton, Mr. B. Drake, Mr. H. Edmunds, Sir K. Elphinstone, Mr. W. B. Esson, Mr. S. Evershed, Dr. S. Z. de Ferranti, Prof. G. Forbes, Mr. E. Garcke, Prof. Andrew Gray, Mr. F. E. Gripper, Mr. H. Hirst, Mr. J. H. Holmes, Mr. W. Judd, Dr. G. Kapp, Sir J. Kemnal, Sir Alex. Kennedy, Dr. A. E. Kennelly, Mr. J. E. Kingsbury, Sir Oliver Lodge, Prof. M. Maclean, Mr. W. H. Massey, Prof. T. Mather, Sir W. Noble, Lord Parmoor, Sir C. A. Parsons, Mr. G. W. Partridge, Mr. W. H. Patchell, Mr. J. H. Rider, Mr. F. H. Royce, Dr. A. Russell, Mr. A. Siemens, Mr. C. P. Sparks, Mr. G. Sutton, Mr. J. Swinburne, Mr. A. A. Campbell Swinton, Mr. J. C. Vaudrey, Mr. A. H. Walton, Prof. E. Wilson, Mr. C. H. Wordingham, and Mr. A. Wright.

A limited number of tickets will be available for visitors introduced by members. Early application for such tickets (not more than one per member) should be made to the Secretary. The tickets will be posted as soon as possible after Feb. 10, and in the event of the applications being in excess of the number of tickets available, a committee of selection will allot the tickets. No tickets will be required for members.

The British Commercial Secretary at Teheran offers to display catalogues of United Kingdom manufacturers of the following, among other articles: electrical gear, engineering appliances, hydro-electric gear, illuminants, and publications. Catalogues should be priced, and if possible, illustrated in colours.

The "Adams" Miners' Lamp.

The demand for better lighting in mines has caused a number of manufacturers to design and put on the market improved ELECTRIC SAFETY LAMPS. Already about thirty types of lamp have been approved by the Board of Trade for general use, and among the most recent of these is the "Adams" lamp, the general design of which is shown in the accompanying illustration. It comprises the following parts:—



1. A cylindrical metal case, with a screwed ring for the attachment of the cover or lantern.

2. An acid electric accumulator, with celluloid casing and fixed spring terminals, so constructed as to prevent the escape of any liquid, whatever the position of the lamp.

3. A cover or lantern containing the lamp bulbs. These are two in number, connected in parallel on a plate of inflammable insulating material in which are embedded segments of brass. The brass segments establish electrical connection between the lamp bulbs and the accumulator when the lamp is assembled.

4. A magnetic lock, which secures the cover to the case when the former has been screwed into position, and so constructed that the bolt can only be withdrawn by applying the pole of an electro-magnet to the face of the lock.

Among the advantages claimed for the "Adams" lamp are that the light obtained exceeds that produced by other types, for one bulb gives the same illumination as one bulb of any other lamp, and, therefore, the two bulbs burning simultaneously give double the light. The superior illumination obtained should result in a marked diminution of "miner's nystagmus," and thus reduce the cost of workmen's compensation. If one bulb should fail, the miner will still have one effective bulb, giving illumination equal to that of most other electric lamps. The fact of one bulb burning when the other is out of commission is a great advantage. The "Adams" lamp, which is made by Adams Brothers, Ltd., nominally gives 4 c.p. for eleven to twelve hours, and its weight is 5 lbs. 14 ozs.

L.C.C. Tramways.

New and cheaper THROUGH BOOKING BY THE LONDON COUNTY COUNCIL TRAMS and the London General Omnibus Company came into operation on Wednesday between North and South London suburban termini and the Mansion House, Ludgate-circus, St. George's Hospital, and Victoria-street. The present through bookings viâ Holborn, Southwark, Moorgate, and Victoria (excepting to Edgware-road Station) have been discontinued. The all-night tram services operating between Brixton (Water-lane) and Blackfriars, and between Tooting-broadway and Savoy-street (Strand), are now run as circular routes viâ the Embankment.

The Tramways Committee are adding 125 NEW CARS to their present fleet of 1 667 cars and 158 trailers. The new cars are similar in type to those now in use, the main points of difference being increased speed and greater comfort. The cars are equipped with 60 H.P. motors, as against 44 H.P. motors in the existing cars. Other advantages are better illumination and improved lighting effects (due to the white enamel finish of the ceilings), weather-protected air outlets on the top deck, improved ventilation, and protection from draughts in the lower saloon, and more efficient safety devices. By an arrangement of double trolley poles continuous illumination at the terminus is ensured, and the necessity for the conductor to walk round the car with a trolley rope is avoided.

The County Council have decided to complete the PURCHASE OF THE LONDON PORTION of the undertaking of the LONDON UNITED TRAMWAYS, LTD., on May 2 next. The Council will pay £235 000 for the lines in Hammersmith, the Chiswick power station, forty-five tramcars, depot and certain fixed plant, implements, &c. The company is to be at liberty to convert a part of the generating station into a transforming station, and to use the same for twenty-one years, but the company will provide free of cost during that period a sufficient supply of direct current for the tramways up to 1 800 000 units a year, the Council paying for any excess at a rate to be agreed or determined by arbitration. The Council may require the company to work the purchased lines exclusively for such time and on such terms as the parties agree, the company handing over to the Council gross receipts less working expenses and a reasonable sum for establishment charges, and the Council lending the company the forty-five cars. If the company are not required to work the lines, the Council are at liberty to run over the company's lines in Middlesex jointly with the company, and the company are at liberty to run over the lines purchased jointly with the Council, the mileage being equal, and each party accounting for gross receipts taken. The company will have access to the transforming station, and the Council to the depot.

For the six weeks ended Jan. 18 the LONDON COUNTY COUNCIL tramways carried 80 219 433 passengers, and the traffic receipts were £538 508, compared with 80 053 280 passengers and £609 155 receipts in the corresponding period of 1920-21.

Standardised Electric Traction.

In an address to his constituents at Hillsbro, Sheffield, last Saturday, on the schemes which are being promoted to increase employment, Mr. Arthur Neal, M.P., Parliamentary Secretary to the Ministry of Transport, said that the Ministry was in ACTIVE NEGOTIATION with some of the leading railway companies TO GET ELECTRIFICATION WORK IN HAND. In a subsequent interview on the matter, Mr. Neal said that he referred to the schemes which the three Southern railway companies hoped to arrange for the electrification of their lines. These railway companies were very anxious to do something in the matter, and as they were desirous of ensuring that the scheme would be one by which they could work in conjunction, he had, at their request, appointed a chairman, Sir Philip Nash, to preside over a small committee which was inquiring into the possibility of a standard scheme for the electrification of the companies, as at present all three companies wanted to adopt different systems.

The Ignition of Firedamp.

At a meeting af the MIDLAND INSTITUTE OF MINING, CIVIL, AND MECHANICAL ENGINEERS, at Doncaster, last Saturday, Prof. R. V. WHEELER, of Sheffield University, read a Paper on "The Ignition of Firedamp." Referring to the miner's lamp, he said that it was impossible to say with certainty whether or not the ignition of mixtures of firedamp and air could be caused by the filament of a miner's electric hand lamp. Nor did the numerous empirical tests made with the bulbs of such lamps afford definite information. The most that could be said was that ignition could be only by a filament at a very high temperature. It would seem that with a current of 2 V, the filament of a miner's lamp bulb, if designed to have a reasonable life, was not of a sufficiently high temperature to cause the ignition of any mixture during the short time of contact between the mixture and the undamaged filament that the breaking of the bulb allowed.

A discussion followed. Mr J. H. W. LAVERICK was of opinion that the use of the electric lamp made for safety in the mine. He was opposed to the practice of mixing oil lamps with electric lamps. Mr. A. C. F. ASSINDER considered the flame lamp a source of danger, and that the element of danger in an electric lamp was infinitesimal.

Prof. WHEELER said he thought it was practically impossible for the filament of an electric lamp, the bulb of which was broken, to ignite a mixture. In regard to Mr. Laverick's remarks on the use of oil lamps where electric lamps were in general use, he (Prof. Wheeler) was a member of a committee now going into the question of what was the best thing to do with regard to the provision for testing for gas, for which oil lamps were used. At the same time the modern flame lamp was an exceedingly safe thing. He had not been able to ignite the most easily ignited mixture with it.

Trade Facilities Act and the B.I. Fair.

With the passing into law of the Trade Facilities Act, British manufacturers and merchants are now able to give CREDIT FROM TWELVE MONTHS UP TO SIX YEARS, according to the commodity, to any of their foreign customers. This means that foreign buyers of all sorts of commodities can now buy British goods without putting down a single penny at the time of purchase. In a word the Act is an arrangement by which the British Government is prepared to grant credit on behalf of any responsible British manufacturer and merchant who needs it. Actually it is an extension of the Overseas Trade (Credits and Insurance) Act of Sept., 1919, but its scope is so much more generous and comprehensive that there is no doubt of the good results it will have for every kind of trade; one of its best points is that the buyer is not troubled over any transaction for the ultimate repayment of the credit. Where the credit is not required for more than a year, the British Government will back the bill for the total value of the invoice, and where longer terms are desired the Government backing will be to the extent of 85 per cent. of the bill. In short, foreign and overseas buyers of all nations who want credit, merely approach the British manufacturer or exporter of their choice, and he arranges everything with the Export Credits Department of the Department of Overseas Trade.

The value of this scheme to foreign and overseas buyers is too obvious to need any emphasis. It applies to every country in the world, except Russia and India, and can be used for any transaction, however small. There is already at least one case in existence where, under the old Act, a credit was applied for and given for a sale amounting only to £40. The fact that any British manufacturer or exporter can obtain these credits has already made itself felt in connection with the forthcoming British Industries Fair. As the facilities which the new Act offers become better known the more widely will the importance of the Fair to buyers of all countries be recognised.

The coming Fair is the eighth and most important of the series and will be held simultaneously in London and Birmingham from Feb. 27 to March 10 next. Practically all trades are included, and already the number of representative firms who have taken space makes it clear that 1922 will prove another great step in its progress. Special interest will be taken in Benn Brothers' stand, which, situated near the main entrance of the buildings at the Birmingham Fair, will contain all the books, journals, and directories published by the firm.

Legal Intelligence.

Is an Electric Truck a Light Locomotive?

At Southport Police Court, on Monday, Wm. Halton was summoned for driving along the public highway an electric truck belonging to the Electrical Vehicles, Ltd., without a licence. As the Superintendent of Police stated there was some doubt as to whether the truck came within the definition of a light locomotive, the case was adjourned to enable the local registration authority to communicate with the Ministry of Transport for a ruling on the point.

Claim for Electrical Goods.

In the Shoreditch County Court, on Monday, Carl Blombach (of Ronsdorf, Remscheid, Germany) sued Grimes and Hawkes, Ltd., for the recovery of £18 14s. 3d. for goods supplied.

Mr. Robinson, who appeared for the plaintiff, applied for an adjournment, as his client was in Germany.

After discussion, the hearing was adjourned, on the understanding that the costs were paid by plaintiff in seven days.

Conspiracy and Protection of Property Act Prosecution.

At Radcliffe (Lancs.) Police Court, on the 25th ult., R. Kirkpatrick, F. Hall, I. G. Ivers and W. Speak, four engine-room attendants employed by the Lancashire Electric Power Company at their power station at Outwood, were summoned for maliciously breaking their contract of employment, whereby they jeopardised the maintenance of the undertaking.

Mr. C. H. Pickstone, who prosecuted for the company, said that the proceedings were taken under an Act of Parliament passed in 1875 for the maintenance of public services, such as gas and water, and which, in 1919, was applied to electricity undertakings. There was no quarrel between the company and any trade union, and the trouble was between the defendants themselves. The men were on night duty on Jan. 9. It appeared that the switchboard attendant, a young man named Gore, was in the habit of having tea provided, as he was not allowed to leave the station without the sanction of the charge engineer. At eleven o'clock at night he wanted tea made, and Ivers, who objected to Hall making it, assaulted Gore. Words followed, and Ivers told the charge engineer he was going home. He was joined by the other defendants, and all four gave an hour's notice of their intention to leave. Efforts to avoid this did not avail, and the station was abandoned to two charge engineers, at 1.20 in the morning. Urgent messages sent to the staff due to come on for the morning shift were responded to, and when the position was explained to them they went on duty. But for nearly two hours the undertaking was jeopardised and public service in danger of being withheld. Happily no mishap occurred. The proceedings were instituted to show the illegality of the course pursued by defendants. The next morning the men claimed to have asserted a right in giving an hour's notice, but legally a week's notice on either side was necessary to terminate the engagement.

Mr. Kinsey (for the men) admitted almost every word Mr. Pickstone had used. Defendants thought that as Gore would have finished his shift at twelve o'clock, he might have waited for his tea. It was definitely in the minds of defendants that an hour's notice could be given, and they felt that with two engineers in charge nothing serious would happen. They were now sorry for what had taken place, and on their behalf he expressed regret. He hoped the justices would not send them to prison, and suggested that the case would be met by the payment of costs.

The justices regarded the offence as very serious indeed, and could not do less than order each defendant to pay £5, the prosecuting advocate's fee of five guineas, and the expenses of witnesses.

Extension of the Hunt Cascade Motor Patents.

On Friday, the 26th and 27th ult., Mr. Justice Sargant heard a petition by Mr. Louis J. Hunt and Sandycroft, Ltd., for an extension of patent No. 6 224, of March 14, 1906, granted to the petitioners (Sandycroft, Ltd., being then known as Sandycroft Foundry Company), for an invention relating to "improvements in alterating current dynamo electric machines"; and also Patent No. 15 711, of July 11, 1906, for "improvements in windings for alternating current dynamo electric machines." Counsel said the first invention consisted of a single winding in place of double stator windings and the provision of tapping points in particular positions upon the winding for control purposes. The other invention was a machine with a stator winding of the type in the first invention, but with separate rotor windings, one of which was connected to a commutator so that the machine could be used as a convertor for providing direct current through the alternating current supply and *vice versa*.

Mr. J. Hunter Gray, K.C., and Mr. Whitehead appeared for the petitioning patentees, and Mr. Dighton Pollock and Mr. Trevor Watson for the Crown.

The merit of the inventions was not opposed by the Crown, and Mr. James Swinburne described them as a distinct stage in the industry, and a stage that involved an immense amount of thinking. By the use of the inventions cascade motors could be built which had high efficiencies, and as the windings were constructed for a smaller number of poles than those required by an ordinary motor, it was possible to build a better commercial slow-speed machine than hitherto practicable. He explained how the inventions simplified and improved the characteristics of that class of motor, and why those machines could be given the starting and speed regulating features of slip ring motors, in spite of the fact that the rotors had very low tension windings and no slip rings or rubbing contacts of any sort. Witness pointed out the advantages those motors possessed for working in collieries, as they were free from sparking, and also that they were particularly valuable for industrial works where dust was prevalent; he also described how the machines operated efficiently at two or three different speeds, and expressed the opinion that there would be great developments in their application to the propulsion of ships.

Mr. John Gray said that if an extension of the patents were granted, the British Thomson-Houston Company would continue to manufacture under them.

Mr. H. A. Gill stated that the German patent, which was the equivalent of both the English patents, had been extended for five years on the ground of war-time losses.

Mr. W. C. Mountain, Mr. Evan Parry, Mr. Louis J. Hunt, and Mr. James Gilchrist, Secretary of Sandycroft Limited, also gave evidence in support of the petition.

His Lordship, in giving his decision, said the inventions were of great utility and involved a deal of scientific knowledge and experience. It appeared on the petition, and was clearly proved by the evidence that there was a great loss to the petitioners, owing to the war. He thought it would be proper in respect of the loss to allow an extension of four years, which would have this incidental advantage—although it had not influenced him in the relief he was granting—that if the four years were calculated from the date of the first patent, the extended term of the patent would very nearly coincide with the extended German patent. The extension would be granted on the terms that the British licences now existing for the manufacture of the inventions were continued.

Institution Notes.

At the anniversary meeting of King's College Engineering Society, to be held at the Institution of Civil Engineers, Great George-street, S.W. 1, on Friday, Feb. 10, at 5.30 p.m., Mr. F. W. Macaulay, of the Birmingham Water Department, will read a Paper on "Water Engineering."

The Institution of Electrical Engineers propose, if a sufficient number of candidates make application, to hold the Associate Membership Examination in London and at other places (at home and abroad) in April next. Particulars can be obtained from the Secretary of the Institution, Savoy-place, Victoria Embankment, London, W.C. 2.

The newly formed West Yorkshire Metallurgical Society held its first general meeting at Huddersfield on Saturday, when a debate on the subject, "That Physical Testing is the Duty of the Metallurgist Rather than the Engineer," was opened by Mr. J. R. Handforth, and opposed by Mr. F. Rawlinson. Mr. T. E. Hull, the President, who occupied the chair, stated that the Society had a membership of forty, drawn chiefly from Leeds, Bradford, Dewsbury, and Wakefield.

On Monday, Feb. 6, at the first of three informal meetings arranged by the Institution of Electrical Engineers, to take place at the offices of the Institution at Savoy-place, Victoria Embankment, London, Mr. J. Joseph will deliver an address on "Some Practical Applications of the Thermionic Valve." On Feb. 13 Mr. J. H. Parker will speak on "The Evolution of a Staff Trade Union," and "The Emergency Use of Oil Fuel During the Recent Coal Strike" will be the subject of an address by Mr. E. F. Hetherington on Feb. 20. The meetings will take place at 7 p.m.

Members of the various sections of the welding industry, at an inaugural meeting held on Jan. 26, at the Holborn Restaurant, adopted the proposal to form a new welding society embracing all systems of welding. A strong committee, with power to add to their number, representing the different interests, was elected to draft the constitution with a view to registration after it had been approved by a general meeting which will be called at an early date. The name agreed upon is The Institution of Welding Engineers, and all interested in the welding and allied industries will be eligible for membership. The temporary offices are at 30, Red Lion-square, London, W.C. 1, and Mr. C. Raggett is the hon secretary (*pro temp.*).

Educational.

Through the generosity of certain local firms, a new chemical research laboratory is to be set up at Birmingham Municipal Technical School.

The annual examinations for a Faraday Scholarship of 50 guineas per annum, tenable for two years in college and one year in manufacturing works, and for a Maxwell Scholarship of 50 guineas per annum, tenable for one year in college and one year in works, will be held at Faraday House on April 11, 12, and 13. Exhibitions may also be awarded to candidates who acquit themselves creditably. Particulars may be obtained from the Secretary, Faraday House, 62-70, Southampton-row, London, W.C. 1.

Electricity Supply.

It is estimated that HULL electricity undertaking will show a loss of £16 000 on the current financial year.

In addition to reducing the charges for light, LIVERPOOL Electricity Committee are contributing £60 000 towards the relief of the rates.

The recent reduction of 1d. per hour in the wages of manual workers represents a saving of £2 000 a year to the ERIGHTON and HOVE electricity undertakings. A reduction in the salaries of the technical staffs will, it is stated, effect a further economy of £300 per annum

The Theatres and Music Halls Committee of the London County Council have notified the Metropolitan Electric Supply Company that the special arrangement entered into in 1905, under which the Council recognised, subject to certain conditions, the two systems of electric light supply of the company as sufficiently independent to comply with the Council's regulation requiring TWO SUPPLIES BY SEPARATE COMPANIES AT PLACES OF PUBLIC ENTERTAINMENT is no longer operative, and that the Council cannot, therefore, accept the supply of the company for both the primary and secondary systems of lighting at cinematograph halls or any other premises licensed for public entertainment.

The necessity of GOOD LIGHTING for SHOPS was emphasised by Sir Chas. Higham, M.P., at last week's meeting of the British Association of Display Men in London. He said there were many shopkeepers who did not seem to realise that they paid half of their rent for their windows. The shop window was intended to draw attention to goods for sale, and without efficient lighting passers-by could not be attracted. If they were going to have a brighter London they had got to have brighter shop windows. If every shop in Central London illuminated its windows at night, London would be one of the most attractive places in the world, and it would pay handsomely.

In February, 1919, the CHESTER Electricity Committee reported that the first five years' working of the hydro station showed that 14 222 744 units were sold to consumers, of which 6 923 315 units were supplied by the steam station, the expenditure being £51 222 and the income £56 540; and 7 299 409 units supplied by the hydro station, the expenditure being £17 188 and the income £59 612. During the year 1920-21, 3 717 802 units were sold, of which the steam station supplied 1 699 101 units, the expenditure being £25 186 and the income £18 571, and the hydro station supplied 2 018 701 units, the expenditure being £5 498 and the income £22 070. During the period covered by the foregoing figures 21 855 038 units were sold to consumers, of which the steam station supplied 10 270 499 units, the expenditure being £106 003 and the income £91 503, and the hydro station supplied 11 584 539 units, the expenditure being £29 148 and the income being £103 223, showing the cost of electricity supplied by the steam station to be £14 500 in excess of the income, and the income from the electricity supplied by the hydro station to be £74 075 in excess of the expenditure.

New Schemes and Mains Extensions.

Steps are to be taken to light the HENLEY-ON-THAMES Town Hall by electricity.

GLOUCESTER City Council have decided to extend the Corporation Electricity Works, at a cost of £50 000.

RETFORD Town Council have decided to support the electricity supply scheme for the North-east Midlands.

SOUTHEND-ON-SEA Borough Electrical Engineer has been authorised to carry out mains extensions at a cost of £1 156.

Mr. A. J. Leigh, electrical engineer, has been instructed by the Council to prepare a scheme for supplying CONNAH'S QUAY with electricity.

SIDMOUTH Urban Council have decided to proceed with a scheme for supplying the town with electricity. The estimated cost is £10 000.

SWANSEA Electricity Committee recommend the Corporation to apply for a loan of £20 000 for services and extension of mains during the next three years.

As the result of a canvass to ascertain the probable number of electricity consumers, no further action is to be taken to form a local electricity supply company in BRACKLEY.

EGHAM AND STAINES Electricity Company have applied to the Electricity Commissioners for a Special Order to extend their area of supply to the parishes of Ashford, Stanwell, Uttraysbury, and Thorpe.

Application has been made to the Electricity Commissioners by MIDDLESBOROUGH Corporation for sanction to the borrowing of £6 000 for a sub-station and services in the Southfield-road and Linthorpe areas.

FULHAM Electricity Committee recommend the Borough Council to provide a sub-station, cables and switchgear, at a cost of £2 000, for a supply of electricity to the works of Manbre Sugar and Malt, Ltd.

The Minister of Transport proposes to confirm the AMMANFORD ELECTRICITY SPECIAL ORDER, 1922, granting electricity supply powers to Ammanford Urban Council, and any objections must be sent to the Ministry of Transport by Feb. 18.

EDINBURGH Town Council has received sanction to borrow a further sum of £516 314 for electricity undertakings in the city, particularly for the power station at Portobello. This makes the total amount authorised to be borrowed £1 632 514.

CARLISLE Corporation has received sanction to borrow £35 500 for the extension of the electricity undertaking by the installation of one 3 000 kW turbo-alternator and accessory plant. Sanction to borrow a further £3 000 for service connections is to be sought.

BRADFORD Electricity Committee has decided to apply for sanction to loans to cover excess expenditure to the extent of £73 514, incurred, or to be incurred, beyond the sums already sanctioned in connection with electricity plant extensions and £13 for converting plant.

Tenders for new sub-stations and all the necessary cable for the new Fairground extension, have been accepted by the SOUTHPORT Electricity Committee, and the work is to be proceeded with immediately. It is proposed to change over from the d.c. to the three-phase system.

On the recommendation of Mr. J. Christie, manager and engineer of BRIGHTON electricity undertaking, an experiment is to be made in the lighting of the sea front with a lantern similar to that recently introduced at Canterbury, which is said to secure better reflection and diffusion of light.

BOLTON Electricity Committee have decided to apply for sanction to borrow £31 200 for a new rotary converter for Spa-road sub-station, additional switch gear at Spa-road and Bradshawgate sub-stations, and for duplicate feeders from Back-o'-th'-Bank to Bradshawgate sub-station.

An inquiry was held on January 24 into the application of WINCHESTER Town Council for a loan of £1 200 for remote control gear for street-lighting purposes, but on the advice of the inspector, Mr. H. R. Hooper, the application was withdrawn, and the cost is to be met out of revenue.

BEDFORD Electricity Committee recommend that the borough electrical engineer be authorised to purchase an additional 350 kVA transformer for use as a spare to the transformers at the electricity works at a cost of £431 10s., and that the main be extended in London-road, at an estimated cost of £80.

DERBY Town Council proposes to apply for sanction to a loan of £90 000 for mains and motors, of which sum £35 000 has already been authorised, but not borrowed. The balance will be required during the coming year, when a further capital expenditure of £11 000 on new plant and extensions is contemplated.

LYME REGIS Corporation have applied to the Electricity Commissioners for a Special Order authorising the Corporation to generate and distribute electrical energy in the borough, and to maintain the generating station and other works at present belonging to the Lyme Regis Electric Light and Power Company, Ltd.

The members of the NEWHAVEN Urban Council are anxious to have a large electricity generating station established in their area, and have asked Lieut.-Col. Campion, M.P., to make representations to the Electricity Commissioners that the present is an opportune time to build a station, capable of supplying electricity to the whole of Sussex.

DUNDEE Town Council have decided to petition against the Provisional Order promoted by the Grampian Hydro-Electric Syndicate. The terms on which Dundee was prepared to accept supply were £2 per kW per annum as a fixed charge, plus 0·125d. for every unit used, against the syndicate's offer of £3 per kW per annum, plus 0·2d. per unit.

Lancaster Town Council have decided to put forward an alternative scheme to the proposal to form a NORTH LANCASHIRE and SOUTH CUMBERLAND ELECTRICITY SUPPLY AREA by establishing an area to comprise Lancaster and Morecambe, the urban districts of Carnforth and Heysham, and the rural districts of Lancaster and Lunesdale. The electricity works at Lancaster would also be extended at a cost of £40 000.

PETERBOROUGH CORPORATION are applying for a special Order to extend their area of electricity supply to certain parts of the Peterborough Rural District, Whittlesey Urban and Rural Districts, Thorney Rural District, Old Fletton Urban District, and Norman Cross Rural District, &c. Any objections must be sent to the Secretary, Electricity Commission, Gwydyr House, Whitehall, S.W. 1, by Feb. 20.

LIVERPOOL City Council will consider, this week, a proposal to apply to the Electricity Commissioners for a Special Order, enabling the Corporation to supply electricity for all public and private purposes to Bootle, and the urban districts of Waterloo and Seaforth, Litherland, and Great Crosby, and also authorising Liverpool to acquire the existing electricity undertakings of the Bootle Corporation and the Liverpool District Lighting Company.

There is some rivalry concerning electricity supply in the rural districts of Chester. The HAWARDEN Council some time ago appointed an electrical engineer to prepare a scheme which involved a bulk supply from the North Wales Power and Traction Company, Chester's offer of a supply from Queensferry having been rejected. The Hawarden scheme will be submitted to the Electricity Commissioners within two or three weeks. At a recent meeting, the

East Saltney ratepayers decided to support the Hawarden Council, who were recommended to make a canvass similar to that recently made by the Chester Council.

A considerable amount of work in connection with the linking up of WALLASEY with BIRKENHEAD has been carried out. An h.t. 6 600 V cable from Bentinck-street generating station has been laid to the Wallasey generating station; a similar cable has been laid from Beaufort-road through the area of big works and along the line of docks to the South-end generating station: a sub-station containing 500 kW of transformer plant has been built at Beaufort-road; a sub-station for 1 000 kW of plant is to be provided at Marshall-street; two new 500 kW sets have been installed at Bentinck-street; another 500 kW at the South-end generating station; and 500 kW at Clover, Clayton & Company's works. It is hoped that this plant, which will increase the existing capacity of the Birkenhead undertaking from 4 700 to 7 200 kW, will be working within a month. The object is the provision of a ring of h.t. mains around Birkenhead.

There is a sharp conflict of opinion between the electric supply undertakers in the MID-LANCASHIRE ELECTRICITY DISTRICT as to the most suitable method of reorganising the supply in the area. Burnley, Accrington, Colne, Darwen and other East Lancashire towns have prepared one scheme, but Preston and Blackburn Corporations have an alternative proposal. Preston is to erect a new station on the south of the Ribble, with two 10 000 kW turbo-generators at the outset, and the Preston and Blackburn undertakings will be connected by duplicate cables. The total cost of the station and of one of the cables is £489 000.

PRESTON Council have already approved recommendations to provide a new electricity generating station, at an estimated cost of £420 000, and to enter into an agreement with Blackburn to connect the stations of the two towns by means of duplicate mains which will save both towns from the necessity of adding 50 per cent. to their generating capacity. In the event of a breakdown in one of the towns, the other will be able to provide the supply for both.

Alteration of Charges.

Owing to the satisfactory accounts of KINGSTON electricity undertaking it is proposed to reduce the charges for lighting from 1s. to 9d. per unit, and to make a reduction of 10 per cent. in the charge for heating and power.

OSWESTRY Town Council have decided to oppose the application made to the Electricity Commissioners by the Oswestry Electric Lighting and Power Company for power to raise the price of electricity from 8d. to 1s. 3d. per unit.

STRETFORD Electricity Committee have decided to reduce the advances over pre-war rates for electricity as follows:—Power, from 125 per cent. to 85 per cent., as from March 1; lighting, from a maximum of 8d. per unit to 6½d. per unit, as from April 1.

Municipal Accounts.

A loss of £16 458 on HULL electricity undertaking is reported for the current year ending March 31. By five votes to four a resolution that a special rate be levied to raise the deficit was defeated at a meeting of the committee last week.

At last week's meeting of the LIVERPOOL Electricity Committee ret... were submitted showing the results of last year's working of ...tricity and tramways undertakings. There is said to be ... electricity undertaking of about £120 000, b... and G... on the previous year. The final returns a... loss is reported on the working of the f...

...ry.

...S. ROWLAND, who for the ...or (Bucks). Previously, on the staff of Drake ... on Tuesday ...Birmingham ...es manu-

The death ... last week, of M... firm of William Mc... facturers, of Small Hea...

The death is announced, at ... J. E. MATHEW, of North Shore, Black... in the service of the Tramway Departme... ten years of which he had been an inspector.

We regret to announce the death, at the age of ... of Sir FRANCIS HENRY BARKER, vice-chairman ... Vickers, Ltd., which took place at Cannes on Saturday, ... had been ill all the summer, and went to Cannes, whe... operation was found necessary.

Owing to various economies effected by ISLINGTON (L... Borough Council, including the use of electric vehicles for refu... lection, the rates have been reduced by 1s. 4d. in the £ f... ensuing half-year. By employing mechanically-propelled v... instead of horse-drawn vans, there is an annual saving of £14...

pe... F... a... I...

...ha... smaller num... it was possible to bu...

Electric Traction.

BURNLEY Tramways Committee have decided not to issue contract tickets.

SMETHWICK Town Council has decided to oppose the BLACK COUNTRY TRAMWAYS BILL.

The BLACKBURN ratepayers have rejected the Corporation Bill to extend the tramways and run motor 'buses.

The Association of Municipal Corporations has decided to oppose the attempt of RAILWAY COMPANIES to secure ROAD TRANSPORT POWERS.

HASLINGDEN AND RAWTENSTALL CORPORATIONS are discussing the question of running through tramcars between Accrington, Rawtenstall and Haslingden.

The BIRMINGHAM Tramways Committee are going into the question of a revision of fares, with a view to the reintroduction of the 1d. stage. The minimum fare is now 1½d.

PLYMOUTH Corporation are applying to the Minister of Transport for an Order under the Light Railways Act, authorising the construction of certain light railways in Devonport.

HULL Corporation have applied to the Minister of Transport for an Order under the Light Railways Act, 1896, authorising the construction, &c., of a light railway from the western termination of the Corporation's tramway in Hessle-road to the junction of Hull-road with Southgate.

BRADFORD Corporation Finance Advisory Sub-Committee have approved of application being made for borrowing powers in respect of the following works:—Tram track reconstruction in Thornton-road (Listerhills), £17 242; tram track reconstruction in Thornton-road (on the new road at School Green), £19 008.

In connection with SHEFFIELD Council's scheme to provide work for the unemployed, the Ecclesall tramway track is to be extended to Millhouses-lane, and the track on the Intake route is to be doubled. The estimated cost is £31 000, and nearly 200 men will be employed for four months. A start has already been made on the Ecclesall extension.

The Minister of Transport has extended for one year from July 26, 1922, (1) the period allowed by the WIMBLEDON AND SUTTON RAILWAY ACT, 1910, for the construction and completion of the railways and other works and for the compulsory purchase of lands for such railways; and (2) the period allowed by the METROPOLITAN DISTRICT RAILWAY ACT, 1915, for the payment of interest out of capital.

The NEWCASTLE-ON-TYNE Transport and Electricity Committee have decided to increase the hours of the employees in the department from forty-four to forty-eight per week as from Feb. 26. On Monday the Committee met the men's representatives, who stated that they had the authority of their union to refuse to accept the new hours. In the case of a strike the Committee state that they have plenty of applications for employment on their books.

The negotiations between TAUNTON Corporation and the Taunton Electric Traction Company in connection with the purchase of the tramways were recently broken off, the Corporation ultimately deciding by twelve votes to seven against the purchase. The Trams Committee recommend that steps be taken to provide a service of motor 'buses for the borough by private enterprise. Arrangements are to be made for the removal of the tram track.

An inquiry on behalf of the Ministry of Transport into an application by the DONCASTER Corporation for an Order for the extension of the tramway system was held in the Mansion House, Doncaster, on Tuesday. The proposal is to construct a loop line from French Gate to the Station-road terminus by way of Trafford-street and Factory-lane, to double and remove a portion of the tramway track over part of St. Sepulchre Gate, and to double a portion of the track in Baxtergate, at a cost of £10 000.

The Labour Party's Policy for the FORTHCOMING LONDON COUNTY COUNCIL ELECTION includes a great and dangerous extension of the principle of municipalisation of public services. The party are in favour of the following:—The administration of municipal services as far as possible by local authorities covering small areas; the conferment of powers on local authorities "to enter into remunerative enterprises and to associate for the purpose of combating private rings and trusts"; and public ownership of motor omnibuses and underground railways.

The EDINBURGH Tramways Committee is to consider a proposal by Bailie Sleigh as to the advisability of applying for statutory powers to construct a tramway along George-street, connecting St. Andrew-square with the West End. Meantime, preparations are to be made to obtain powers in the Provisional Order which the Corporation are promoting in the near future. The electrification of the northern tramway routes at an early date is also to be considered, and the tramways manager is to prepare a report for the information of the Committee.

With regard to the gradients in the city and their relation to the running of electric tramcars, Mr. A. H. Campbell, Burgh Engineer, states that the new town gradients are not by themselves dangerous for electric traction. But in operating, dangers develop at the lower ends of gradients, where the lines curve sharply. Though precautions are available, both by car brake equipment and by permanent way design, he points out that serious accidents have occurred on tramway systems where the gradients are no steeper than in Edinburgh.

Personal and Appointments.

Dr. W. Rathenau, chairman of the Allgemeine Elektricitäts Gesellschaft, has been appointed German Foreign Minister.

Admiral of the Fleet Sir Henry Jackson has been elected President of the London Wireless Society, in succession to Major J. Erskine Murray. The Society was formed in 1913, and has now a membership of 380.

Dr. Arthur MacGowan has been appointed assistant physician and Dr Albert Bowie medical officer in charge of the electro-therapeutical department of the London Homœpathic Hospital, Great Ormond-street, W.C. 1.

Mr. J. V. Moinet, manager of the Scarborough Tramway Company, who is shortly leaving Scarborough to take up an appointment at Hamilton, near Glasgow, has been presented with a case of stainless knives and silver-plate forks from the Staff of the company.

The following officers of the Kent Fortress Engineers have resigned their commissions :—Capt. E. Leafaux, Lieut. A. P. Isard, Lieut. A. M'L. Atkinson, Lieut. J. C. de Wardt. The last three mentioned have been given the rank of captain on leaving the corps.

Mr. W. H. Patterson, who has been associated with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pennsylvania, for the past sixteen years, has resigned to become vice-president of the Kaestner & Hecht Company, electric elevator builders, Chicago.

The Carnegie Heroes' Fund Trustees have awarded a medallion and an annuity of £100 to Dr. J. Hall Edwards, of Birmingham, one of the pioneers in radiography. It will be remembered that, as a result of X-ray experiments, Dr. Edwards contracted dermatitis, which necessitated the amputation of his left hand and forearm, and four fingers of the right hand.

Business Items, &c.

The address of the British Electrical Development Association is now 15, Savoy-street, Strand, London W.C. 2. (I.E.E. Building, East Entrance). The telephone number is Regent 4570, and the telegraphic address, "Electreda, Rand, London."

Mr. Arthur J. Cridge has resigned his position as manager of the Transformer Sales Department of Metropolitan-Vickers Electrical Company, in order to join the staff of the Brush Electrical Engineering Company, to sell that comapny's transformers.

Herbert Terry & Sons, Ltd., are organising a prize competition, open to all amateur physical culturists using Terry's Patent Steelspring Exercisers. Prizes amounting to £150 will be awarded. Full particulars of the competition can be obtained from the headquarters of the firm at Redditch.

Exhibition Notes.

A discount of 20 per cent. is to be allowed on tariff rates of freight for exhibits at the Malaya-Borneo Exhibition. All cases, &c., must be clearly marked as destined for exhibition.

The General Electric Company announce that an exhibition of industrial electrical labour-saving devices, including electric drills, grinders and polishers, is to be held in their Industrial Showroom at Magnet House, Kingsway, London. The exhibition will be opened on Monday, Feb. 6, and will continue throughout the week from 2.30 p.m. until 6.30 p.m. daily.

Irish motor traders and the Royal Irish Automobile Club have agreed to collaborate in holding an international motor exhibition in Dublin during February, 1923. The Society of Motor Manufacturers and Traders has agreed in principle to support the Irish motor show, and will co-operate to make it a success, provided that the new Irish Government raises no obstacles to trade in British cars.

No import or export licences are required for goods for exhibit at the Leipzig Sample and Building Fairs, and the Frankfort International Fair, provided the goods are cleared at the Chief Customs House at Leipzig and the Frankfort Customs House, respectively, and remain under Customs control until the time of re-exportation, which must be effected within two months of the close of the Fairs.

Benn Brothers' stand at the British Industries Fair, which is to be held at Birmingham from Feb. 27 to March 10, is in Building "A," No. 4, quite near the first entrance. All books, journals, and directories published by the firm will be on sale, and representatives will be in attendance to answer all enquiries. The Editor of "The Export World" has a block of the plan of the exhibition, showing the position of the stand, from which stereos could be taken if required.

An International Sample Fair is to be held at Zagreb (Agram), Jugo-Slavia, from June 3 to 15 this year. The Fair authorities are anxious that the United Kingdom should be represented. Customs duties will be remitted, and there will be a 50 per cent. reduction within the Kingdom on transport costs of exhibits and fares for exhibitors. The charges for space range, according to position and type, from 200 to 800 crowns per square metre. A limited number of application forms is available on application to the Department of Overseas Trade

Wireless Notes.

It is stated that there are between five and six thousand people in Great Britain with licences for amateur wireless apparatus for receiving purposes, and about 150 with transmission licences.

The Government took over the radio-telegraph stations in British North Borneo in 1916, and in that year 11 145 messages were transmitted. This number has increased gradually, until in 1920 the number had risen to 22 400, exclusive of Press messages. The service is proving useful for commercial and business purposes.

A lecture on "The Radiation of Electro-Magnetic Waves in Wireless Telegraphy" was given by Prof. G. W. O. Howe, of the National Physical Laboratory, at the Technical College, Bradford, on Saturday, in connection with the wireless exhibition organised by the Bradford Wireless Society. Practical demonstrations of music and speech by wireless were also given.

The Post Office authorities have agreed to permit the sending out by wireless telegraphy on certain fixed wave-lengths, of speeches and music, for half-an-hour on one day in every week, for the benefit of amateur wireless enthusiasts. It is understood that the Marconi Company will undertake all necessary arrangements at their high-power station at Chelmsford. The Wireless Society of London has been trying for about twelve months to secure this privilege for amateurs. It is hoped the permission will be formally granted this month.

Telegraph and Telephone Notes.

The Melbourne-Sydney new trunk-line is now being operated as a composite telephone and duplex telegraph circuit.

In the new Persian Cabinet which took office on Jan. 21, Ettelaes-Saltaneh has been appointed Minister of Posts and Telegraphs.

It was stated on Monday that, as the result of a severe storm, direct cable communication with Tangier had been interrupted.

Hull municipal telephones show a profit in the current financial year of £4 500 after the payment of £7 000 in rates and £10 000 in royalties to the Government.

The Chinese Ministry of Communications is preparing to install a long-distance telephone between Peking and Harbin via Fengtien and Tientsin, which will be in operation next year.

In connection with the Genoa Conference, to be held next month, the Italian Government are taking steps to double the telephonic, telegraphic and wireless facilities. The Minister of Posts and Telegraphs has applied for a credit of 1 000 000 lire for this purpose.

The Havre Chamber of Commerce is negotiating with M. Loth for laying a leader cable in the port of Havre. It would run out from the port to the lightship moored westward of Cap La Heve, and beyond the lightship in a direction parallel with the coast up to Cap d'Antifer, a total distance of about thirty miles. The cable would be laid in the navigable channel, and, although fogs are rare at Havre, the authorities are anxious that a French port should be the first to utilise a French invention of such importance.

Imperial Notes.

Negotiations have been commenced between this country and the United States on the proposed waterway between the Great Lakes and the St. Lawrence, it being believed that some international agreement should be reached before any action is taken by Congress.

A large amount of tramway track renewal will have to be carried out during the next two or three years by the Johannesburg Tramway and Lighting Committee, and the Council have decided that where there is no alternative route by which the traffic might be diverted, the work can be carried out by the use of portable crossovers.

In reply to a question in the House of Representatives, on Monday, Mr. Massey, the Prime Minister, stated that his Government had given a contract for hydro-electrical plant and supplies to a British firm, in spite of the tender being £15 000 more than that of a New Zealand firm handling American machinery. The preference tariff reduced the difference to £7 000.

The Postmaster-General of the Australian Commonwealth has given a definition of a "book" by eliminating the publications which he considers should not be included. In the excluded list are directories, Acts of Parliament, law reports, and statistical works, which are classified as printed matter chargeable at 1d. for every 2 oz. The rate for books is 1d. for every 8 oz. when printed in Australia, and when printed elsewhere 1d. for every 4 oz.

The proposal to erect a transmission line for the supply of electricity from Port Kembla Power Station, Sydney, N.S.W., to Bowral, Mittagong and Moss Vale, with a branch line to Picton, has been modified by the New South Wales Parliamentary Standing Committee. Only the line to Bowral, Mittagong and Moss Vale (about twenty-two and a half miles in length), will be erected, and it will be employed to convey the surplus power (about 1 000 kW) from Port Kembla to meet the immediate needs of the towns and districts mentioned for town lighting, water pumping, brickmaking and quarrying. The estimated cost is £32 000.

Foreign Notes.

It is stated that forty-nine United States railway companies have been ordered to instal automatic train control by July 1, 1924.

The N'zilo and Lufira Falls in the Belgian Congo are to be utilised by the Union Minière du Haut Katanga to provide electric power for the company's new copper ore treatment plant.

In consequence of the wages dispute between the United Electric Tramways Company of Montevideo and its employees, the Municipal Council of Montevideo have taken the high-handed step of seizing the company's property, and they are paying the men the increased wages demanded! The managers are retaining their posts on instructions from the board in London.

A considerable amount of industrial progress was made by Czecho-Slovakia during 1921, and, like most countries, the tendency is to form large combines. According to "The Times Financial and Commercial Review" of the year, the new issues amounted to 634 million Czsl.K., in which the East-Bohemia and the Moravo-Silesian Electricity Works participated to the extent of 118 million Czsl.K.

Miscellaneous.

The Amalgamated Engineering Union has rejected by 50 240 votes to 35 525 the proposed agreement regarding management and overtime.

Among the recommendations of the Geddes Committee, it is suggested, the "Manchester Dispatch" states, that the Ministry of Transport, the Road Fund, and the Electricity Commission be done away with, and the work at present done by these bodies be transferred to the Board of Trade.

Scarborough Town Council has fixed a basic rate of pay for its officials and workmen. Both are to be on the same basis, namely, that the basic salary or wage shall be generally at the rate of 25 per cent. above the pre-war rate, the difference between that and the present scale, salary, or wage to be regarded as bonus.

Mr. W. E. Mandelick, secretary of the Underground Electric Railway Company, and of the London General Omnibus Company, left estate of the gross value of £10 563, with net personality £8 802. His bequests included £1 000 to the Railway Benevolent Institution and £50 each to L. Burrows and A. Sheale, of Electric Railway House.

Booklets containing the general conditions of tender, applicable to calls for tenders issued by the Belgian Ministry of National Defence, Ministry of Railways, Post and Telegraphs, Ministry of the Colonies, and Ministries of Agriculture, Industry, and Public Works may be inspected at the Department of Overseas Trade. (Reference D.O.T. 13 561/F.W.).

Members of the Leicester Association of Engineers and friends to the number of 130 paid a visit to the works of Herbert Morris, Ltd., Loughborough, on Saturday, to inspect the latest type of transporting apparatus in operation, and also the means of producing the same. The firm's staff gave up their half-holiday for the occasion, and the directors spared no pains to make the visit a success.

During the year 1921, fuel, power and waterworks companies increased their capital by £33 797 932. Of this sum, electrical companies only accounted for £503 000. The total increase in the metal industries amounted to £12 247 849, of which total engineering and machinery companies accounted for £4 272 616, electrical companies £2 749 398, iron and steel companies £2 749 398, and other metals £1 330 833.

The nineteenth annual report and statement of accounts of Callender's Hospital and Distress Fund was submitted and approved at the general meeting held at the Belvedere works last Saturday, over which Sir Tom Callender presided. Owing to the unemployment caused by the coal strike, the number of members decreased, and the weekly subscriptions showed a decrease of £16 on the previous year, the total amounting to £745 17s. 6d., against £761 19s. 7d. The committee gratefully acknowledge additional contributions amounting to £73 2s., including £50 from Callender's Cable and Construction Company, and £5 5s. from Sir Tom Callender. The annual awards to the hospitals, convalescent homes, &c., amounted to £661 10s. (against £640 10s. last year), of which Guy's Hospital received £210 and the Royal Westminster Ophthalmic Hospital £63.

Trade Inquiries.

A British subject in Belgium is desirous of obtaining the agency of electrical or mechanical machinery manufacturers in the United Kingdom. Particulars from the Department of Overseas Trade (Ref. No. 95).

A Canadian firm manufacturing copper lightning conductors are desirous of receiving quotations from United Kingdom manufacturers for: (*a*) bright soft drawn copper wire, No. 17 B. & S. gauge 0·045 in. diameter; (*b*) copper tubes, No. 20 B. & S. gauge (·032 in.), $\frac{5}{8}$ in. outside diameter. Particulars may be obtained from the Department of Overseas Trade (Reference D.O.T. 7631/E.D./S.C.2).

Social Notes.

Old Students of the Finsbury Technical College held an informal dinner and smoking concert at the Engineers' Club, Coventry-street, London, on Friday, last week. Mr. W. G. Head (President of the Association) presided. Under the direction of Mr. L. N. Clark a well-varied musical programme was carried out.

The newly formed musical section of the Ferranti Recreation Club gave three performances of the Gilbert and Sullivan opera, "Trial by Jury," in the works canteen on Wednesday, Thursday and Monday, Jan. 18, 19, and 23, preceded by a miscellaneous concert. The performances proved a great success both musically and financially.

An informal dinner and reunion of past employees of R. W. Paul, late of New Southgate, was held on Saturday, Jan. 28, at the Great Eastern Hotel, London. Mr. Paul presided, and the evening was an unqualified success. Past employees who were not notified on this occasion are asked to send their names and addresses to F. Stroude, 20, Lea Bridge-road, Clapton, London, E. 5.

The Electrical Contractors' Association have arranged to hold a smoking concert at the Engineers' Club, Coventry Street, London, W., on Tuesday, Feb. 14, at 8 p.m., at which the President of the Association has promised to be present. In addition to the concert, matters relating to the electrical industry as a whole will be discussed, with special reference to the work of the E.C.A. Any London electrical contractor, whether a member or not, who wishes to attend, should apply to the secretary, Mr. L. G. Tate, for a ticket.

Companies' Meetings, Reports, &c.

The Electrical and Industrial Investment Company recommend a dividend at the rate of 6 per cent. for the year on the preferred ordinary shares.

Herbert Morris, Ltd., announce the usual half-yearly dividend to Jan 31 on the 6 per cent. (less tax) and 5 per cent. (tax free) cumulative preference shares.

Clontarf and Hill of Howth Tramroad Company have declared a half-yearly dividend at the rate of 3 per cent. per annum and a bonus of 1s. per share, both less tax.

Hong Kong Tramway Company have declared a final dividend of 1s. 7d. per share, making 2s. 7d. per share for the year on the 5s. shares, equivalent to a dividend for the year of 51 3-5 per cent.

The City of Buenos Ayres Tramways Company recommends a balance dividend of 1s. 3d. per share, making 5 per cent. per annum, less tax, placing £2 000 to general amortisation fund, and carrying forward £7 339.

The directors of the Tottenham District Light, Heat and Power Company recommend dividends for the half-year ended December 31, 1921, at the rate of 5 per cent. per annum on the preference stock, $7\frac{1}{4}$ per cent. per annum on "A" stock, and $5\frac{3}{4}$ per cent. per annum on "B" stock, all less tax.

The Stock Exchange Committee has ordered the following securities to be quoted in the Official List:—$5 567 000 5 per cent. first mortgage gold bonds of the Mexican Electric Light Company, $11 340 500 5 per cent. first mortgage gold bonds and $1 000 000 5 per cent. second mortgage 50-year bonds of the Mexican Light and Power Company, $10 298 000 general consolidated first mortgage 50-year 5 per cent. gold bonds and £1 250 000 6 per cent. 50-year mortgage bonds of the Mexico Tramways Company, and £800 000 5 per cent. first mortgage 50-year bonds of the Pachuca Light & Power Company, in lieu of deposit receipts now quoted.

The report of the Dublin United Tramways Company (1896), Ltd., for the year ending Dec. 31, 1921, shows a net profit of £95 778. Interim dividends, amounting to £19 530, were paid on July 30, and it is recommended that a dividend at the rate of 6 per cent. per annum, less income-tax, be paid on the preference stock for the half-year ending Dec. 31, and that a final dividend at the rate of 7 per cent. per annum, less income-tax (making 5 per cent. for the year), be paid on the ordinary stock for the same half-year; and £35 000 be set aside towards renewal of track. The dividends and sum set aside will absorb £83 300, leaving £12 478 to be carried forward.

Presiding on Tuesday at the annual meeting of the East London Railway, at the Great Eastern Hotel, E.C., Lord Claud Hamilton stated, with reference to the grouping of the railways, that under the Railways Act, 1921, the railways in the metropolitan area had been left to take their own course. So far they had considered no scheme of general amalgamation, but he believed that it would be in their own interests, and especially in the interests of the public, that they should form one group, which, of course, would include the East London. Unfortunately, the East London was not a free agent, and must be dependent on what might be the final destination of the six lessee companies. An abstract of the accounts was given in our issue last week.

At an extraordinary general meeting of the Calcutta Electric Supply Corporation, held in London last week, to consider a resolution authorising the borrowing of a sum not exceeding £500 000, the Chairman (Lord Meston) stated that to meet the growing demands both for domestic and manufacturing purposes, the generating plant capacity, which would this year be increased from

21 000 to 42 000 kW, would require to be further augmented next year by the addition of a 15 000 kW set; that for the latter and certain other urgent requirements another £500 000 would be required; and that if the members approved, the Trade Facilities Act Advisory Committee were willing to recommend to the Treasury that it should arrange a loan of that amount and guarantee on behalf of the Government both the capital and the interest. The resolution was carried unanimously.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, 116-118, Chancery-lane, London, W.C. 2.

Gerald Cars, Ltd. (179 222), Norwich House, Southampton Street, Bloomsbury, W.C. Registered Jan. 24. To acquire certain patents for inventions in relation to variable speed power transmission gear, and to carry on the business of manufacturers of motor cars, motor cycles, &c. Nominal capital, £25 000 in 19 000 ordinary shares of £1 each and 120 000 deferred shares of 1s. each; Minimum subscription £7. Director: F. D. Gerald Taylor. Remuneration of directors £200 each. Chairman £250. Public company.

United Sugar Engineers, Ltd. (179 209), 115, Holland Road, W. 14. Registered Jan 23. Dealers in machinery for the manufacture of sugar. Nominal capital, £10 000 in 10 000 shares of £1 each. Director: R. Mitchell. Private company.

Veco, Ltd. (179 210). 6, Back York Place, King Street, Leeds. Registered Jan. 23. To manufacture and deal in electrical accessories. Nominal capital, £1 000 in 1 000 shares of £1 each. Directors: C. L. Douthwaite and R. Lindley. Qualifications of directors, five shares. Private company.

Watt Electrical Co., Ltd. (179 173). Registered Jan. 20. Electrical, manufacturing, mechanical and general engineers. Nominal capital, £600 in 600 shares of £1 each. Directors to be appointed by subscribers. Qualification of directors, one share. Subscribers: L. N. Abrey, 533, Lordship Lane, East Dulwich, S.E. (electrical engineer), and E. H. Whatton. Private company.

Catalogues, Price Lists, &c.

"Meldrum" Forced Draught furnaces are fully described in a loose-leaf illustrated pamphlet just issued by the firm.

The Electric Heating Company are circulating a folder giving illustrations and particulars of their fires, irons, and soldering stoves.

Wright Motors, Ltd., have issued a new price list of their single, two, and three phase induction motors, pipe ventilated, and totally enclosed induction motors and crane-rated motors.

Julius Sax & Company have published a new catalogue of their electric bell and light accessories. The book contains seventy-two pages, and is artistically produced and well illustrated.

In a descriptive folder, entitled "Universalize Your Home," L. G. Hawkins & Co. illustrate and describe a number of their "Universal" electric appliances, including grills, toasters, milk-warmers, coffee percolators, and irons.

G. N. Haden & Sons have issued a pleasing wall calendar for 1922. The monthly sheets, which measure 9½ in. by 12 in. each, contain a large photograph of some well-known buildings in which the heating installations have been provided by the firm. Below these photographs is printed in clear black letters the calendar for the month, on either side of which, in smaller figures, appear calendars for the preceding and following month.

Forty Years Ago.

(The Electrician, Feb. 4, 1882).

Eastern Telegraph Company.—The traffic receipts of this Company for the month of January, 1882, amounted to £53 648, and to £47 445 in the corresponding period of 1881, being an increase of £6 203.

Institution of Civil Engineers.—At the meeting of this institution on Tuesday next, a paper is to be read by Mr. Paget Higgs. The subject will be "The Measurement of the Candle Power of the Electric Light."

The Electric Light for the House of Commons. The "Daily News" says: "The electric light will not, for the present at least, be used for the illumination of the House of Commons; but should experiments in addition to those tried last year prove more satisfactory than the latter have turned out, it is probable the electric light will be laid on permanently during the Easter recess."

Electric Light and Gas in Belgium.—"L'Industrie Belge" for Jan. 26th gives the following comparative figures of the cost of the Jaspar system of electric lighting and gas. According to our contemporary, M. Jaspar's factory in the Rue Jonfosse, at Liege, was originally lighted by forty gas burners at a cost of 1.25 francs per hour. The expense of lighting the same with his lamps is: For carbons 20 centimes, coal and oil for motor and machine 15 centimes, calculated for wear and tear 15 centimes, total 50 centimes, or half a franc. M. Jaspar uses reflectors to a very large extent, thereby avoiding shadows and lighting up all corners.

Arrangements for the Week.

FRIDAY, Feb. 3rd (to-day).

Institute of Cost and Works Accountants.

2.30 p.m. At the Holborn Restaurant, London, W.C. Costing Conference on "The Necesity for Scientific Costing."

Institution of Mechanical Engineers.

6 p.m. At Storeys Gate, London, S.W. Discussion on "Some Observations on a Producer-Gas Power Plant," by Messrs. H. S. Denny, C.B.E., and N. V. S. Knibbs.

Junior Institution of Engineers.

8 p.m. At Caxton Hall, London, S.W. Lecturette on "Utilisation of Waste Heat from Internal Combustion Engines," by Major W. Gregson.

MONDAY, Feb. 6th.

Society of Engineers.

5.30 p.m. At the Geological Society, Burlington House, Piccadilly, London, W. Presidential address by Mr. T. J. Gueritte, B.Sc.

Institution of Electrical Engineers.
(Western Centre).

5.45 p.m. At the South Wales Institute of Engineers. Park Place, Cardiff. Address on "Commercial Development." by Mr. J. S. Highfield.

Institution of Electrical Engineers.
(Informal Meeting.)

7 p.m. At Savoy Place, London, W.C. Discussion on "Some Practical Applications of the Thermionic Valve," opened by Mr. J. Joseph.

TUESDAY, Feb. 7th.

Institution of Civil Engineers.

6 p.m. At Great George Street, London. S.W. Paper on "Hydro-Electric Installations of the Barcelona Traction, Light and Power Company," by Dr. H. F. Parshall.

Institution of Electrical Engineers.
(N.-Western Centre.)

7 p.m. At the Engineers' Club, Albert Square, Manchester. Paper on "The Interconnection of A. C. Power Stations," by Messrs. L. J. Romero, and J. B. Palmer.

Institution of Electrical Engineers.
(Students' Section, S.-Midland Centre.)

7.30 p.m. At the University, Edmund Street Birmingham. Paper on "Telephone Transmission through Submarine Cables," by Mr. A. Rosen, B.Sc.

Röntgen Society.

8.15 p.m. At the Institution of Electrical Engineers. Savoy Place, London, W.C. Papers on "A New High-Tension Generator for X-Ray and other Work," by Mr W. H. Wilson; "Canny Ryall Diathermy Apparatus," "Ionostat," "A New Iontoquantimeter," and "New X-Ray Protective Material," by Mr. H. C. Head; "The Taylor Jones Electrostatic Oscillograph," "A New Design of Gold Leaf Electroscope," by Mr. H. E. Donithorne; "A New Boiling-water X-Ray Tube," by Mr. C. Andrews; "Diathermy Apparatus," by Messrs. F. R. Butt and Co., Ltd., and "A New Model of X-Ray Table," by Mr. E. E. Burnside.

WEDNESDAY, Feb. 8th.

Industrial League and Council.

7.30 p.m. At Caxton Hall, London, S.W. Lecture on "Industrial Unrest: Does it make for Progress?" by Prof. A. W. Kirkaldy, M.A.

Liverpool Engineering Society.

8 p.m. At the Royal Institution, Colquitt Street, Liverpool. Paper on "Aerial Wire Ropeways," by Mr. J. W. White.

THURSDAY, Feb. 9th.

Institution of Civil Engineers.
(Students' Meeting.)

6 p.m. At Great George Street, London, S.W. Paper on "The Design of Modern Water-Turbines," by Mr. E. J. Kingston-McCloughry, D.S.O.

Institution of Electrical Engineers.
(Liverpool Students' Sub-Centre.)

7.30 p.m. At the University, Liverpool. Popular Lecture on "Wireless Telegraphy and Telephony," by Prof. E. W. Marchant, D.Sc.

National Liberal Club Political and Economic Circle.

8 p.m. At the Club, Whitehall Place, London, S.W. Lecture on "Incentives in a New Industrial Order: Will a New Order Work?" by Mr. T. Fisher Unwin.

FRIDAY, Feb. 10th.

Institution of Electrical Engineers.
(Scottish Centre. Students' Section.)

7.30 p.m. At the Royal Technical College, Glasgow. Paper on "The Sperry Gyro Compass," by Mr. H. M'Comb.

Tenders Invited and Accepted.

UNITED KINGDOM.

Warrington Corporation. Feb. 6.—Main e.h.t. switchboard extension. Specification, &c., from the Borough Electrical and Tramways Engineer.

Dublin Electricity Supply Committee. Feb 7.—One or two years' supply of extra high-pressure and low-pressure cables, cable laying, and supply of troughing, section pillars and joint boxes. Specification, &c., from the City Electrical Engineer, Fleet-street, Dublin.

Burton-on-Trent Board of Guardians. Feb. 8.—Installation of electric light at the hospital. Tender forms from the Clerk, Mr. H. E. Askew.

Midland Railway Company Northern Counties Committee (Ireland). Feb. 9.—Three, six, or twelve months' supply of stores, including telegraph ironwork, wire, batteries, electric lamps, carbons, &c. Forms of tender from the Stores Superintendent, York-road Station, Belfast.

Dundee Tramways Committee. Feb. 10.—One year's supply of stores, including anti-friction metal, armature coils, commutators, carbon brushes, insulated tapes, wire, lamps, switches, castings, oils, grease, trolley rope, &c. Specifications from the General Manager, Tramway Offices, Dundee.

Manchester Electricity Committee. Feb. 10.—One 2 000 kW induction motor-generator, complete with the necessary operating switch-gear. Particulars from Mr. F. E. Hughes, the Secretary, Electricity Department, Town Hall.

Leeds Corporation. Feb. 10.—Electrical Fittings. Particulars from Mr. W. T. Lancashire, City Engineer, Municipal Buildings, Leeds.

Manchester Tramways Committee. Feb. 14.—Tramcar type Ah meters, armature and field coils, lamps, bells, and cells, insulation material, overhead equipment material, power and lighting cable, &c. Particulars from Mr. J. M. McElroy, General Manager, Corporation Tramways, 55, Piccadilly, Manchester.

Cardiff Corporation. Feb. 15.—400 tons of steel tram rails. Specifications, &c., from the City Engineer.

Edinburgh Corporation. Feb. 15.—Auxiliary circuits and electric lighting and earthing for Westbank power station. Specification, &c., from the Electrical Engineer, Dewar-place, Edinburgh.

Islington (London) Borough Council. Feb. 16.—One year's supply of stores, including cables, electricity meters, fuse boxes, compounds, lamps, wires, electrical sundries, transformers, carbons, arc lamp globes, insulators, &c. Specification, &c., can be obtained at the Town Hall.

Bradford Corporation. Feb. 18.—Steel girder tram rails. Particulars from Mr. F. Marsden, City Engineer and Surveyor, Town Hall, Bradford.

Dublin Electricity Committee. Feb. 20.—Transformers for one or two years. Specifications, &c., from the City Electrical Engineer, Fleet-street, Dublin.

Great Western Railway. Feb. 20.—Stores for three months from March 1st, including telegraph instruments, electrical apparatus (insulators), &c., electrical wires and cables, telegraph ironwork, and tools, telegraph drysalteries, and electric lamps.

Hammersmith Borough Council. Feb. 22.—Stores for 3, 6, or 12 months, commencing on April 1, including electric light sundries, insulated wire, metals, packing and jointing materials, tools, joint boxes and connections, and meters. Particulars from Mr. G. G. Bell, Borough Electrical Engineer, 85, Fulham Palace Road, W. 6.

Metropolitan Water Board. Feb. 23.—Electric lamps, &c., for three, six, or twelve months. Forms of tender from the Chief Engineer, 173, Rosebery-avenue, London, E.C. 1.

Eston. Feb. 28.—The erecting and providing of plant in connection with the overhead lines, underground cables, transformers, sub-station equipment, and public lighting fittings required under Eston Electricity Special Order, 1921. Particulars from the Clerk, Mr. T. Belk, Cleveland House, Grangetown, S.O., Yorks.

Hampstead (London) Borough Council. March 15.—Supply of various stores for six or twelve months, including electrical engineers' stores and oils for the electricity station. Form of tender, &c., from the Town Clerk.

Aylesbury Corporation.—300 kW converter, with e.h.t. and l.t. switchgear. Specifications, &c., from the Borough Electrical Engineer.

Accrington Corporation.—Supply, delivery, and complete erection of 25 000 lb. water-tube boilers, economisers and brickwork. Particulars from Mr. A. W. Clegg, Engineer and Works Manager.

AUSTRALIA.

New South Wales Government Railways and Tramways Department (Electrical Engineer's Branch).—Feb. 22, 1922.—*Supply, delivery, erection and maintenance of one 5 000 kW 50 cycle turbo-alternator with condenser and accessories, at Zarra-street power house, Newcastle. (Contract No. 556.) Tenders, to the Secretary for Railways, Phillip-street, Sydney, N.S.W. Local representation is essential.

Postmaster-General's Department, Adelaide. April 5.—* Twelve adjustable condensers for use on telegraph duplex circuits. (Schedule No. 613.)

Postmaster-General's Department, Brisbane. April 19.—* Supply and delivery of testing and telegraph instruments, including d.c. ammeters, a.c. bridge condenser coil, condensers, cross-talk meters, detectors, milliammeters, polarised relays, and artificial telephone cable boxes. (Stores Schedule No. 549.)

NEW ZEALAND.

Public Works Department, Wellington. Feb. 28.—*Supply and delivery, ex ship's slings Lyttelton, of a bank of three 11 000 V reactances, complete, for the Lake Coleridge electric power scheme.

Dunedin City Council. March 31.—*Supply and delivery of one 150 h.p. three-phase induction motor and reduction gear for the Mornington Cable Service.

Auckland Harbour Board. April 25.—Four double-barrel electric winches for the Central Wharf, Auckland. Specifications from W. & A. McArthur, 18-19, Silk-street, Cripplegate, London, E.C. 2.

SOUTH AFRICA.

Municipal Council of Johannesburg. Feb. 9.—*Fifty 500 A and fifty 200 A knife switches, and the following cable, viz.: 6 160 yds. h.t. 0·15 by 0·15 sq. in., concentric, paper insulated, lead covered, and double tape armoured; 880 yds. h.t. 0·15 by 0·15, by not less than 0·212 sq. in.; and 6 160 yds. h.t. 0·25 by 0·25 by not less than 0 35 sq. in., twin concentric, paper insulated, lead covered and double tape armoured.

Durban Corporation Electrical Department. April 12.—* Two 500 kW rotary converter automatic sub-station equipments. Alternative tenders for mercury arc rectifiers may be submitted instead of rotary converters, the switchgear to be completely automatic and suitable for their proper operation and control.

ITALY.

Director-General of the Italian State Railways. April 30.—Electrification of the Bologna-Venice-Monfalcone line. Particulars from the Direzione-Generale, Ferrovie dello Stato, Rome.

SOUTH AMERICA.

Argentine Ministry of Public Works. Feb. 21, 1922.—*Nine electric motors, 36 tip waggons, 1 centrifugal pump with electric motor. Specification expected at the Department of Overseas Trade by Dec. 28.

State Electric Power House, Montevideo. March 21.—* Diesel set, comprising a 4-stroke Diesel engine directly coupled to a d.c. generator of 125 kW for a three-wire system at 2x235 V. Local representation is essential.

BULGARIA.

Bulgarian Department of Posts, Telegraphs, and Telephones. February 20.—*2 000 telephone instruments for table use, with local battery and magneto. Also for spare parts.

Bulgarian Department of Posts. Feb. 27.—*Electricians' small tools, including 900 pairs pincers, 20 brazing lamps, 100 soldering irons, 1 500 bits, 300 axes.

Bulgarian Department of Posts. March 8.—*Porcelain insulating tubes for telephones (10 000), insulating tubing (impregnated paper) for telephones (2 200 metres), ebonite caps (1 700), and insulated copper wire (1 000 metres).

Bulgarian Post and Telegraph Authorities, March 15.—* The supply of 1 A fuses, cartridge fuses for protection from lightning, 3 A fuses, line annunciators, carbon lightning arresters.

Bulgarian Postal Authorities, March 21.—*Telephone, pole-line hardware (4-pin carriers for insulators, bolts, etc.).

Bulgarian Postal Authorities, March 27.—*3 000 junction pieces for batteries. Delivery required within four months.

Salford Corporation have accepted the tenders of W. T. Glover & Company for 2 000 yds. l.t. cable, £446; and Enfield Ediswan Cable Company, 4 000 yds. ditto, £839.

Wimbledon Electricity Committee recommend the Council to accept the tender of the English Electric Company for h.t. switchgear at Raynes Park sub-station, £859 10s.

London County Council have accepted the tender of Steel, Peech and Tozer for 2 000 tramcar trailing wheel tyres at £1 16s. each. There were two lower tenders, which were not to specification. Seventeen offers were received, and in sixteen of these alternative figures were given for 2 000 and 1 000 tyres. The highest and lowest tenders for 1 000 were £5 and £1 1s. 6d. respectively, and for 2 000 £5 and £1 1s., while one offer was £27 per ton.

Keighley Town Council have accepted the tender of Babcock & Wilcox, amounting to £4 349, for the execution of the work and supply of all material required in extensions to the boiler-house and coal-conveying plant at the electricity works, the contract to contain a special clause providing that in the event of any reduction in the cost of labour or materials during the execution of the work the Corporation shall be entitled to the benefit of such reduction.

Spencer & Company, Ltd., Melksham, Wilts, have obtained from the Union Government of South Africa an order for grain elevator machinery of the value of £400 000 to £500 000. It is intended to erect a large shipping grain elevator at Durban and a smaller one at Cape Town, together with thirty-four elevators in different parts of the country. The elevator at Durban and the thirty-four country elevators will be erected by Messrs. Spencer.

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* *Particulars from the Department of Overseas Trade.*

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Bankruptcy Information.

FIGGINS, James Victor, 3, Pottery-terrace, Alexandra-road, Newport, electrical engineer. First meeting, Feb. 9, 11.45 a.m., County Court Office, Dock-street, Newport. Public examination, March 14, 10.30 a.m., Town Hall, Newport.

ROTHWELL, Peter, 64, Higher Bridge-street, Bolton, in partnership with P. A. Rothwell (a minor), under the style of P. A. Rothwell & Company, electrical engineer. First meeting, Feb. 8, 3 p.m., Official Receiver's Offices, Byrom-street, Manchester. Public examination, Feb. 15, 2.15 p.m., Court House, Mawdsley-street, Bolton.

Notice of Intended Dividend.

BECKETT, Samuel (jun.), Deane-road, Bolton, Co. Lancaster, electrician. Last day for receiving proofs, Feb. 4. Trustee, J. G. Gibson, Official Receiver, Byrom-street, Manchester.

Notices of Dividends.

DOWNIE, Charles Philip Manners, 355A, Westborough-road, and 88, Ronald Park-avenue, Southend-on-Sea, Essex, electrical engineer and factor. Amount per £, 4s. 9½d. First and final. Payable Feb. 3, Official Receiver's Office, 29, Russell-square, London, W.C. 1.

HYDE, Thomas, 180, London-road, Croydon, Surrey, electrician. Amount per £, 1s. 9¾d. First and final. Payable Feb. 15, 29, Russell-square, W.C. 1.

WARING, Thomas Driffield, late 18, Waterloo-place, Coney-street, York, electrical engineer. Amount per £, 8s. 11d. First and final. Payable Feb. 6, Official Receiver's Offices, Duncombe-place, York.

Edinburgh Gazette.

In the sequestration of R. ANDERSON WILSON, electrical engineer, 19, Waterloo-street, Glasgow, James Andrew French, 116, Hope-street, Glasgow, has been elected trustee, and W. F. Strang, A. E. R. Copland, and T. Armstrong, of Glasgow, have been elected commissioners. The examination of the bankrupt will take place in Sheriff Boyd's Chambers, County Buildings, 70, Hutcheson-street, Glasgow, Wednesday, Feb. 1, at 2.15 p.m. The creditors will meet in the trustee's chambers Friday, Feb. 10, at 12 noon.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

BENNETT, Mr. W., 1, Richardson-street, Derby, electrician. £22 3s. 1d. Nov. 16.

ELECTRICAL EXCHANGE COMPANY, 43, St. Nicholas-street, Bristol, electrical factors. £41 13s. 6d. Nov. 22.

FALSHAW, Cyril, 69, Dragon-parade, Harrogate, electrical engineer. £17 3s. 5d. Nov. 18.

JAY, Arthur, 20, St. Thomas-square, Hackney, electrician. £30 2s. 2d. Nov. 22.

JOHNSON, Jas. Nelson, 62, High-street, Hull, electrician. £34 7s. 2d. Nov. 17.

THOMAS & EVANS, 5 and 7, Salubrious-place, Swansea, electrical engineers. £14 4s. 9d. Nov. 22.

WILSON, Bruce (and wife), 2, Senior-street, Moldgreen, Huddersfield, electrical engineer. £17 10s. 2d. Nov. 18.

WILSON, Wm., 27, Fowler-street, South Shields, electrical engineer. £11 17s. 6d. Nov. 15.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

CULKIN & PARKINSON, LTD., Leeds, electricians. Registered Jan. 23, £400 debentures; general charge.

KEIGHLEY ELECTRICAL ENGINEERING COMPANY, LTD. Registered Jan. 20, debentures, to Barclay's Bank, Ltd., securing all moneys due or to become due to the bank; general charge. *£5 000. Nov. 30, 1921.

READING ELECTRIC SUPPLY COMPANY, LTD. Registered Jan. 16, trust deed dated Dec. 31, 1921, securing £100 000 debenture stock; charged on hereditaments specified in trust deed, also general charge. *£50 000. April 21, 1921.

SOUTHERN BRAZIL ELECTRIC COMPANY, LTD., London, E.C. Registered Jan. 23, £194 500 8 per cent. notes (including £176 500 already registered) (filed under Sec. 93 (3) of the Companies (Consolidation) Act, 1908), present issue £18 000; general charge. *£863 410. Dec. 29, 1921.

YORKSHIRE & DISTRICT ELECTRIC LAMP REPAIRING COMPANY, LTD., Sheffield. Registered Jan. 21, mortgage securing all moneys not ex. £1 500, which the mortgagees may pay under their guarantee to the company's bankers, to H. J. M. Cockayne, Sheffield, and others; charged on Heeley Mill, and other buildings, at Saxon-road, Heeley. *£1 500. Sept. 13, 1921.

Satisfactions.

KEIGHLEY ELECTRICAL ENGINEERING COMPANY, LTD. —Satisfaction registered Jan. 23, £5 000, registered Dec. 28, 1909.

SAUNDERS ELECTRICAL COMPANY, LTD., Coventry.—Satisfaction registered Jan. 25, £500, registered Sept. 14, 1920.

Receivership.

SIMOON ENGINEERING COMPANY, LTD. H. C. Chambers, 5, Chancery-lane, W.C., was appointed receiver on Jan. 14, 1922, under powers contained in mortgage debenture dated Mar. 26, 1920.

Bankruptcy Proceedings.

LANGSFORD, Edwin Growdon, 24, Bar-street, Burnley, late 74, Westgate, Burnley, Lancashire, electrician. The public examination of this debtor was held recently at Burnley. The gross liabilities were shown as £411, of which £397 were expected to rank for dividend, while there was a deficiency of £397. Debtor attributed his failure to ill-health. He commenced business with £20 capital. He was in business in Westgate for about a year before he joined the army. He was discharged shortly afterwards owing to ill-health. He returned to the shop, but was not able to book any orders for electrical work. Seven or eight years ago he had an administration order made against him by that court, and the debts were only partially cleared off. He was closely questioned regarding money which had been lent to him, and the examination was adjourned.

Private Meetings.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

BARDSLEY, J. N., 179, Katherine-street, Ashton-under-Lyne, electrical fitter, &c. The creditors interested herein met recently at Manchester, when a statement of affairs was presented which showed liabilities of £1 250, of which £725 was due to the trade, while there was one cash creditor for £195, and the bank were scheduled as creditors for £320. The assets totalled £387, thus leaving a deficiency of £863. The assets comprised: Stock-in-trade, tools, fixtures, fittings, &c., £100; motor van, £37; book debts, £251, expected to produce £150; and insurance claims, estimated to realise £100. A fire had taken place at the debtor's premises during the last few weeks, in respect of which debtor had made a claim, as shown in the statement of affairs. Debtor started in business in August, 1919. He attributed his position to lose through two motors not being of any use, and collision of one, illness of self, competition, and cutting of prices. Only a rough set of books had been kept, which had been imperfectly made up. It was eventually resolved that the estate should be dealt with under a deed of assignment to Mr. Arthur T. Eaves, of Manchester. The following are creditors: Crowther & Osborn, Ltd., Salford, £14; Samuel Gratrix, Junr., & Brothers, Ltd., Manchester, £241; The Park Electric Engineering Company, Manchester, £283; Beardsall, W. E., & Company, Ltd., Manchester, £15; B.T.T. Electric Lamp and Accessories Company, London, £42; Power & Lighting Supplies Company, Manchester, £14; Wholesale Fittings Company, Ltd., Manchester, £14; Giddings & Dacre, Ltd., Salford, £12.

FOUNTAYNE LAMP AND ENGINEERING COMPANY (1910), LTD. (in voluntary liquidation), Tottenham, London, N. The creditors of the above were called together recently in London. The shareholders had previously passed the usual resolution, and had appointed Mr. B. R. Heaton, of 8, New-square, Lincoln's Inn, to act as liquidator. The liabilities amounted to approximately £1 999, while the assets were only estimated to realise £100. It was stated that there was also a claim by the landlord in respect of dilapidations, and the present position had been largely brought about by the liquidation of Messrs. Butler and Wilson, Ltd., with whom the company had large stocks. No resolutions were passed, and the voluntary liquidation of the company will, therefore, be continued with Mr. Heaton as the liquidator.

Patent Record.

APPLICATIONS FOR PATENTS

October 24, 1921.

28 142 Turner. Electric arc welding.
28 144 Tucker & Co. & Line. Electric fuses.
28 146 Moore. Electric chronoscope.
28 160 Denner & Lepine. Electric wall, &c., plugs.
28 175 Anderson & Huntsworth. Coin-actuated electric apparatus for selling tickets, &c.
28 190 Hitchmough & Shade. Electric oven light.
28 192 Donisthorpe. Thermionic valves.
28 194 Norske Aktieselskab fur Elektrokemisk Industri Norsk Hypotek bank. Electric furnaces. (1/11/20, Norway.)
28 196 Western Electric Co. Telephone Exchange system. (25/10/20, U.S.)
28 210 B. T.-H. Co. (G. E. Co.). Radio transmitting systems.
28 221 Radio Communication Co. & Scott-Taggart. Eliminating currents for wireless telegraphy.
28 225 Vickers, Ltd. & Etchells. Electric regulating systems.
28 232 Gleeson & Sanche. Electro-therapeutic apparatus. (17/12/20, U.S.)
28 241 Siemens-Schuckertwerke. Apparatus for precipitating dust from gases by electricity. (22/10/20, Germany.)
28 242 Akt. Ges. Brown, Boveri et Cie. Single-layer winding for a.c. dynamos. (28/10/20, Switzerland.)
28 243 Akt. Ges. Brown, Boveri et Cie. Suppression of higher harmonic voltages in a.c. dynamos. (28/10/20, Switzerland.)

October 25, 1921.

28 249 Evershed & Vignoles & Needham. Electrical transmissions for directional purposes.
28 264 Bosch (R.) Akt. Ges. Magnetos. (8/11/20, Germany.)
28 315 Siemens Bros. & Co. & Goodwin. Protective devices for electric circuits.
28 322 Boughton. Automatic circuit interrupter for ignition systems.
28 352 Wolfe. Portable apparatus for producing electric light or igniting a wick.
28 354 Kelly. Appliances for inserting switch or control, &c., apparatus within electric circuits.

October 26, 1921.

28 385 Brock. Electric lamps.
28 389 Turnbull. Electric light fixtures.
28 393 Preston. Switches.
28 411 Short. Combination electric switch and fuse.
28 428 Henney. Electric motor for gramophones.
28 452 B. T.-H. Co. (G. E. Co.). Switches.
28 456 Ireland, Turner, & Lucas. Electric resistances.
28 460 Durtnall. Electric, &c., locomotives, trams, &c.
28 461 Vickers, Ltd. & Etchells. Electro-magnetic switching devices.

October 27, 1921.

28 550 Barrington, Goldfarb, & Bottom. Electrical fittings.
28 561 van Hooydonk. Dry battery.
28 568 Watson. Impulsive driving mechanisms for magnetos.

October 28, 1921.

28 593 Pilkington & Young. Electrical transmitter microphones.
28 619 Mackintosh. Electrically-driven reciprocating tool.
28 643 Rootes, Ltd. Means for indicating and controlling charging of batteries.
28 645 Macintosh Cable Co. & Watson. Electrical connections in disconnecting link box.
28 659 Hamilton. Wireless apparatus.
28 660 Kerr-Nesbitt, Green, & King. Electric motor.
28 666 Carter. Reversible bracket for electric lamp holders.
28 672 Marryatt & Scott. Lamps operating by electric discharge.
28 674 Hosie. Electric wire insulators attached to poles.
28 675 Metropolitan-Vickers Electrical Co. & Scanes. Electrolytic starters or controllers for motors.
28 676 X-Rays, Ltd. & Codd. X-ray apparatus.
28 688 Callender's Cable & Construction Co. & Watson. Bonding devices for electrical junction boxes.
28 689 Gilligan. Electric heaters.
28 696 Dowsett. Arc generators of electric oscillations.

October 29, 1921.

28 708 Robinson. Vacuum tubes.
28 721 Meager & Southard. Assembling and protecting electric wires for connecting commutator and ignition coils of engines, &c.
28 760 Tennant. Electric number indicator.
28 778, 28 779, & 28 781 Electric water heaters.
28 789 Hutcheson. Devices for registering telephone calls.
28 790 Sefton-Jones (Loranz Akt. Ges.). Apparatus for production of high-frequency oscillations by low-frequency a.c.
28 791 Sefton-Jones (Loranz Akt. Ges.). Process for increasing frequency by static frequency transformer, &c.

October 31, 1921.

28 815 Powell. Mouthpieces for telephones, &c.
28 820 Automatic Telephone Mfg. Co. Railway signalling apparatus.
28 827 Wakefiecd & Sons & Lymburn. Electric lamps.
28 831 Morris. Combined ammeters and voltmeters.
28 832 Morris. Voltmeters, ammeters, &c.
28 840 Preston. Shock-absorbing device for electric lamps.
28 848 Somagni. Electric machines. (30/10/20, Italy.)
28 853 Huther & Weeke. Electric alarms.
28 871 Bulimore. Thermionic valve for wireless telegraphy, &c.
28 880 Horafman Gear Co. Time switches.
28 884 Kelly. Respirator mouthpieces and telephone transmitters.
28 888 National Pneumatic Co. Electrical transmission of communications. (16/5/21, U.S.)
28 889 National Pneumatic Co. Radio signalling systems. (16/7/21, U.S.)
28 895 B. T.-H. Co. (G. E. Co.). Electric condensers.
28 897 Packford. Transformers.
28 922 Rich. Alternate current electrical signalling devices.
28 927 Electro Heater Co. & Baden. Electric water heaters.
28 929 Wilson. Electric irons.

November 1, 1921.

28 935 Brewerton. Electric connection plugs and sockets.
28 963 Craston & Quilliam. Bracket arm hangers for trolly wires.
28 984 Scorey. Electro-magnets for magnetising permanent V magnets.
28 985 Scorey. Switch for changing from parallel to series two electrical windings or lamps.
29 001 Bi-jet Co. & Sharpe. Electrical inspection lamps.
29 010 Siemens & Halske A. G. Closed circuit relays. (11 12 20, Germany.)
29 017 Callender's Cable & Construction Co. & Worswick. House service, &c., fuse boards.
29 022 Bullimore. Thermionic valves.

November 2, 1921.

29 084 Myer. Fittings and couplings for electric conduits.
29 091 Hudson. Telephone system for trains.
29 099 Nelson. Electric terminal.
29 116 Hampshire. Means for audible signalling upon sounds being reproduced in a telephone receiver.
29 117 Moltke-Hansen. Electric heating arrangement. (3/11/20, Norway.)
29 129 Smith. Controller gear of electric tramcars, &c., for sanding the rails.
29 138 Three Star Accumulators Ltd. & Kendall. Batteries.
29 139 Three Star Accumulators, Ltd. & Grund. Storage batteries.
29 140 Three Star Accumulators, Ltd. & Kendall. Batteries for miners' lamps, &c.
29 142 Pollak (Siemens & Halske A. G.). Telephone systems.
29 143 Dickinson. Electric heating devices.
29 164 Poulsen & Co. Electric spark indicators. (1/9/21, Denmark.)
29 165 Ges. für Drahtlose Telegraphie. Wireless receiving systems. (24/11/20, Germany.)
29 167 Huth & Schwarz. Antennæ for influencing h.t. conductors, &c. (2/11/20, Germany.)

November 3, 1921.

29 224 McClelland. Switches.
29 245 Electric Control, Ltd. & Ellifsen. Brakes for electric lifts.
29 256 Romer. Intercommunication telephone sets.
29 269 Allmanna Svenska Elektriska Aktiebolaget. Compression device for transformer windings. (8/3/21, Sweden.)
29 292 Fessenden. Submarine signalling.
29 309 Cerrito. Circuit breakers, switches, &c., for ignition systems.
29 310 Runbaken & Torrance. Varying illumination of vehicle lamps.
29 321 Naamlooze Vennootschap Philips Gloerlampenfabricken. Electric discharge tubes. (10/11/20, Holland.)
29 322 Naamlooze Vennootschap Philips Gloerlampenfabricken. Manufacture of ionic valves. (10/11/20, Holland.)

November 4, 1921.

29 330 Barber. Combined electric radiator and fan.
29 351 Knorr. Electrically controlled locks.
29 381 Tadman. Connecting devices for conductors.
29 388 Graham. Support for telephone transmitter, &c.
29 389 Graham. Adjustable electric resistances.
29 390 Brocklies, Ricketts & Graham. Electric motor driven horns.
29 395 Carr & Co. & Greenwood. Apparatus for cooking wafers, &c., electrically.
29 408 Dunker. Ventilating systems for electric machines.
29 414 Braun. Arc lamps, &c.
29 426 Macintosh Cable Co. & Watson. House-service cut-out.
29 428 Pederan. Wireless transmitting systems. (18/11/20, Denmark.)
29 431 Siemens & Berry. Impulse transmitters for automatic, &c., telephone systems.
29 446 Soc. Anon. des Ateliers de Sachern & Mayforth. Electrically driven vehicles. (30/11/20, Switzerland.)

November 5, 1921.

29 467 Astley. Device for packing and carrying bulbs for wireless telegraphy.
29 483 Creffield. Electric water heaters.
29 489 & 29 490 Harlwood. Miners', &c., electric lamps.
29 491 Harlwood. Electric lamps.
29 512 Coutell. Stator and rotor a.c. synchronous motor.
29 515 Metropolitan-Vickers Electrical Co., Gittins & Peck. Protective devices for electric circuits.
29 520 Scubb. Enabling running rails to be utilised as running rails.
29 528 Adams. Electrically operated stippling pens.

Prices of Metals, Chemicals, &c.

Tuesday, Jan. 31.

	Price.	Inc.	Dec.
Copper—			
Best selected per ton	£68 0 0	—	£1
Electro Wirebars .. „	£72 10 0	—	15s.
H.C. wire, basis..... per lb.	0s. 11d.	—	$\frac{1}{16}$ d.
Sheet ..... „	0s. $10\frac{5}{16}$d.	$\frac{1}{16}$d.	—
Phosphor Bronze Wire (Telephone)—			
Phosphor-bronze wire, basis..... „	1s. 3d.	—	$\frac{1}{16}$d.
Brass 60/40—			
Rod, basis ..... „	0s. $7\frac{1}{2}$d.	—	—
Sheet, basis..... „	0s. $10\frac{1}{2}$d.	—	$\frac{1}{2}$d.
Wire, basis ..... „	0s. $10\frac{3}{8}$d.	—	—
Pig Iron—			
Cleveland Warrants per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 SWG „	£22 0 0	—	—
Lead Pig—			
English ..... „	£24 10 0	—	—
Foreign or Colonial .. „	£23 2 6	2s. 6d.	—
Tin—			
Ingot ..... „	£157 15 0	—	£1 5s.
Wire, basis ..... per lb.	2s. $1\frac{1}{2}$d.	—	$\frac{1}{4}$d.
Aluminium Ingots	£120 0 0	—	—

Salammoniac.—Per cwt. 65s.-60s.
Sulphur (Flowers).—Ton £10 10s.
„ (Roll-Brimstone).—Per ton £10 10s.
Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.
Copper Sulphate.—Per ton £28 5s.
Boric Acid (Crystals) —Per ton £65.
Sodium Bichromate.—Per lb. 5$\frac{3}{4}$d.
Sodium Chlorate.—Per lb. 3$\frac{1}{2}$d.
Rubber.—Para fine, 1s. 0d.; plantation 1st latex, 9$\frac{1}{8}$d. to 9$\frac{3}{8}$d.

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Notes of the Week.

Mr. Dunlop on the Electrical Industry.

If Mr. D. N. Dunlop only occasionally uses those gifts of eloquence and directness which he employed with such effect at the dinner of the Electrical Wholesalers' Federation last week he will have no need to complain of charges of reticence or that the B.E.A.M.A. are accused of too freely employing the methods of secret diplomacy. For ourselves we require from Mr. Dunlop not a constant flow of talk and propaganda, which leads nowhither, but succinct information regarding the principles which influence the policy of the important Association he directs and about the results which that policy has successfully attained. In this we represent the electrical industry. Moreover, we only ask a little where we have had almost nothing. By providing what we ask Mr. Dunlop would not only be assisting the Press, whose task it is to mirror the doings and thoughts of the electrical industry, but would be contributing not a little to the well-being of his own Association. Mr. Dunlop's speech went so far towards binding together the varying sections of the electrical industry that it would be a pity if his actions did not consolidate what his speech began.

Co-operation the Essential of Progress.

Mr. Dunlop's arguments are easily summarised, though not with the eloquence that he himself employed. They have, in fact, often been advanced before. The chief novelty is that it is Mr. Dunlop who now re-states them. In the old days, he said, the British electrical industry suffered mightily from foreign competition and trading methods. Its state was sickly, and the first task of the B.E.A.M.A. was to renew its health so that it could not only pay its way but also provide something for research and other necessary development work. This recovery of health has been achieved in spite of prejudices, in spite of the national vice of individualism, and in spite of more material obstacles. This is what the manufacturer in association has done. But the manufacturer requires the help of the wholesaler and of the contractor to sell his products, and is willing that, with certain exceptions, the sale of those products should only take place through them. The co-operation of these three bodies in the electrical industry, he added, should be stimulated until there was no opening for the foreign products. At the moment the manufacturer had to face foreign competition so cut-throat that to carry on was difficult, but with the assistance of every branch of the industry they should be able to obtain a stabilised home market which, with increased production, would enable many difficulties to be overcome.

A Statement and an Appeal.

This is at once a statement of the case and an appeal. It is a statement which we hope will be examined with care. It is an appeal which we hope will not be left unheard. As has happened before, the manufacturers, more than all other branches of the electrical industry, are feeling the effects of the depressing conditions under which we are now labouring. But if the manufacturers continue to suffer the whole of the electrical industry will soon be suffering with them. For all parts of the industry are so interlinked that what affects one must sooner or later affect the other. Depression can thus be best warded off by all pulling together for the common good. This may seem to be so trite that it is needless to state it. In fact, it is so trite that too many in the electrical industry neglect to recognise it as a necessary part of their policy. Too often even now (it was obvious at the Wholesalers' Dinner) one section of the industry is more eager to fight against another than to meet and settle differences—except, of course, in after-dinner speeches. It is not the least for this reason that Mr. Dunlop's speech will, we hope, be listened to and acted upon without delay. If it brings about a change of heart it will have done all that can be expected of it.

The North Lancashire Electricity District.

The inquiry into the scheme for the reorganisation of electricity supply in the North Lancashire and South Cumberland electricity district, which was concluded on Friday, revealed a peculiar state of affairs. It showed clearly, what we have long suspected, how difficult it is to get a group of small urban and rural authorities to co-operate with one another for any length of time. It was originally proposed to form a Joint Authority of thirty members for the district. This body would have taken over the five generating stations of the existing undertakers in the area, and would have constructed 33 000 V main transmission lines between the principal towns and 6 600 V lines from Lancaster to Morecambe and Heysham, and between Barrow and Dalton. It was also proposed to purchase the Cavendish Park generating stations of Vickers, Ltd., at Barrow, to erect a hydro-electric station on the River Leven, and eventually to lay distributing mains in certain areas which are at present without a supply.

Paper v. Practice.

On paper the scheme seemed a feasible proposition, but as soon as the Commissioners (Sir John Snell and Mr. H. Booth) had opened the inquiry they were met with the announcement that the Barrow Corporation, the principal supporters, had withdrawn and were separately represented by counsel. This defection was followed by the withdrawal of, or notice of opposition by, the leading councils in the district. Lancaster, Morecambe, Heysham, Windermere, Kendal, Ulverston and other places all wanted to be excluded or to put forward alternative proposals for dealing with portions of the area. This epidemic of defections were relieved by the desire of Millom to come in, but Sir John intimated that the Commissioners would want to hear expert evidence before that could be allowed. Apparently, Barrow's *volte face* is due to the lack of Government assistance, and, as this is not likely to be forthcoming, the outlook for the formation of a Joint Electricity Authority is indeed gloomy.

The Morley Award.

The employees of electricity undertakings have been deeply stirred by the publication of the award of Sir Wm. Mackenzie in the Morley case, to which we recently referred, and the various engineering and official associations affected are said to be considering the situation in order to take concerted action. We hope they will be successful. For though Sir Wm. Mackenzie is a very able and impartial arbitrator in industrial courts he is not the most suitable type of referee on the status of electrical engineers. In fact, we have not the slightest hesitation in asserting that the transformation of Morley from a generating station into a distributing bulk supply station involved such a loss of status as is contemplated by Sec. 16 (III.) of the Electricity (Supply) Act, and if an electrical engineer had been arbitrator he would have so found. We fancy that Sir William's judgment was swayed by the fact that Mr. Ellis and his assistant were being retained at their old salaries, but the salary is not the only, or even the chief, element in the status of engineering officials.

Need for Careful Revision.

As there will be many cases similar to that of Morley within the next few years, the situation should now be reviewed with care in order that the present case shall not establish a precedent. There are two courses open to those affected. First, they should make a strong and united representation to the Minister of Labour, whose province it is to nominate the arbitrators, to appoint an impartial electrical engineer, who will readily appreciate at their proper value all questions of status affecting the engineering staff. If this point be conceded, further action may not be necessary, but as the section permits the appointment of "a referee or board of referees," it may be advisable to have such a board in complicated cases, or an electrical engineer could sit as assessor on engineering questions. At all events, now is the time for the Electrical Power Engineers' Association and the Companies' Officers' Association to investigate the position fully in order that Sec. 16 of the 1919 Act may not prove something worse than a dead letter.

Details of the City Breakdown.

The breakdown on the Charing Cross Company's system, which deprived part of the City of London of its electricity supply for some hours on Thursday of last week, was an indication that every effort should be made by supply engineers and electrical manufacturers to secure additional plant to give them a margin to provide against such mishaps, and that neighbouring supply authorities should devise without delay an adequate scheme of interlinking. While it is true that interlinking will not prevent breakdown and may, as we showed a short time ago, bring with it dangers of its own, in the majority of cases it does mitigate subsequent trouble and permits the *status quo* to be established with a minimum of delay. That is, after all, the main thing.

The Trouble Explained.

The primary reason of the breakdown was the failure of one of the trunk mains supplying the City area from the Bow generating station. This failure caused an arc to take place at the back of the E.H.T. bus bars, resulting in a short circuit between the bars. The damage caused was so extensive that what actually happened is difficult to discover, and is therefore, perhaps, better imagined than described. The immediate result was the breakdown of about 7 000 kW of plant, the load on the station at the time being approximately 18 000 kW. Matters, bad as they were, were complicated by the fact that, owing to the difficulty in obtaining delivery of plant, a turbo-alternator, which should have been running in the early part of 1921, was not in commission. Had it been available to take up the load of the damaged machines it is probable that supply would not have been interrupted, or, at least, the interruption would have been very much shorter than it actually was. The efforts of the engineers concerned, who, as may be gathered, have been having a strenuous time during the past few days, have resulted in this set now being in running order, so that when the repairs have been completed on the damaged plant, which we understand will be in the very near future, the company will have sufficient reserve at its disposal to deal with any emergency that is likely to arise. It is only fair to point out that the supply was restored within 15 minutes in the major part of the area, and it was only in a comparatively small section that a delay of some hours was experienced.

The G.E.C. Grows Up.

The twenty-first anniversary of the foundation of the General Electric Co.'s engineering works at Witton was officially celebrated on Tuesday last by a visit of representatives of the technical Press. Unofficially it was also celebrated by the announcement made by Dr. M. Railing,

at the luncheon given in the Magnet Club at Witton, that the company had secured a contract for the supply of traction motors to the London, Brighton and South Coast Railway in connection with the extension of the electrically operated lines on that system. This is a matter upon which not only the General Electric Company, but the whole of the British electrical industry may be congratulated. It is, we hope—indeed, we feel certain—the forerunner of many similar orders, and it is a most satisfactory break with the bad tradition of going abroad for this kind of plant.

A False Argument.

The excuse for this procedure has, of course, been that foreign designers were more experienced in the production of traction equipment, and that, though by giving the contract to a non-British firm, manufacturers and labour in this country were adversely affected, in the end the result was for the good of the community generally. This argument contains much that is false, and at the present time, when not only is it necessary that British industry should be re-established by every means in our power, but when our own designers are in possession of sufficient experience to enable them to build plant of equal efficiency and soundness as that turned out by their foreign competitors, it is to be hoped that the example of the Brighton Railway will be widely followed. We shall look forward with interest to the designs which the General Electric Co. will provide in fulfilment of this contract and to the performance of the equipment when it is eventually delivered.

The Wimbledon Mess.

At the moment there is a lull in the Wimbledon affair. Having done their deed of shame, action no longer rests with the Council, unless they eat their resolutions without further prompting. But behind the scenes the E.P.E.A. are busy, though they have failed to persuade the Ministry of Labour to set up an inquiry under the Industrial Courts Act. At the inquiry all cards should be laid on the table, especially Mr. Sparks' report and Mr. Lee's comments thereon. For the Council's reticence and the innuendo of those who brought about Mr. Lee's dismissal are the worst points of the whole affair. We admit that it is within the right of any employer to dismiss an employee after proper notice or to make that dismissal instant by paying over an appropriate proportion of salary. But it is not within the right of any employer either to give no reason for his action or to give an obviously evasive reason, whose main effect is to cast an additional slur on the dismissed employee. The Wimbledon Council are guilty on both these counts. Officially, the party in power, as a party, refuse to give any reason whatsoever for Mr. Lee's dismissal, but certain members of the "party," as individuals, hint that it would be better in Mr. Lee's own interests that this request for information should not be pressed, or say that those who require further details "should read between the lines." That is adding insult to injury.

An Inquiry Essential.

The attitude of those who support Mr. Lee, whether on the Council or outside, is perfectly clear. Mr. Lee, they point out, has been given no opportunity to defend himself, nor can he defend himself until some charge is made against him. Moreover, until that charge is made no one can possibly say whether he deserves dismissal or not. If the Council's case is a good one they have nothing to fear and Mr. Lee has everything to lose. It is upon this point especially that the various protective associations which are supporting Mr. Lee are basing their action, for they argue cogently that if this procedure is allowed to pass unchallenged any municipal employee might be ruined by a group of councillors whom he had offended. All these points could be cleared by an inquiry. Unfortunately, the Ministry of Labour is disinclined to set up such an inquiry unless the situation becomes "dangerous," *i.e.*, apparently, unless the employees of electricity supply undertakings throughout the country threaten to enforce their demands by a strike. This is the most wooden-headed procedure that could be conceived. The only result will be to compel the E.P.E.A. to adopt methods which we have always deplored to obtain the benefit of legislation framed expressly to prevent local trouble from spreading. The case, therefore, not only throws an interesting light on the byways of local politics, but upon modern bureaucratic methods of dealing with urgent cases of injustice. There the matter must rest for the moment, but we cannot say that we are too happy as to its outcome.

Prof. Thomas Mather, F.R.S.

Many generations of electrical engineers will learn with interest, not untinged with regret, that after thirty-seven years' service at South Kensington, following upon two at Finsbury, Prof. T. Mather is retiring from the chair of electrical engineering at the City and Guilds (Engineering) College of the University of London. To some it will be yet another indication that they are growing old, to others it will come as a shock that the professor with whom they have only lately parted company, and whose work did so much to engender in them a real enthusiasm for electrical knowledge, is seeking a well-earned rest. To all it will mark the retirement from an active career of one who has exerted an unobtrusive, but not the less powerful, influence on electrical engineering progress, and of a worker whose researches during the very early days of the electrical industry have already placed him in one of those niches which are reserved for the famous dead. After strenuous labours any man is well entitled to a rest. We are only expressing the general wish when we hope that Prof. Mather will long be spared to enjoy his.

To Be or Not to Be?

London supply undertakings will shortly have to decide whether there is to be a District Joint Board for London, and a meeting to settle the question will be held within the next few weeks. It is true that some more or less ineffective meetings have already been held, but the forthcoming one is to be final. The matter is not altogether easy, for most of the important municipal undertakings want to set up a board, while the directors of London Companies have so far shown themselves in opposition to such a proposal. Once again then we are living in an atmosphere of uncertainty and indecision! The members of the E.P.E.A. who form the other side of the Board meantime patiently await the result. What is required is that every undertaking shall think out its policy and stick to it. Simply to do nothing will mean disaster, for the good relations between the technical staff and the management are at stake. The question is simply: Can those good relations be best maintained by a Board or otherwise? One thing is certain—they cannot be maintained by evading the issue. Every undertaking should, therefore, be represented at the meeting and both express an opinion and vote.

The Power Supply Problem in the U.S.

It is not surprising to find that the same problems are cardinal in the development of electricity supply in the United States as in this country. On the other side of the Atlantic, as here, the war caused an accelerated demand for electrical energy, over-loaded the existing plant and, for financial reasons, made extensions which would have been undertaken in the ordinary way more difficult to carry out and more unremunerative when completed. As here, it has been recognised that one of the best means of overcoming these difficulties and ensuring progress is by a thorough investigation of future electrical requirements and of the possible ways of meeting these requirements without interfering more than is absolutely necessary with existing conditions, or, more important, with those who are now successfully carrying out the work.

The "Super-Power Zone."

As a first step towards this end a Committee, of which Mr. W. S. Murray was chairman, was appointed by Congress rather over a year ago to examine and report on conditions in the "Super-power Zone" along the Atlantic border between Boston and Washington. This Committee has now reported and the report contains numerous facts and figures which cannot fail to be of interest to those concerned with electricity supply in this country, while certain fundamental omissions will be of no less interest.

The Extent of the Zone.

The zone examined by the Committee lies between the thirty-ninth and forty-ninth parallels and extends from the Atlantic coast approximately 150 miles inland. It embraces parts of the States of Maine, New Hampshire, Vermont, New York, Pennsylvania, Delaware and Maryland and the whole of the States of Massachusetts, Rhode Island, Connecticut and New Jersey. Its population is about one-quarter of the total of the United States. It is an industrial area and is already pretty well electrified. This is evident when we say that it contains 558 public electricity supply undertakings with a capacity in 1919 of 4 408 200 kW, 96 000 factories, 76 000 of which use electricity either bought or generated, with an average demand of 350 h.p., and 36 000 miles of single track steam railway. The electricity consumed in this area in 1919 was 12 650 240 000 kWh, and it is estimated that this will be increased to 31 000 000 000 kWh in 1930, the date by which it is assumed the super-power plant could be erected and the necessary extensions to existing stations made to deal with the load. As is obvious from the figures we give above such extension and concentration is eminently desirable.

Steam and Water Power—Capital Stations.

Under the super-power system the number of power stations required in 1930, including seven "extra super" stations, which it is suggested should be erected, will be reduced to 273, of which 218 will belong to existing undertakings. Four of the new large stations will be steam driven and will have capacities from 60 000 to 300 000 kW, with turbo-generator units not less than 30 000 kW. The remainder of these stations will be operated by water power and will apparently have an aggregate capacity of about 1 050 000 kW, though there seems a little discrepancy in the report on this point. Eventually the powers of the St. Lawrence and the Niagara River might be available for supplying the zone.

It is rightly recognised as of importance that the new power stations should be located so as to ensure the maximum economy both in generation and transmission, and that to do this existing plant which can be economically utilised will be employed to the fullest possible extent. From what we have already said it is obvious that this will be done where the stations make that course possible.

Some Financial Advantages.

A further argument for consolidation is shown by the statement that of the 12 650 240 000 kWh generated in 1919 about 9 311 440 000 kWh were developed in private stations, and only 3 338 800 000 kWh were purchased. Some striking figures are given of the financial, let alone the engineering, disadvantages of this individual growth. It is said, for instance, that the 96 000 establishments could save $190 000 000 annually above their fixed anual charges on the capital investment of $185 000 000, necessary to provide motor and other equipment for using electric power. Moreover, a capital sum of $856 000 000 would have to be provided by the present electricity supply undertakings to meet the demand for power in 1930, while under the super-power system this sum would be reduced to $693 218 000, or an annual saving of $16 300 000. As regards the cost of the power itself, it is estimated that in 1930 with the super-power system in working order, the cost at the bus bars of the present electricity undertakings, inclusive of fixed charges, would be 1·06 cents. per kWh, while under the independent system it would remain the same as in 1919, *i.e.*, 2·12 cents. per kWh. This is rightly stated by Mr. W. S. Murray as being a fundamental argument in favour of the change.

The Waste of Small Plants.

If further argument is needed on this point we may call attention to the statement that in 1919 it would have been economical to shut down 4 008 200 h.p. of prime movers in small plants and purchase energy to the amount of 5 623 800 000 kWh instead. The saving in coal thus effected would have been 13 502 100 tons, or 71 per cent. of the coal used by the industries for producing power, or 25 per cent. of all the coal used by the industries. In general it was found, as might be expected, that plants which require 500 h.p. or less can economically draw their energy from the mains, though an exception is made in the case of those which obtain power as a by-product of the industrial processes which they carry on.

Railway Electrification.

The matter is carried a step further in connection with railway electrification as the zone contains systems upon which the traffic is sufficiently dense to warrant a careful consideration of the savings that might be effected by making this change. It is pointed out that about $150 000 000 is already spent annually by the railways in extensions and improvements, and that this sum would in three or four years suffice to cover the cost of electrifying the 19 000 miles of track which could be profitably converted. We are glad to see in this connection that Mr. Murray insists that it is the business of the supply undertakings alone to generate electricity and that railways and other industries should purchase energy, not make their own.

Technical Advantages of the Zone.

From the purely engineering point of view the super-power zone scheme has many advantages. Though there is not so much water power available as, for instance, in California it will on the other hand be possible to erect three steam stations in the anthracite region at sites on the Susquehanna River where sufficient condensing water is

present to allow plant of a capacity of 300 000 kW to be used. In addition five hydro-electric stations on the Potomac, Susquehanna, Delaware, Hudson and Connecticut rivers will allow an aggregate capacity of 1 050 000 kW to be developed. Existing steam plant with a capacity of 2 677 000 kW or 79 per cent. of the total capacity in 1919 will be retained with an average capacity of 44 600 kW. Apart from extra super power stations fourteen further stations with an aggregate capacity of 3 930 000 kW will be required by 1930. The extra super-power transmission system will consist of 970 miles of line operating at 220 000 V and 4 696 miles of line operating at 110 000 V, and to these lines will be connected 5 600 000 kVA of transformers. In general 220 000 V will be the transmission voltage from the power stations at a considerable distance from the load, while 110 000 V will be used within the power area and between load centres.

Some Important Omissions.

Taking into account British conditions only these are figures at which the imagination boggles. It must, however, be noted that the problem differs, in degree not in kind from that with which we are faced in this country, and that this area, large as it is, is the one which industrially speaking is the most developed in America. It is a pity therefore that Mr. Murray's study could not have been extended to the entire country when it would have been easier both for American engineers and ourselves to envisage the conditions both in a more wholesale way and in the proper perspective.

Interesting and important as the report is, however, there are two important omissions. Nothing is said about either the financial or the legal means by which this Gargantuan development is to be carried out. Engineering problems are hard enough to solve, but as we know to our cost they become insignificant compared with these factors. Electrical engineers connected with the "super-power zone" are, we fear, only at the beginning of their troubles.

Rates and Rate Aid.

The engineer and manager of the Liverpool Corporation electricity undertaking is to be heartily congratulated on a successful year's working. Indeed, he has been a little too successful, for the net profit of the department for 1920 amounts to very nearly £147 000, of which enormous sum no less than £60 000 has been devoted to the relief of rates, the balance being transferred to the renewal fund. In view of the purchase of the undertakings of the Bootle Corporation and of the Liverpool District Lighting Company, nothing but good can be said about the latter allocation, but we are very much opposed to the policy of transferring so large a sum as that proposed to the consolidated rate fund. No doubt the ratepayers will be glad of any relief, however slight, in these days of crushing rates and taxes, but it will be so small that it would be much sounder finance, both for the individual and for the industrial prosperity of the city, if a reduction in the charges for electricity for power and lighting were now made. This is the only correct policy to pursue in a municipal trading department. For reduced power charges would enable manufacturers to lower their costs of production, and place them in a better position to meet competition at home and abroad. Only in this way will the industrial revival, of which we are glad to see signs, really arrive.

The Legal Position.

Unfortunately the law relating to the disposal of the so-called profits of municipal electricity undertakings is not very definite, and it would be well if it were amended to meet modern conditions. By Clause 7 of the Electric Lighting (Clauses) Act of 1899 the revenue of a municipal electricity supply department must be applied in payment of working and establishment expenses, maintenance charges and interest on loans, in providing sinking fund instalments, and in paying all the other expenses of executing the Special Order, not being expenses properly chargeable to capital. Subject to this, the local authority *may* create a reserve fund not exceeding in amount one-tenth of the aggregate capital expenditure, and then the net surplus in any year, as well as the annual proceeds of the reserve fund when amounting to the prescribed limit, *may* be carried to the credit of the local rate, or may be applied to local improvements, or in reduction of the borrowed capital. When, however, the net surplus exceeds 5 per cent. of the capital expenditure, the undertakers must make "such a rateable reduction in the charge for the supply of electrical energy as, in their judgment, will reduce the surplus to that maximum rate of profit."

Practice of Local Authorities.

It is obvious that, in addition to lack in clarity, the clause is mainly permissive. There is a wide choice of objects to which the net profit, until it exceeds 5 per cent. of the capital expenditure, may be devoted, and the practice of local authorities varies as widely. Some arrange matters by voting sums to the relief of rates and to other purposes, so that the 5 per cent. limit is never reached. This is scarcely fair to the consumers. It retards local industrial progress, and is detrimental to the best interests of the local authorities. We should, therefore, like to see it made illegal for any supply undertaking to relieve the rates until the prices of electrical energy for power and lighting were reduced at least to the pre-war figures. At present the Electricity Commissioners have not any very great authority over municipal finance, though they can exert a great deal of indirect pressure; and they may, and we hope will, use their influence to discourage rate relief until the supply is much cheaper than it is at present.

What is Capital Expenditure?

There is some doubt as to what is the precise meaning of the "capital expenditure" of a municipal electricity department at a given time. Loans are usually repaid either by annual instalments of principal and interest, or by means of yearly contributions to sinking funds, or by a combination of both methods. In the case of Liverpool the capital expenditure at the end of 1920 was returned at £2 699 423, but about £850 000 had been repaid, and the reserves and sinking fund amount to over £1 600 000. If, therefore, we take the repayments of capital, the reserves, and the sinking fund into consideration, the net capital outstanding is a comparatively small figure. But upon which of these items, the gross or the net capital, the 5 per cent. is to be calcalculated is not clear. By taking the former a local authority might postpone a compulsory reduction in price, and devote sums to relief of rates in a way which would not be possible if the calculation were based on the net, written-down value of an undertaking.

We have taken the Liverpool undertaking, which is one of the most progressive and best managed in the country, as an illustration, and we do not challenge anything in their business methods, except the allocation of so large a sum to the relief of rates.

Flux Distribution in Air Gap and Teeth of Dynamos.

By ALFRED STILL.*

This article deals with the flux distribution in the air gap and teeth of dynamos from the standpoint of fundamental laws and principles, it being found that in presenting such problems to engineering students it is as well to avoid many of the methods used by the practical designer. The subject is dealt with under the headings of permeance of the air paths, the air gap, and of the conditions in highly saturated teeth. Calculations of the tooth density in terms of air gap density and m.m.f., with a correction for the tapering of the teeth are made, the whole argument being illustrated by a numerical example.

Although this article explains the derivation of a new formula for use in calculating the ampere-turns required to overcome air-gap and tooth reluctance, its aim is not so much to contribute additional material for the use of the designer as to explain how the difficult problem of tooth and slot reluctance may be solved without the use of empirical constants or tables of design co-efficients. The writer finds that, in presenting design problems to engineering students, it is well to avoid many of the methods used by the practical designer, and base all arguments and calculations on fundamental laws and principles. If, at the same time, this leads to methods of calculation which are neither longer nor more tedious than those used by practical designers, they would seem to be preferable to all others, not only because they tend to keep in sight the physical aspects of the problem, but also because, when departures are made from standard designs, their application will generally yield more accurate results.

Permeance of the Air Paths.

To calculate the permeance of the air paths over one slot pitch at the centre of the pole face, when the density is low, the magnetic lines will be supposed to follow the paths indicated in Fig. 1. The tooth is drawn for convenience with parallel sides, and the magnetic lines entering the sides of the tooth are supposed to follow a path consisting of a straight portion of length δ, equal to the actual air clearance, and a circular arc of radius r, all as indicated in the figure. This is

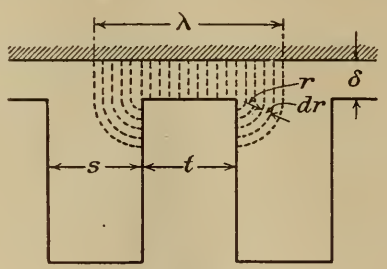


FIG. 1.

obviously an arbitrary assumption, but it is convenient for calculation and gives very good results. It agrees very closely with the results obtained by Messrs. H. S. Hele-Shaw, Alfred Hay, and P. H. Powell in their classic Institution Paper,† and also with the correct mathematical conclusions arrived at by Mr. F. W. Carter, based on certain assumptions, including that of infinite permeability of the iron in the teeth.‡

The Air Gap Analysed.

Consider a portion of the air gap 1 cm. long axially (*i.e.*, in a direction normal to the plane of the section shown in Fig. 1) and note that the permeance over the slot pitch of width λ is made up of two parts: (1) the permeance P_1 between pole face and top of tooth, of value $P_1=\frac{t}{\delta}$, and (2) the permeance $2P_2$ where P_2 is the permeance between the pole face and one side of the tooth. The permeance of any small section of thickness dr and depth 1 cm. measured axially, as indicated in Fig. 1, is:

$$dP_2=\frac{dr}{\delta+\frac{\pi}{2}r}$$

whence

$$P_2=\frac{2}{\pi}\int_0^{\frac{\pi}{2}}\frac{dr}{\frac{2\delta}{\pi}+r}$$

$$=\frac{2}{\pi}\log_\epsilon\frac{\delta+\frac{\pi s}{4}}{\delta}$$

The average permeance *per square centimetre* over the slot pitch at centre of pole is, therefore:

$$P_{sq.\,cm.}=\frac{P_1+2P_2}{\lambda}$$

$$=\frac{\frac{t}{\delta}+\frac{4}{\pi}\log_\epsilon\left(\frac{\pi s}{4\delta}+1\right)}{\lambda}$$

where the tooth pitch, λ, is expressed in centimetres.

The reciprocal of this quantity is the reluctance per square centimetre of air-gap cross section, or the length, δ_e, of what may be called the equivalent air-gap. Thus:

$$\delta_e=\frac{\lambda}{\frac{t}{\delta}+\frac{4}{\pi}\log_\epsilon\left(\frac{\pi s}{4\delta}+1\right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

This is the length of air gap that would be necessary to give the same air-gap reluctance between pole and armature if the actual toothed armature were replaced by a smooth core armature. The formula (1), when applied to normal designs of dynamo-electric machinery, gives results very similar to those obtained by the application of the many and various formulas used by designers, some of which are approximations to the values obtained by using Carter's co-efficients, while others include empirical constants. No exact formula has yet been evolved, and, owing to the difficulty of allowing for variations in the permeability of the iron in the teeth, and also to the fact that such variations will cause corresponding changes in the length of the equivalent air gap, the designer need not look for any closer approximation than that obtainable from formulas now available.

A formula which is simpler to use than formula (1) is that proposed by Mr. T. C. Baillie §; it gives values for δ_e very closely approximating to those obtained from formula (1) and also from the use of Carter's co-efficient. When put in the same form as formula (1) it may be written:

$$\delta_e=\frac{\lambda}{\frac{t}{\delta}+\left(\frac{5s}{5\delta+s}\right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

If the radial ventilating ducts in the armature are closely spaced, or exceptionally wide, the gap δ_e for the equivalent smooth-core armature, as given by formulas (1) and (2), might have to be slightly modified, but the calculation of fringing at the sides of vent ducts is usually an unnecessary refinement.

Conditions in Highly Saturated Teeth.

Consider now Fig. 2, which illustrates the extreme case of a highly saturated tooth. The lines of flux are shown parallel over the whole of the slot pitch, a condition which is

*Professor of Electrical Design, Purdue University, U.S.A.

†"Hydrodynamical and Electromagnetic Investigations Regarding the Magnetic-flux Distribution in Toothed-core Armatures." Proc. Inst. E.E., Vol. 34, p. 21.

‡"Electrical World," Vol. 38, Nov. 30, 1901, p. 884. The reader is also referred to Hawkins and Wallis, "The Dynamo," fifth edition, Vol. 1, p. 456, where Carter's co-efficient has been used in preparing curves giving the ratio between the "apparent" and actual air gap.

§ THE ELECTRICIAN, Jan. 8, 1909, p. 494.

approached—but never attained—as the density in the tooth is forced up to higher and higher values. It is obviously only when the permeability of the iron in the tooth becomes equal to unity—that is to say, equal to the permeability of the air paths—that this parallelism of the flux lines would occur. This is an extreme, and, indeed, an impossible, condition ; but

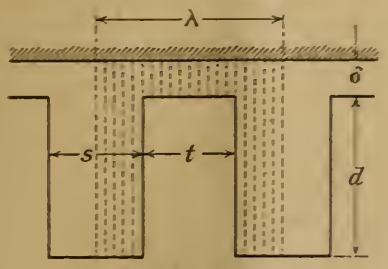


Fig. 2.

since, even at comparatively low flux densities in the iron of the teeth, there will be some flux passing directly from the pole face to the bottom of the slot in addition to the flux lines indicated in Fig. 1, a close approximation to actual conditions may be obtained by assuming a parallel field between the pole face and the iron at the bottom of the slot superimposed upon the field of Fig. 1. The resultant or actual field in the air gap and slot will then be somewhat as indicated by the flux in Fig. 3. With low values of tooth density, the m.m.f. between the tooth tops and the bottom of the slots will be small, and few flux lines will pass from the pole face into the armature core without entering the teeth ; but with higher tooth densities the m.m.f. to overcome tooth reluctance becomes large, and more flux will be diverted into the parallel path and pass directly from the pole face to the bottom of the slot. The amount and distribution of the flux in the air gap and slot will, therefore, change with every alteration in tooth density.*

Calculation of Tooth Density in Terms of Air-Gap Density.

Notwithstanding the fact that the inclusion of the flux component which passes directly from pole face to bottom of slot will modify the length of the equivalent air gap and cause this to be dependent upon the flux density in the teeth, no appreciable error will be introduced by considering the reluctance of air gap, teeth, and slots as consisting of two reluctances in series, (*a*) the reluctance of the equivalent air gap (as calculated by formula (1) or (2) for the centre of the pole face), and (*b*) the reluctance of the tooth and slot in parallel. The calculation of this latter quantity depends upon a knowledge of the actual flux density in the tooth. For low densities in the iron—up to about 14 000 gausses—the actual

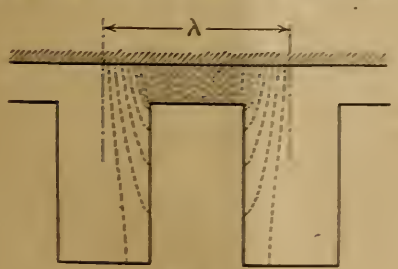


Fig. 3.

tooth density will be approximately equal to the apparent density ; that is to say, practically all the flux entering the armature over one tooth pitch will pass into the core through the root of the tooth. For densities exceeding 14 000 gausses, and even for lower values when the depth of slot is small in relation to the air gap, the calculations should take account of that component of the total flux which goes from the pole face to the bottom of the slot without entering the teeth.

*The method here outlined for attacking the problem of tooth and slot reluctance is similar to that proposed by Mr. F. H. Douglas in the "Electrical World," of Oct. 24, 1914 (Vol. 64, p. 812) except that he uses Carter's co-efficient instead of formula (1) or (2) in obtaining an expression for the equivalent air gap.

The following symbols will be used in the calculations :

B_g = the average air-gap flux density at armature surface ; i.e., the average density over one tooth pitch of width $(t+s)=\lambda$ and length l_a.

B_t = the actual flux density in the tooth.

μ = the permeability of the iron in the teeth.

B_s = the flux density in the slot and parallel spaces occupied by air or insulation.

l_a = the gross length of the armature core.

l_i = the net length of the armature core (iron only).

The other dimensions are given in Fig. 4.

M.M.F. Calculation.

The full m.m.f. necessary to overcome the reluctance of air gap and teeth acts between two cylindrical equipotential surfaces passing through the bottom of the slots and the roots of the teeth. The assumption is now made that this total m.m.f. is the summation of two m.m.f.'s acting in series, the one of value $B_g\delta_e$ required to overcome air-gap reluctance, and the other of value $\left(\frac{B_t}{\mu}\right)d_t$ to overcome the tooth reluctance. Since the flux component in the slots and parallel spaces not occupied by iron will depend upon the total m.m.f. between

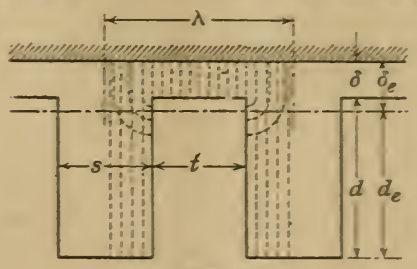


Fig. 4.

the two equipotential surfaces previously defined, we may write the equation :

$$B_t(d_t+\delta_t)=\frac{B_t}{\mu}d_t+B_g\delta_e$$

whence
$$B_t=B_t\frac{d_t}{\mu(d_t+\delta_t)}+B_g\frac{\delta_e}{(d_t+\delta_t)} \quad \ldots\ldots\ldots\ldots (2)$$

The total amount of flux entering the armature over the space of one tooth pitch is :

$$B_g\lambda l_a=B_t t l_a+B_s(\lambda l_a-t l_a) \quad \ldots\ldots\ldots\ldots (3)$$

By inserting for B_t in this equation the value given by (2), it is possible to express B_g in terms of B_t, the final expression being :

$$B_g=B_t\left[\frac{(d_t+\delta_t)+\frac{d_t}{\mu}\left(\frac{\lambda l_a}{t l_a}-1\right)}{d_t\left(\frac{\lambda l_a}{t l_a}\right)+\delta_t}\right] \quad \ldots\ldots\ldots\ldots (4)$$

By selecting a number of values for B_t, the corresponding values of μ can be obtained for the particular quality of iron used in the armature. The air-gap density B_g can thus be calculated, and a curve plotted giving the relation between B_g and B_t for the particular design under consideration and for any value of tooth density.

It is interesting to note the form taken by formula (4) for the limiting conditions of tooth saturation ($\mu=1$) and infinite permeability of the teeth. In the first case we have the condition $B_g=B_t$, which is obviously correct, while in the second case ($\mu=\infty$),

$$B_g=B_t\left[\frac{(d_t+\delta_t)}{d_t\left(\frac{\lambda l}{t l_a}\right)+\delta_t}\right] \quad \ldots\ldots\ldots\ldots (5)$$

a formula which will be sufficiently accurate for all practical purposes when the value of B_t is less than (say) 14 000 gausses.

The formula (5) shows that the actual tooth density is never quite equal to what is known as the apparent tooth density, which assumes all the flux leaving the pole face to pass through the teeth. On this assumption the relation would be :

$$B_g=B\left(\frac{t l_a}{\lambda l_a}\right) \quad \ldots\ldots\ldots\ldots (6)$$

(*To be concluded.*)

Auxiliary Features in Automatic Telephone Systems.*

An Impulse Converter.

By W. AITKEN, M.I.E.E.

In the Relay Automatic Telephone Company's system a device is used which responds to the dial, or other, impulses, and builds up a circuit to energise a relay associated with the called line to complete a connection. This device was for some time called a "selector," but there was confusion between this and the "Strowger" selector. It was then called a "recorder," which appears inapplicable, as it records nothing. I have taken the liberty of naming the device to be described a "converter," because it converts a set of impulses into a circuit that will call a line having that impulse code. In the commercial system a 100-line converter is used, in which a set of interacting relays, in response to impulses, first build up the tens and then the units circuit to energise a relay on the called line.

The impulse converter shown in the diagram is for a capacity of ten to fifteen lines, but could probably be developed farther. In its present form it might be used for small offices or for selecting groups of trunks. It is interesting as showing the number of lines that may be called by the manipulation of two wires and earth by the emission of two impulse operations only. This requires two wires and earth or three wires.

Contacts K1, K2, and K3 may be closed in any suitable way, as by keys. K1 and K2 are the impulsing contacts.

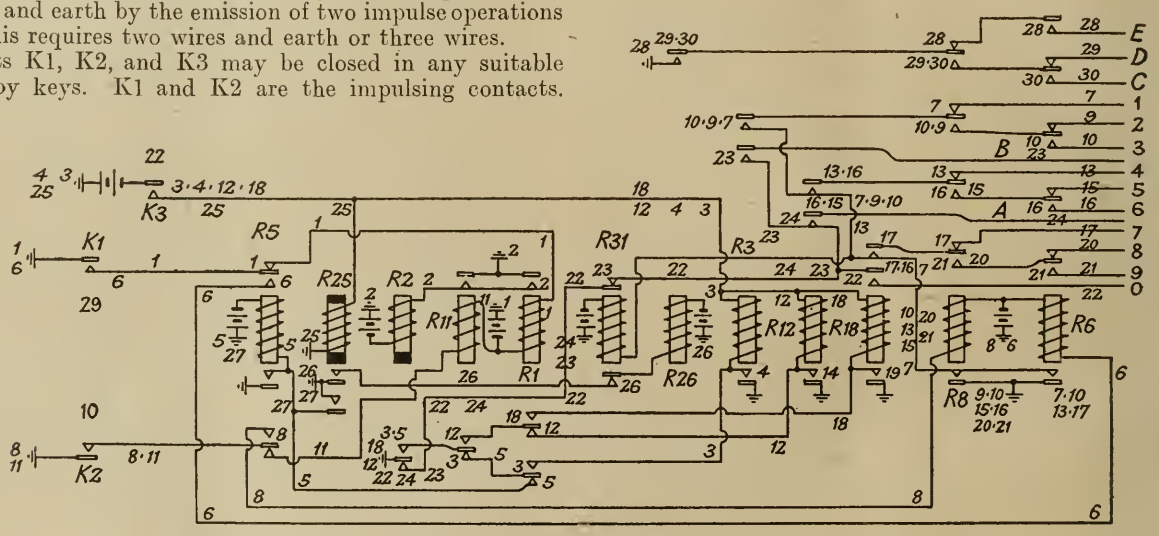


Diagram of the Impulse Converter.

A slow relay de-energises after the emission of one or after two impulses, as the case may be. The contact K3 is closed for a period corresponding to the other contacts except in the case of the three last circuits (E, D, E), when it is closed for a period prior to the impulses to give time for a slow-to-energise relay (R25) to energise.

Contacts K1 and K2 are in the two wires of the line circuit. The circuits are numbered as follows:

Contact K3 is closed in a suitable manner for a time sufficient to allow R25 to energise.

1. R1 energises when K1 is closed.
2. R2 (slow to de-energise) energises.
3. R3 energises.
   K1 opened and R1 de-energises but not R2 and R3—
4. R3 holding circuit.
5. R5 energises.
   R1 again closed.
6. R6 energised.
7. External apparatus may be energised over line No. 1.
   If K2 had been closed in a manner similar to K1—
8. R8 energised.
9. External apparatus on line 2 would be energised.
   If K1 and K2 had been closed together for the second impulse R6 and R8 would be energised—
10. An energising circuit would be completed over line 3.
11. If K2 closed for the first impulse R11 and R2 energise.
    If K1 closes for the second impulse—
12. R12 energises.
14. R12 locking circuit.
    K2 held open R5 energises in circuit 5.
13. Energising circuit over line 4.
    If K2 closed twice, R12 and R8 energise—
15. Energising circuit over line 5.
    If K2 is first closed, then K1 and K2 together R12, R6 and R8 energise.
16. Energising circuit over line 6.
    If K1 and K2 are closed together then K1 closed, R1, R11 and R18 energise.
17. Energising circuit over line 7.
18. R18 energises.
19. R18 holding circuit.
    If K1 and K2 are closed together, then K2 closed, R8 and R18 energise.
20. Energising circuit over line 8.
    If K1 and K2 are closed together twice, R6, R8 and R18 energise.
21. Energising circuit over line 9.
    If K1 and K2 are closed together once, and then released, R2 de-energises and R18 energises.
22. Energising circuit over line 0.
    If K1 closed once, R2 de-energises and R3 energises.
23. Energising circuit over line B.
    If K2 closed once, R2 de-energises and R18 energises.
24. Energising circuit over line A.
25. K3 is closed for a time sufficient to allow R25 to energise.
26. R26 energises.
27. R5 energises.
    K1 closed once, R6 energises.
28. Energising circuit over line E.
    K2 closed once; R8 energises.
29. Energising circuit over line D.
    K1 and K2 closed together once; R6 and R8 energise.
30. Energising circuit over line C.
    R31 may be introduced to further safeguard circuits C D. E, and be operated for circuits to lines 1 to 9.

Improved Handling Facilities at Docks.

Considerable activity prevails at many of the important ports in order to provide better handling facilities. At the new cold storage building of the Union Cold Storage Company at Alexandra Branch Dock No. 3, Liverpool, extensive use is made of modern handling machinery. There is an overhead meat conveyor, extending the full length of sections 14 and 15 of the north shed of the Alexandra Branch Dock No. 2, with an overhead cross conveyor connection to the new building. The Company will also carry out extensions at the Albert Dock, and provision will be made for the electrical operation of the machinery. The Mersey Docks and Harbour Board have purchased twenty-four warehouses in Bootle, and electric mains for lighting, power and heating are being laid.

Extensive additions are being made to their equipment by the Leith Harbour Commissioners. A large new shed has been erected on the north side of the Imperial Dock, and there are electric cranes both in the shed and on the quay. For the continental traffic additional railway sidings have been constructed, and cranes and capstans installed. Power capstans are also being provided throughout the dock area. New equipment is also being installed on the Clyde dock system, and at two docks hydraulic coaling cranes are being replaced by electric cranes and capstans.

THE LANCASTER-MORECAMBE-HEYSHAM ELECTRIC RAILWAY.

Some Experiences of Fourteen Years' Working with the Single-Phase Overhead System.

(*Concluded from page* 129.)

The Lancaster-Morecambe-Heysham branch of the Midland Railway was equipped with single-phase electric traction in 1908 to obtain experience which would be valuable in dealing with the wider problem of main line electrification. This article gives an account of the failures and modifications which have been shown to be necessary in various parts of the apparatus during fourteen years' working. Protective devices, bonding, induction effects, power supply and the traction equipment are dealt with.

Protective Devices and Earthing.

As regards lightning protection three sets of safety devices are fitted at Heysham Harbour. These consist of a choke coil to take off thunder discharges, a Moseiki condenser for high frequency discharges, and a Giles' valve for discharges of a more moderate frequency. A lightning arrester is also fitted on the overhead equipment every half-mile, and an earth wire connected to the gantries is run the whole of the line, being connected at intervals to heavy rubber insulated cable which in turn is connected to earth plates. Large earth plates are also fitted in duplicate at Heysham Harbour and at Morecambe at the end of the Midland Railway pier. These plates are of copper and for protection are enclosed in large iron caissons. At Lancaster the running rails are earthed to the cast iron columns of the bridge across the Lune, where water is always flowing. As a test of the efficiency of the various earths, recording ammeters were put in to indicate the proportion of current which returns by this route. It was found that this current was negligible, all the current being dispersed from the rails into the earths within a very short distance.

Bonding.

For bonding purposes the Forest City type bond is employed, the outer rail of each line being bonded throughout its length in duplicate. For protection the bonds are placed under the fish-plates. At all crossings and junctions the rails are bonded together for greater continuity, these bonds as well as those used for cross bonding being copper cable bonds of the ordinary type.

During the installation of the bonding very great care was exercised to prevent any moisture getting into the drill holes or on to the bond plugs, and this care has been justified by the comparatively few bonds which have had to be replaced under ordinary maintenance. Approximately, about 40 cable bonds of various lengths have, however, had to be removed at junctions owing to the copper strands having broken from vibration, while about 1 500 of the ordinary bonds have had to be removed at various times in consequence of re-laying operations or the removal of the rails. About 83 per cent. of the bonds thus removed have been rendered fit for further use by conversions into pin bonds. This has been effected by drilling the solid terminals. It was found that the damage to the bonds was very much less between Heysham Harbour Junction and Morecambe, where the permanent way is solid, than between Lancaster and Morecambe, where the permanent way is less solid, and the fish plates were therefore often badly worn.

Induction Effects.

A point which always arises with single phase railways is the effect their operation will have on neighbouring telegraph and telephone wires. Telephone and telegraph wires run alongside the line through the whole of the electrified section, and some valuable results as to inductive effects have therefore been obtainable. Inductive influence was to some extent removed by installing the earth wire which, as mentioned above, is fixed to the gantries between the high tension contact wire and the telegraph wires, while by arranging an electrostatic E.M.F. to counteract the induced E.M.F. on the A and B wires of the telephone complete silence has been obtained over the short lengths involved. Over long distances, however, it is probable that inductive effects would continue to cause trouble, and it is one of the points which those employing single phase traction will have to consider carefully, and especially to follow closely the work which has been done in this direction in America.

It may be added that for communication purposes portable telephones are provided at a number of places between the stations over which the engine driver may give information or receive instructions from the signal box. Both the signalling and the telegraph and telephone wires are protected by a link consisting of a carbon lamp.

Power Supply.

A few words may be said about the power house from which the line is supplied. This is situated at one end of the line at Heysham and was originally equipped with three sets of American built Westinghouse gas engines and generators, each with a capacity of 150 kW, for supplying the power load at the harbour. A battery with a capacity of 100 kW at the five-hour discharge rate was also installed. When the electrification of the Lancaster-Morecambe-Heysham section took place an additional engine with a capacity of 235 kW was added, this set being of the six-cylinder tandem British Westinghouse type. These engines are supplied from two Mond gas producers each with a 1 000 H.P. capacity with the necessary auxiliary blowing, steam producing and cooling apparatus. Steam for the gas producers is raised in a locomotive type boiler, using locomotive smoke box ashes as fuel, and by boilers using the exhaust gas from the engines. During the war it is interesting to note that advantage was taken of the gas-making plant to supply large quantities of ammonium sulphate, though the present day prices do not make the production of this useful chemical worth while.

Generating Changes.

At first the energy for traction was obtained from two E.C.C. motor generators, each with a nominal capacity of 175 kW single phase output, but capable of peak outputs as large as 700 kW. This latter output is occasionally obtained when three trains on the line start together. These sets were designed with very low constant losses, but notwithstanding this, the infrequency of the electric service over the greater part of the year brought down their overall efficiency to about 50 per cent. only. In 1914, therefore, the three original Westinghouse engines were replaced by two tandem sets, each with a capacity of 235 kW. These were coupled through helical gearing to the motor generators which thus became double current sets so eliminating the constant losses of one machine per set. Under this arrangement traction peaks are supplied first by the whole power of the engine being transferred to the alternator, any charging current that has been passing into the battery ceasing, and the battery taking over the harbour direct current load. Subsequently, any further access of alternating current load causes the direct current machine to motor from the battery and help the engine. A Westinghouse regulator controls the battery booster in place of the original and usual arrangement of control governed by variations of the direct current load. The station is of interest because, although it is equipped with gas engines, it deals successfully with very heavy load variations, and also because of its very small capacity in comparison with the peak loads with which it has to deal.

Traction Equipment.

Turning to the design and equipment of the rolling stock a very full description of the original cars provided by Siemens Brothers Dynamo Works and the British Westinghouse Company is given on page 363 of THE ELECTRICIAN, June 19, 1908. In general, these cars have proved fairly satisfactory during the thirteen years' operation, and further reference to their design and equipment is therefore unnecessary. We, however, give a few details of points which have received attention with sufficient information about the original equipment to make these clear. Two out of the three motor-cars provided for running the line were equipped with Siemens' equipment of German manufacture, and one was equipped with American Westinghouse equipment. The latter has straight series compensating motors and electro-pneumatic control and has been entirely satisfactory throughout.

Original Specifications.

It is true that nowadays the brush construction and brush gear wear would be considered excessive compared with direct current equipment, but it must be remembered that these cars are fifteen years old. The original specification called for two motors per car, both of which were to be carried on one bogey, it being considered both the more economical and the more mechanical arrangement to concentrate the motive power and reduce the number of parts as much as possible. The normal train was specified to consist of a motor-car and two trailers. The weight of these without any electrical apparatus or mountings is 25 tons and 17 tons respectively, with a total passenger capacity of 310 with 180 seats. The contractors were also required to make their equipments capable of being worked from the same master controllers, while the motors in the case of the Siemens set were nominally of 180 H.P. output, and in the Westinghouse set of 150 H.P. output. The specification required that these motors should be capable of delivering their declared

output for one hour with a temperature rise not exceeding 135°F. on the test bed and a temperature rise not exceeding 90°F. after having run the three-coach train for six double trips from Heysham to Morecambe, Morecambe to Lancaster and return. The collector bows which deviate a little from the standard practice usual at the time have given no trouble. The weight of the Siemens motor coach is 40 tons 10 cwt. and of the Westinghouse 37 tons 10 cwt.

Motor Details.

The two Westinghouse motors embody resistance strips in the armature connections to the commutator, but there is no record of strip failure on these equipments; electro-pneumatic control gear has also been entirely satisfactory. The equipment was of a type already in some use elsewhere and was standardised when it was purchased.

The Siemens equipments, on the contrary, were among the very early productions of their makers and embodied a number of features wherein theory was in advance of practice. They have therefore not been quite satisfactory, and, in fact, it is believed that the two Midland equipments are the only ones of the batch made to these designs which survive to-day in actual work.

The motors are series compensated type with the addition of a commutation winding, and also have resistance strips. In this case these have been the source of much trouble; there have also been other weaknesses, both mechanical and electrical.

Mechanical Defects.

The original lubricating system was very elaborate, and failed because its pump and pump drive would not stand up to the work. It was simplified to a simple reservoir and oil-pad arrangement with a new bearing and a motor end plate. The bearings originally wore too rapidly. They were bored slightly eccentric so as to carry the armature somewhat above the centre, and so relieve the weight. The spider mounting of the armature core did not give adequate bearing surface, the arms being too narrow so that the core worked loose. These arms had to be widened. The core looseness caused a great deal of breakage of connections the cause of which for some time was difficult to locate. Core looseness on traction motors, of course, is a defect not confined to single phase equipments.

Electro-Mechanical Defects.

In 1910 to 1911 a series of electrical troubles, which were finally traced to a mechanical fault, commenced and caused a very bad breakdown record for some six months. The faults consisted of short circuits between commutator segments, with consequent burn-outs of the winding sections; the cause was finally traced to bad mechanical design, inasmuch as the commutator quill was in two halves, which did not close up when the commutator was put together and tightened up. Access of dirt, &c., into the interior of the commutator was thus possible; in fact, copper and steel turnings were found inside most of the commutators and must have been there from the time of manufacture. Why they had not made their presence felt earlier is inexplicable.

Electrical Defects.

The earliest electrical troubles were short circuits on both armature and stator windings, resulting from dirt and carbon dust bridging the bare metal end connectors, which were too close together. Insulating distance pieces were inserted between each winding section, and the trouble was finally rooted out by cementing up the windings solid. Insulation failures to earth occurred mainly at the corners where the windings left the slots. These were attributed to vibration in the end windings set up by the a.c. current and damped down at the slot corners. This, also, was finally cured by cementing the windings. Earth faults developed due to dirt accumulating in the neighbourhood of the ventilating duct openings through the armature and stator. These ventilating openings were finally eliminated by rebuilding the armature and stator in solid form without them; a resulting gain of 1½ in. enabled the ventilation path to be reversed so as to blow from the windings to the commutator and not *vice versa*, an arrangement which blew all the carbon dust into the windings. So far as the stators in these motors are concerned this treatment has, practically speaking, entirely eliminated insulation breakdown both to earth and between windings.

Resistance and Connection Troubles.

Resistance strip and connection troubles have been the most difficult to overcome, the faults when driven from one point appearing elsewhere. By overheating and unsweating the commutator connection lugs, it was found that the area of connection between them and the resistance strips was not sufficient. The resistance strip was then soldered into a long tubular connector with which it had a large contact area and a copper wire connector was taken thence into the commutator.

Subsequently expansion of the straight resistance strips at both ends of the armature caused them to break; an "S" shaped bend was therefore embodied in them. Expansion trouble afterwards made its appearance inside the slots and occasionally under the binders, and this has not yet been altogether eliminated.

The main cause of the overheating of strips is the heavy current which passes at times of starting and the induced circulating current in the coils short circuited by the brushes when a motor is standing with current on.

Causes of Overheating.

Of these two causes of overheating it is believed that of the starting current is worse than that of the more infrequent case when a car fails to start at once (say on a gradient), and is not notched up quickly enough so that some coils remain short circuited for a period. The original type of strips accordingly have recently been discarded and other material of lower resistance substituted so to produce less heating from the starting current. The length of the strips has been increased to give added radiating surface and a square section has been used instead of the original flattened section in the slots so as to give added strength to resist the tendency to rising and kinking in the slots. So far this looks like being more satisfactory, the lower resistance rather improving commutation than otherwise.

Controller Defects.

Single phase all electric control gear has proved workable, but is more costly than d.c. in maintenance and inspection, and it is impossible to get rid altogether of the vibration which wears the working parts unduly. There have been a number of connection breakages which can only be attributed to this vibration arising from the a.c. drive. When these motors are in good condition their commutation is almost sparkless and their brush wear satisfactory, a mileage of 47 000 for one set of brushes having been recorded. The brushes are of the sliding type in box form brush holders, and though flexible connectors between brush and brush-holder are fitted, there is a good deal of brush-holder wear due to sparking between brush and brush-holder. This wears away the interior of the brush-holders and deteriorates the fit of the brushes in them, causing the brush to take up a different bearing as between one direction of travel and the other, and adversely affecting commutation by reducing the effective brush area. Re-lining of the brush holders is therefore necessary at intervals, and their complete renewal at longer intervals. An experiment tried with heavily coppered brushes and no flexible connection was unsuccessful, aggravating the above trouble though giving good enough operation at first.

Of course it must be borne in mind that these equipments, and particularly the Siemens ones, were among the very early single phase equipments. It is understood that most of the weak points brought out by the above history of defects have been eliminated in later designs; the latest American and British single-phase equipments, for example, have no resistance strips.

The work to which we have drawn attention in this article has been carried out under the supervision of Mr. J. Sayers, O.B.E., Telegraph Superintendent of the Midland Railway, and Mr. J. Dalziel, Chief Electrical Assistant in the Mechanical Engineer's Department. Mr. R. Meakin, chief draughtsman, and Mr. F. B. Holt, chief technical officer in the Telegraph Superintendent's Department, were largely responsible for the new design of overhead equipment.

Electricity Projects in Ceylon.

Though there has been much discussion in CEYLON about HYDRO-ELECTRIC DEVELOPMENT, so far little progress has been made. However, the recent visit of the Director of Public Works (Mr. Chapman) to Canada, Switzerland, France and Italy, and the visit of Lord Northcliffe to Ceylon have given a fillip to some of the proposals. Mr. Chapman is said to be now convinced that with an estimated cost of 7 cents per unit for electrical energy delivered at Colombo the existing industries could be revolutionised, while new ones would be readily attracted to the colony.

The Government have now decided to proceed with the Aberdeen-Laxapana hydro-electric project, but in partnership with an English electrical engineering firm. Of the necessary capital of about Rs. 14 000 000, the Government will contribute three-fifths by raising a special loan in England at an early date, and the remainder will have to be invested by the firm. The plans and estimates will be forwarded at an early date to the Crown Agents.

The sale of domestic electric appliances and small electrical goods locally has greatly increased. A year or two ago to find in Colombo daily newspapers a small advertisement referring to electric material was a curiosity; to-day it is quite common to find half a page devoted entirely to illustrating electrical goods.

Several British firms approached the authorities with a view to carrying out the scheme, but the Government are determined to finance the matter themselves, though they have no money available, and as the Colombo Municipality did not exercise the option to buy the Colombo electric tramways from Boustead Brothers, who have secured a renewed tenure of eight years, it was feared the Laxapana-Aberdeen electricity scheme would be shelved.

The Interconnection of Alternating-Current Power Stations*

By L. ROMERO and J. B. PALMER.

Since November, 1916, when Mr. J. S. Peck read a Paper on this subject, several interlinking schemes have been put into commission or projected, and the purpose of this Paper is mainly to show the importance of power-factor phenomena in interconnectors. While the conclusions arrived at apply with equal force to transmission lines which are not interconnectors, it is intended only to deal with the general problem of transmission lines connecting power stations.

In deciding the lay-out of an interconnector scheme the designer is confronted with the problems: What variation in power factor will result from interconnection with a given voltage "boost" applied to the interconnector? And conversely: What voltage "boost" will be required to transmit power at a given power factor of transmission. In the original Paper an appendix, giving formulæ for estimating these values, is included.

General Operating Conditions.

The division of load in any desired proportion between two a.c. power stations depends wholly on the adjustment of the steam supply to the prime movers. The adjustment of the field strength of the generators, or the raising of the voltage at the "sending" end only causes wattless kilovolt-amperes to flow round the circuit formed by the generators at the two power stations and interconnecting cable; the true power or kilowatts remains unaltered, except for the copper loss in the interconnector.

When current flows through a circuit having resistance and reactance (such as an interconnecting cable, with or without step-up and step-down transformers) the voltage at the two ends of the circuit will differ either in magnitude or phase displacement, or in both.

For a given load the position of the voltage triangle with respect to the current vector will vary with the difference in magnitude of the station voltages. The power factor of transmission at one end of the line can be controlled and kept constant by varying the voltage of one station with respect to the other, as the load varies.

There are three main conditions of voltage relationship under which power can be transmitted between two power stations, viz.:

(1) *Station voltages constant and equal.*—The mean power factor of transmission remains at a constant leading value. The power factors at the station ends of the interconnector vary (within small limits) in opposite directions as the load varies or reverses in direction.

(2) *Station voltages constant and unequal.*—The power factor of transmission varies with load in the direction of lag to lead as the load increases, and *vice versa* as the load decreases. This method is suitable only for transmission of power in one direction.

(3) *Station voltages varied by booster or other means as the load varies.*—The power factor may be kept constant at any desired value within the range of voltage variation available.

Station Voltages Constant and Equal.

Under condition (1) power may be transmitted in either direction without varying the voltage or mean power factor. The load in the interconnector is at a leading power factor throughout its length, the mean angle of lead depending on the ratio of reactance to resistance in the circuit. The power factor of transmission at the two ends of the line varies in opposite directions with the load, the mean power factor remaining constant.

This method might be used for a line connecting two stations each with a load at or near unity power factor, and where it was necessary to reverse at short notice the direction of transfer of power in the line. Under these conditions $\tan a = \frac{X}{R}$ where a is the mean angle of lead of the current, X is the reactance of the line, and R is the resistance of the line. By making X as large as would be safe from the point of view of synchronising power, the mean power factor of transmission might be fairly near unity. Power could then be transmitted in either direction without serious interference with power-factor values elsewhere. Unfortunately, most power stations are probably unable to receive and absorb into their systems a bulk supply at a leading (or even unity) power factor without serious disturbance to their operating conditions. This method has, therefore, a limited field of application unless special measures are taken to supply the large wattless component which might be required.

Station Voltages Constant and Unequal.

Under condition (2) the voltages are usually fixed to give the best power factor of transmission at full load. This method is used with success in some cases where load is trasmitted in one direction only. It makes it possible to transmit a fixed load at any desired constant power factor, but it is only suitable for transmitting power in one direction, as a reversal of power would flow at a low leading power factor. Further, the power factor varies with a change in load. Lastly, with a large voltage-difference in circuit it would hardly be practicable to operate without a regulator to reduce the voltage-difference when synchronism is approached or departed from; otherwise the sudden making or breaking of the large wattless current which would flow at no load would have serious effects on the busbar pressure at one or both stations. These considerations appear to rule out a fixed large voltage-difference, although this method gives fairly good results under favourable conditions, and where transmission is effected in one direction only.

Variable Station Voltages.

Condition (3) appears necessary in most cases. The variation of voltage may be obtained either (*a*) By varying the busbar voltages at one or both stations, or (*b*) By introducing "boost" in the interconnecting line.

For power undertakings distributing alternating current, variation of busbar pressure for this purpose is inadmissible since it means a corresponding variation in voltage at the consumers' terminals. This method can therefore only be used where the power to be transmitted is small and the interconnecting cable short. Almost invariably a fixed pressure is aimed at, and restored after longer or shorter periods of variation.

The introduction of boost into the interconnector is thus the only generally applicable method of varying the voltage relationship between the two stations. The variable boost in the line can be introduced by induction regulators, static boosting transformers with step-by-step regulators, or variable regulating tappings on the main transformers.

Types of Regulators.

In the original Paper the authors summarise the types of regulators that can be used, including the step-by-step and induction types. For large powers and high voltage the former type is at a disadvantage owing to difficulties in building the necessary remote-control switchgear. Contactor-type and face-plate step-by-step regulators are limited to pressures of about 3 000 V, and supplementary transformers are usually needed.

An induction regulator is in effect a transformer with one movable winding, and can be wound for pressures up to 11 000 V. At this voltage it is equivalent to two auxiliary transformers and switchgear as used in step-by-step methods, and is superior to it in simplicity and fineness of voltage regulation. In America, combinations of both types have been designed for the control of electric furnaces, and this field is promising. In three-phase induction regulators the secondary induced pressure is constant, the variation in resultant pressure (regulated) being obtained by an alteration of the phase angle between the applied and induced voltages. Where only two stations are interlinked there is not much objection to this method, but where more than two stations are concerned the phase angle thus introduced may lead to complications. Hence it is desirable to wind the regulator with its series winding in two halves, connected in reverse series. The resultant voltage is then in phase with the applied voltage.

Interlinking schemes are often required to be reversible. This simplifies the lay-out, as the plant at each end of the line can be in duplicate. However, the cost of the installation may be increased, and the requirement involves certain limitations. Where power is transmitted for considerable distances it is often desirable to instal regulating plant at each end of the line (each regulator half the total capacity), otherwise the voltage boost required by the regulator might bring the resultant voltage to a value too far above the nominal transmission voltage.

It appears that no regulators, either induction or step-by-step, have been developed for pressures above 11 000 V. In these circumstances regulators must be so connected as to operate by varying the pressure applied to the low-tension windings of the main transformers. This is feasible, but transformers required to give their full output over a range of primary voltage are larger and more expensive than those working at a fixed voltage. In the original Paper several alternative arrangements are illustrated.

Effect of Power-Factor Variation.

The power factor of transmission is important, since the capacities of the line, main transformers, and auxiliary apparatus, depend on it. Further (especially when the power factor of the normal connected loads on the interlinked power stations is different), it might happen that the station receiving power would find itself loaded with wattless kilovolt-amperes to such an extent as to neutralise the advantage anticipated from the interconnection.

Transmission from one station at unity power factor has some

* Abstract of a Paper read before the Institution of Electrical Engineers.

advantages. The capacity of line and transformers can be reduced and transmission losses are a minimum. The power factor at the second station is objectionably low. The excessive wattless component could be dealt with by a synchronous condenser, but its capital cost would not always be justified.

If synchronous condensers were installed, the most economical power factor of transmission would be unity. A small saving is obtained by their use, but they should only be installed when a substantial saving on the total cost of transmission could be effected.

Synchronising Power.

There are cases of interconnected alternating-current power stations where the synchronising power of the interconnecting line is not sufficient to produce satisfactory parallel running under the conditions of load fluctuation met with in practice. Trouble is unlikely to be experienced from this cause in the 33 000 V and higher voltage interconnection schemes to be laid down in this country in the near future.

It appears that the magnitude of the oscillations, and therefore the adequacy of the line from the point of view of satisfactory synchronous running, depends only on (*a*) the strength of the original desynchronising force, and (*b*) the synchronising power of the line.

The capacity of the stations would not, therefore, directly affect the magnitude of the oscillation. The authors are of the opinion that the adequacy of the synchronising power of a proposed interconnecting line should, if possible, be calculated theoretically before the line is installed, as the results of installing a line with inadequate synchronising power might be very costly.

Annual Exhibition of the Physical Society of London and the Optical Society.

(*Concluded from page* 99)

H. Tinsley & Company.

The exhibit of H. Tinsley & Company included several new instruments in addition to the apparatus already familiar to our readers. Among the novelties should be mentioned Shotter's integrator for flow meters, of which we hope to give a description at some later date. We also noticed an interesting design of disappearing filament pyrometer. This is a compact little instrument based on one developed by Messrs. Griffiths and Schofield, of the National Physical Laboratory, and made up complete with temperature indicator and rheostat so that it can be held in one hand, the cells being the only extraneous element. The special feature of

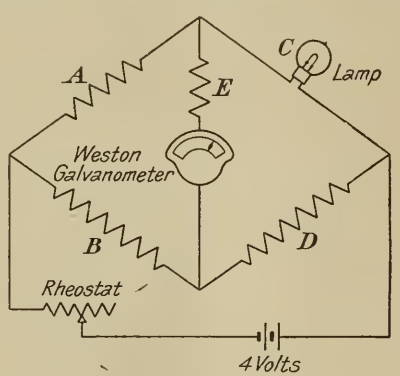


Fig. 21.—Diagram of Disappearing Filament Pyrometer.

the instrument is the arrangement of the electric circuits so that the lamp forms one arm of a bridge instead of being simply in series with a rheostat and a battery. Referring to Fig. 21, the arms A, B and D are of manganin, and the value of D is adjusted so that with the lamps running at some particular temperature, say 700°C, the bridge is balanced. The zero of the scale thus corresponds to 700°C. If now the current in the lamp is increased by adjusting the rheostat, thus increasing the current in all the arms of the bridge, the resistance of the lamp increases while the resistances A, B and D remain unchanged. There is then an out of balance current through the indicator, and consequently a deflection, which is a measure of the temperature. The resistance E is adjusted so that the upper end of the scale corresponds with the desired upper limit of temperature. This method has the great advantage that the range of temperature fills the whole length of the scale, whereas, if the indicator measures the current passing through the lamp then the temperature indications cover only a portion of the scale. This objection can be overcome by "setting back" the zero, but the controlling spring is then in a state of permanent strain. With the present arrangement the scale can be further extended by reversing the polarity of the battery. If the bridge is balanced at the mid-range point the deflections for temperatures below this value can, by reversing the battery, be made to be in the same direction across the scale as for those above this value. By this simple device the scale length becomes equivalent to 6 in.

A Low Frequency A.-C. Generator.

In some investigations it is necessary to have alternating current of very low frequency and of sine form. This is the case in investigating telegraph signals through long distance submarine cables. Apparatus for this purpose, however, is often not readily available, and therefore H. Tinsley & Company have produced a simple generator. This consists of a rheostat, over which a sliding contact travels through, being coupled to a rotating flywheel driven by a motor. A steady current is passed through the rheostat and thus a pure sine wave is obtained. By this means frequencies from 0·1 to 10 per second are possible. If higher frequencies are desired these can be obtained from slip rings fitted to the d. c. motor. The latter has been so designed as to eliminate harmonies.

A large inductance bridge for submarine cable investigations was also shown. The design is such that the lowest residual or resistance or impedance can be balanced out to a high degree of accuracy (to as many as 7 figures). Special attention is given to the time constants of the coils, and a compensated method of connection is used to maintain the inductance of the connections constant by having two separate studs for each coil.

Creed & Company, Ltd.

Messrs. Creed & Company exhibited their apparatus for high speed automatic printing telegraphy and gave demonstrations at intervals. Some of this apparatus was described fully in our columns a year ago. There was also exhibited a radio signalling key, which was primarily developed for the control of a 300 kW arc transmitter, as shown in Fig. 22, and diagrammatically in Fig. 23. The key, which is mainly pneumatic in its mechanism, is intended for control by an ordinary Wheatstone or other automatic transmitter or by a hand key. It is convenient to prepare the necessary, perforated paper tape for the control of the Wheatstone on a keyboard perforator, such as the Kleinschmidt. To those unfamiliar with ordinary line telegraph practice it may be explained that this is a machine resembling a typewriter which, on the depression of its keys, punches in a paper tape a series of holes grouped according to the characters of the Morse code. This tape is passed through and controls the Wheatstone transmitter, which is so arranged as to supply a small current in one direction until a signal is to be made, when the current is reversed for the duration of the signal. These currents in turn are passed to a Carpenter power relay A (Fig. 23), which operates the valve of a pneumatic engine C. This is known as the control engine. Reference to the diagram will show that this

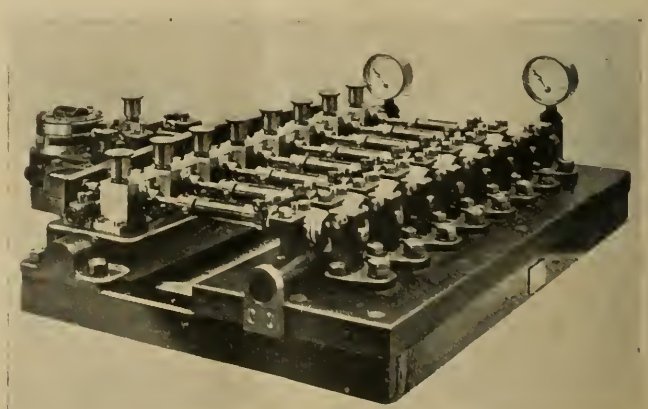


Fig. 22.—Signalling Key of 300 kW Arc Transmitter.

engine, through the medium of suitable link-work, is adapted to oscillate the rockshaft K. On this shaft are fitted saddle-pieces M to which are connected links operating the slide valves of a number of pneumatic engines P, as many as may be necessary for the power to be controlled, in this case eight. On insulated extensions of the

piston rods of these engines are mounted the silver-faced disc contacts R, which are thrust into contact with, or withdrawn from, the stationary adjustable contacts S. Beneath the row of contacts an air pipe, suitably slotted, introduces into the space between the opening contacts a ribbon-shaped draught of compressed air which cools the contacts, and helps to de-ionise the gaps. The de-ionising power of the silver contacts themselves is, however, mainly relied on, and provided the current to be broken is properly proportioned to the area of the contacts in use, much less flashing occurs in practice than might be expected. Moreover, the airblast required is of quite low pressure. It is found that, provided the current on contacts of the particular size fitted does not exceed 50 A, an air pressure of 14 in. of water is quite sufficient.

Perfect Synchronism Obtained.

It will be noted that the saddle-pieces M on the rockshaft are adjustable as to their angular position by means of their clamping screws. By this means it is possible to arrange for the contacts to open with almost perfect synchronism. The bias of the key may be adjusted by means of the buffer screws B B. Adjacent pairs of the moving contacts are connected together by laminated conductors, and corresponding pairs of the fixed contacts are connected to the ends of a single coil having mutual inductance with the A.T.I. The closing of the contacts reduces therefore the inductance of the A.T.I., thus altering the emitted wave-length.

The form of the key is such that any number of pairs of contacts appropriate to the power to be controlled may be used by the addition of extra pneumatic engines, and it will therefore be seen that there is practically no limit to the power for which keys can be built. The key shows good clear-cut signals at speeds up to about 120 words per minute Morse, with an air pressure of 2 kg per sq. cm. on the engines (28 lbs. per sq. in.)

This alteration of the emitted wave-length in order to effect the necessary signalling has been stated in the past to be more prone to cause interference with other stations than the method which utilises the complete starting and stopping of the oscillations in the aerial. It must be borne in mind, however, that extremely sensitive means of discrimination between the oscillations of different wave lengths exist, and that a very small percentage change in frequency is all that is necessary to effect signalling where a spacing wave is

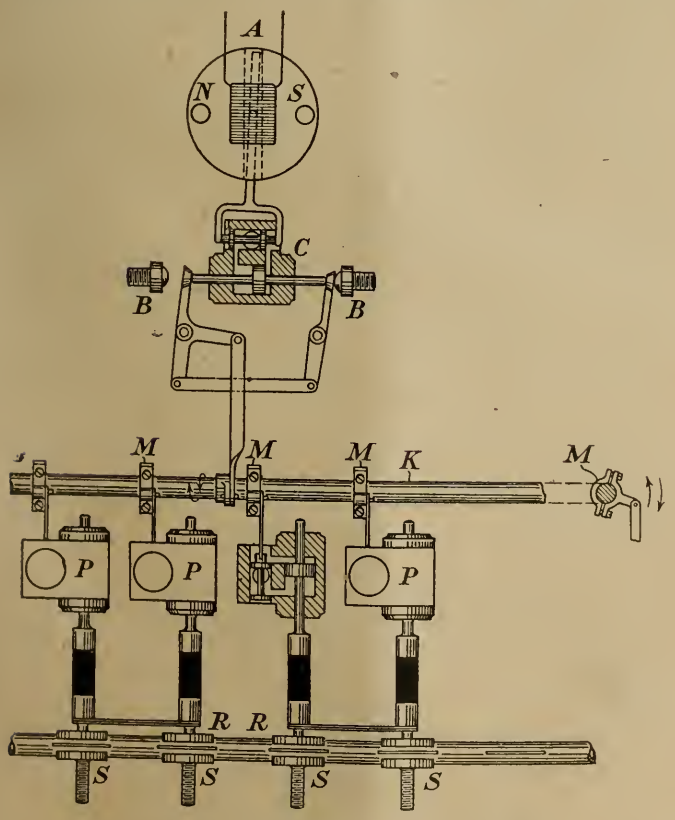


Fig. 23.—Diagram of Signalling Key.

permitted. If, however, it is desired to start and stop the oscillations in the aerial completely to effect signalling, it will be seen that at high telegraphic speeds and long wave lengths, the rate of growth and decay of the oscillations must be high, and it is clear that this high decrement radiation will give rise to serious jamming. It would seem that so far as high speed, long wave stations are concerned the change of frequency method of signalling is actually to be preferred to the other.

R. W. Paul.

Mr. R. W. Paul showed a beautiful piece of work in the form of a standard of mutual inductance. The design of this standard, evaluated from its geometrical dimensions, is due to Mr. Albert Campbell; special care has been directed to permanence and ease of setting up. The general construction can be seen from Fig. 24. The primary is of bare wire wound in a screw thread cut in a marble

Fig. 24.—A New Standard Mutual Inductance.

cylinder, and has two equal sections, each of a single layer, with a space between their inner ends. The secondary is a multi-layered coil wound in a groove in a marble ring; this surrounds the cylinder, and is adjustable both axially and radially in relation to the latter. It is set midway between the two primary helices, and has a mean diameter such that the field due to the helices is zero at the mean circumference; thus, for a given displacement from the correct position the change of mutual inductance is a minimum. Curves were exhibited showing variations of diameter and pitch of the primary as measured by the National Physical Laboratory. Calculated curves were also shown giving the consequent variations of mutual inductance. The resulting calculated value of the standard is $10{\cdot}0071_9$ millihenries.

Weston Electrical Instrument Company.

The Weston Electrical Instrument Company had a large exhibit of their well-known instruments. A new type of high frequency measuring instrument has been introduced, consisting of a thermo-couple embedded in a heating element, the couple being connected to a Weston d.c. permanent magnet moving coil galvanometer mounted in the same case. The indications are not affected by changes in frequency, and an overload of 50 per cent. is permissible. These instruments are made for various ranges, from 125 mA up to 750 A. The greater part of the scale is very open, and the accuracy is guaranteed to be within 1 per cent. For ranges above 100 A external heating elements are provided. The instrument can be checked by d.c. current, and the indications are not affected by changes in room temperature, compensation being provided. Galvanometers are also supplied, having scales uniformly divided so that the indications are proportional to the square of the current, such instruments being useful on wavemeters and in decrement measurements.

A new model a.c. and d.c. dynamometer type voltmeter, ammeter, and wattmeter has been introduced. These are guaranteed to an accuracy of $\frac{1}{10}$th per cent. on full scale deflection.

The Edison Swan Electric Company.

The Edison Swan Company showed some remarkable Pointolite incandescent lamps, the largest being of 10 000 c.p., and the next smaller size 4 000 c.p. They are intended for use in projectors where arc lamps have hitherto been used. Small Pointolite lamps, filled with argon, have been developed for portable sets combined with a 32 V battery. For photographic purposes lamps are arranged with a series resistance which can be short-circuited at

the moment of exposure, so that in the case of a 100 c.p. lamp the candle power for this short period is increased about three times and the life of the lamp is much prolonged. A cylindrical glass deflector is now sometimes fused into the top of the bulb so as to restrict the convection currents, and by this means a large increase in the life of the lamp is obtained. For use on a.c. circuits a mercury or other rectifier is fitted. We also noticed ordinary vacuum lamps having the bulbs so tinted that a fair approximation to daylight is obtained.

Gambrell Brothers.

At the stand of Gambrell Brothers much interest was shown in the variations of resistance of the human hand. Moistened electrodes were fixed to the back and palm of the hand, and the resistance was balanced so as to bring the spot of light to the centre of the scale. A slight mental shock to the patient (for example, a sudden and unexpected movement by the operator) usually produced a marked lowering of the resistance, with a pronounced time lag. The phenomenon was shown recently at the Royal Institution by Dr. Waller. The hand seems to be particularly susceptible in this respect, the effect not being necessarily obtained with other parts of the body.

Another item of interest on this stand was a new transmitter for wireless telephony. In most transmitters the aerial is oscillating continually, the modulating valve absorbing energy. This, of course, wastes power, and the valves, being continually fully loaded, get very hot and have a short life. In the present pattern there is practically no current in the aerial till the microphone is spoken into, when there are very large increases in the aerial current strictly in accordance with the speech waves. The microphone controls, but does not carry, the high tension current to the plate of the oscillating valve. The normal current from the generator is very small, but increases in conformity with the speech waves in the microphone. The advantage of this system, apart from saving in power and increased life of valves, is that the aerial radiation increases from an extremely low normal to large values during speech, thus minimising interference with other stations. We understand that speech is transmitted excellently, and that the instrument is very suitable for duplex working.

Isenthal & Company.

Electrostatic instruments to the design of Mr. G. L. Addenbrooke were exhibited by Isenthal & Company. These included an electrostatic wattmeter similar to the instrument which has been described in connection with Mr. Addenbrooke's work. With 200 V on the needle and one volt between the quadrants the deflection is equivalent to 2 000 mm. at 2 metres scale distance. Thus, at ordinary power factors, a reading of 200 mm. is obtained for a drop of 0·1 V between the quadrants. This sensitiveness can be doubled or even quadrupled for special purposes. The instrument can be used to measure the loss in condensers of 0·001 mfd. and at very low power factors.

We also noticed on this stand Zehnder accumulator batteries which are suitable for high voltages.

Miscellaneous Exhibits.

A large exhibit of potentiometers and measuring instruments was shown by Crompton & Company. The moving system of this firm's moving coil instruments has been designed with a view to easy removal, so that repairs can be readily effected. The moving coil and moving iron instruments are now identical in appearance and the connection studs are equally spaced in all sizes so as to facilitate interchange on switchboards.

Many interesting instruments were shown by John J. Griffin & Sons, Ltd., for laboratory work. We noticed particularly a subdivided wire wound megohm (ten equal coils) at a reasonable price. This firm's gyrostats were a source of popular interest.

Light Signals in Night Flying.

Speaking before the Illuminating Engineering Society last week, Lieut.-Col. L. F. Blandy described the illumination of the interior of the rigid commercial airship R. 36, which is carried out with ordinary 12 V metal filament incandescent lamps, the current being derived from five generators, one in each of the engine cars. He said that in the D.H. 34—one of the most modern British heavier-than-air machines for passenger traffic which would be flying this year—similar provision had been made for internal lighting. Difficulty had been found in obtaining the correct formula for the tinting of the coloured glasses. The usual signal red and signal green, manufactured to existing formulæ, did not give a satisfactory signal colour when high intensity filaments were used. The Board of Trade and the Air Ministry Research Department were now working in conjunction to determine satisfactory formulæ. Colonel Blandy described the various forms of illumination used to facilitate the landing of aircraft at night, and referred to a device with which the Research Department was experimenting—a high-power 12 V lamp which would withstand landing shocks. The weight of the complete lamp, he said, was 7 lbs., and it functioned from either the engine-starting accumulator or the general service battery.

The Institution of Electrical Engineers.

Electrical engineers who inhabit the Strand and City areas, among them the staff of The Electrician, felt it peculiarly appropriate that the Institution of Electrical Engineers should have devoted Thursday evening, Feb. 2, to a discussion on the interconnection of power stations, or, as some speakers preferred to call it, the interconnection of networks. The breakdown at the Bow Station of the Charing Cross, West End and City Electricity Supply Company is the reason, and this, perhaps, also explained why, in spite of the inclement weather, there was such a good attendance. It is to be feared they were not rewarded by a discussion of outstanding merit.

After the Paper, an account of which will be found on another page of this issue, had been read in abstract the President said that after the four names on his list had been exhausted he hoped the discussion would develop on more informal lines, and that they would see four or five gentlemen jumping to their feet at once, as was usual on Monday nights of the Institution.

Mechanical Causes Fundamental.

Mr. P. V. Hunter, in opening the formal discussion, said the essential point to recognise in any interconnection scheme was that the energy was entirely controlled by the steam side. Phase swinging for instance was purely due to mechanical causes. To interconnect stations with voltages that were constant and equal must be unsatisfactory, because the station supplying the energy did not supply the wattless current. Of the three types of regulator described by the authors he preferred the induction type, though it might be more expensive to instal. He objected to the title of the Paper because it was usually the networks that were interconnected and not the power stations, and the tables given in the Paper seemed to admit it. The arrangement shown in the Paper for the connection of two stations both generating at 6 000 V and using a transmission voltage of 33 000 V would, he felt, be the final practical solution.

The Voltage the Determining Factor.

Mr. F. H. Clough pointed out that the wattless component depended not on the steam end, but on the voltage. When one station was supplied by another, the former often required power on the inductive as well as on the energy side. To determine the voltage required to transmit energy meant the usual problem of calculating alternating current in an inductive circuit. That was dealt with more conveniently by using imaginary than trigonometrical quantities. If two stations were connected together through a low reactance the total capacity might be beyond the capacity of the switches at either of the stations.

Some Earthing Problems.

Mr. H. Brazil said that Mr. J. S. Peck, in the Paper he had read before the Institution in 1916, had suggested several methods of earthing the neutral points of interconnected systems, and the discussion on the Paper had favoured the method of placing reactance or resistance in circuit with the neutral point at each station. Opinions since that date had favoured the use of resistance rather than reactance. Too little notice had been taken of the loss due to earth currents between the neutrals. Mr. Peck in the Paper he had read in 1912 on earthing resistances had taken the view that this loss was not of any great importance. He (Mr. Brazil) gave figures which conflicted with that view. The ideal was to have a resistance which would reduce the circulating current to a very small figure and yet allow the full current to pass when a fault occurred.

Some Practical Points.

Mr. J. M. Donaldson said it was desirable to run such stations as Brimsdown and Willesden of the North Metropolitan Company in parallel, as that might allow the plant to be operated in an economical manner. The question of running plant load factor had a considerable influence on the running costs, far more than the load factor of supply. Another obvious advantage was that one power station could assist the other in event of trouble, though that advantage was counteracted to some extent by the fact that serious breakdown at one station might upset the whole of the network. In the case of the North Metropolitan system, they had come to the conclusion that the limiting feature was the ratio of the reactive resistance of the whole circuit. Any reactance that was inserted should be put in in the centre of the system, and not at one end, or both ends. The voltage was controlled from one or other of the power stations and all the other stations had to regulate their plant so that their power factor was about what it would normally be when they were doing their share. The current was interchanged only at the centre of the system, but with power stations that were interconnected, and specially with power stations which belonged to different undertakings, it would be as well to have an independent means of adjusting the voltage. Induction regulators, at least those of the three-phase type, were not made

in this country. They had an awkward phase angle which complicated matters, and he would, therefore, like to see their use ruled out. Variations of the tapping system patented by Mr. Berry, appealed to him as being a more satisfactory method.

End of the Formal Discussion.

This concluded the formal discussion and the PRESIDENT then invited informal speakers. Only two, Mr. G. W. Partridge and Mr. A. R. Everest responded, and they did so without any of that eagerness the President desired, both of them pointing out that it was only the informal character of the proceedings that induced them to rise at all.

Two Different Sorts of Interconnections.

Mr. G. W. PARTRIDGE said that there were two sorts of interconnected systems, one with power stations at a great distance apart and the other with power stations close together, as in London and Chicago. In the latter case, enormous short circuit currents might have to be dealt with at any time. In the first case, chances could be taken; but in the second, arrangements must be made so that if anything went wrong the system could be automatically subdivided by means of reactances or special switches. At Deptford they had no difficulty in running in parallel with the power station at Greenwich, the load being adjusted by means of the excitation. The power factor varied from 0·85 to 0·97 and from 5 000 to 6 000 kW was transferred as and when required. The reactance should never be less than the resistance, and he was inclined to agree that, in general, the induction regulator was the best to employ. He had had the same trouble with the automatic booster as had been described by the authors.

Mr. A. R. EVEREST remarked that the Paper clearly brought out a point of fundamental importance, that if two stations were interconnected at equal voltage the only exchange current passing was a leading current. If the station carrying the load only took leading current obviously the lagging current must be obtained elsewhere, which meant very heavy lagging loads on the machine. It was for this reason it was not practicable to run with equal voltages.

The Author's Replies.

Mr. J. B. PALMER, in reply, said that he was not clear as to the point made by Mr. Clough, about the receiving station having to carry the wattless component of the other station. Stations usually obtained all the wattless components they could deal with. With regard to Mr. Brazil's remarks, he thought that the Board of Trade regulation which prohibited the earthing of a system in more than one place would have to be altered. The Pacific Gas & Electric Light Company had about one hundred and sixty earths on their high-tension system without any trouble from inductive interference.

Mr. L. ROMERO, who also replied, did not agree with Mr. Hunter's statement that phase-swinging was only due to mechanical causes. Any de-synchronising force, such as a sudden increase of load, would cause swinging if the synchronising power of the line was inadequate. (Mr. HUNTER intervened to point out that an increase of load was a mechanical disturbing force, and was not primarily due to electrical phenomena.) To run with equal voltages might be a good plan in some cases and would, at any rate, save complication in boosting apparatus. A disadvantage would be that the receiving stations would always have to supply the extra wattless current.

During the course of Mr. Romero's reply the President announced that a certain member was urgently wanted on the telephone. About a dozen gentlemen occupying the back seats immediately left the room. Was this guilty conscience?

German Competition in Belgium.

There is an increasing demand for domestic electrical apparatus, motors, and electric lighting fixtures in BELGIUM, but serious complaints are being made of German competition at very low prices. The figures for German dynamos and motors are said to be 50 per cent. below American, and 20 per cent. under Belgian quotations. Metal filament lamps are largely imported from Holland, but some come from Germany, while France, Switzerland and Italy export electric heating and cooking appliances. A large Belgian lamp factory is to be erected by some Belgian and American firms in order to oust the foreign lamps. With the rapid extension of electric supply undertakings the demand for all electrical goods is likely to be maintained.

The BELGIAN bureaucrat seems to be remarkably like his British confrère—very slow and ineffective in action. It appears that it is within the province of the Ministry of the Interior to authorise changes in the price of electricity and gas. The Union des Villes et des Communes demand the suppression of the Government Committees who deal with the matter and the creation of an arbitration committee, composed of one representative of the supply company and one of the commune, with a third to be appointed by the Government or the other two members.

Correspondence.

HYDRO-ELECTRIC DEVELOPMENT.

To the Editor of THE ELECTRICIAN.

SIR,—In the "Notes of the Week" of your last issue you refer to certain hydro-electric problems, your comments on which appear to some of us to be somewhat misleading.

It is questioned whether our engineers are quite ready to begin the development of water power in Great Britain, on technical grounds. This idea has a certain degree of currency, which it is believed rests on quite an inadequate foundation, and has, in fact, done the engineers of this country considerable harm in the past, and is likely to become accentuated in the future, if efforts are not directed towards exposing this fallacy. It is unfortunate to find this repetition in one of our leading technical journals.

British engineers are rather forced to hide their light under a bushel for fear of the appearance of self-advertisement, which is not the case with some well-known engineers in other countries. This has tended towards certain important large hydro-electric installations being placed in the hands of foreign engineers in British Dependencies; and there appears even to be a tendency to invite their invasion of this country itself. That there is, in fact, no necessity for this attitude is evinced by the successful installations which have been put up in this country, in our Colonies, and abroad, in the past, under British supervision.

There is no doubt that we have a sufficient number of engineers experienced in hydro-electric work, capable of handling all projects of this nature in the Empire.

In another Note you refer to the shortage last year of electricity in Europe from hydro-electric installations on account of the drought. No doubt risks are run unwittingly where rainfall records are incomplete, but in many cases it is merely a question as to whether the cost of impounding sufficient water is justified financially. The broad facts are, that the driest year has a rainfall about 40 per cent. less than the average, and the three driest consecutive years each has 30 per cent. less than the average. In many instances cheap power is of more consequence than the remote risk of shortage of supply. Whether a standby of impounded water or a steam plant is desirable, depends on financial and local geographical considerations in each case, and the necessity or otherwise of an absolutely reliable supply. I am, &c.

London, S.W., Feb. 6th. F. BOLTON.

ELECTRICAL versus MECHANICAL ENGINEERS.

To the Editor of THE ELECTRICIAN.

SIR,—With reference to your article, also the correspondence, in THE ELECTRICIAN of the 27th inst. Is it really a question whether the "mechanical" or the "electrical" shall be "top dog" upon a railway or any other engineering concern? Is it not rather that the man shall be an "engineer"? For it appears to me that, to-day, the man who aspires to be an engineer, apart from civil engineering, is sorely lacking in essential qualifications unless he is well qualified both mechanically and electrically. An engineer will, of course, specialise as he progresses in life, but this would not cause him to show bias to either side. He will judge as an engineer, not as a "mechanical" or as an "electrical." There must be a "chief"; and he must be qualified to treat all branches of work upon its merits.

We have, unfortunately, a large number of men in the electrical world who are labouring under the misfortune of having no mechanical training or knowledge. To these the electrical industry owes many misfortunes.—I am, &c.,

WILLIAM B. PINCHING, A.M.I.E.E.

Winchmore Hill, N. 21, Feb. 6.

[We should be pleased to have other opinions on the point raised in our recent Editorial Notes.—ED. *E.*]

THE "REVO" ELECTRIC IRON.

To the Editor of THE ELECTRICIAN.

SIR,—As manufacturers of "Revo" Electric Irons we are particularly interested in the letter in your correspondence column over the name Wm. B. Scourfield. In reply, we confirm that the iron in question was correctly rated and that the testimonial referred to was an unsolicited one.

It is news to us that "all the heating and cooking appliance manufacturers of the world, aided by all the resources of modern science, have striven for, and failed to achieve" a loading of "64 W per sq. in." This has not been our ambition. Instead we have made it our aim to produce articles that besides doing their work satisfactorily will withstand a reasonable amount of rough use, and in this we claim to have been successful. In spite of your correspondent's remarks quoted above, several manufacturers have for years made and used successfully elements for 64 W per sq. in. and more.

Your correspondent is "tempted to enquire what the thermal efficiency of the iron would be." He bases his figures on a presumed

loading which is incorrect, and assumes a radiating area which is also incorrect. Might we suggest that Mr. Scourfield gets his information right before rushing into print. If your correspondent had considered for a moment he would have realised that an electric iron is never in use continuously; further, modern electric irons are frequently given a high loading for quick heating, and so that heavy damp work can be done; consequently, when the same iron is doing light work the current is only used part time—in fact your correspondent might have "presumed" that the current would be switched off sometime before the iron became red hot to allow ironing to be proceeded with.

Regarding the "adaptability of electric irons on *any* circuit, no matter what the voltage," we do not think it is necessary to explain in a technical journal that an electrical appliance should be used on a circuit of the correct voltage. The fact that a "Revo" iron intended for use on a 100 V circuit was used as a 200 V iron and withstood the "test" for a considerable time, as vouched for by an independent witness, will be satisfactory evidence to the majority of your readers, if not to Mr. Scourfield, that the appliance in question was built on substantial lines, and it is only because the iron was incorrectly used that there is anything remarkable in the incident. A manufacturer cannot always find out what treatment his products get, but when he hears of their being used in an abnormal and absurd manner and standing up to it, then, even if a sense of humour is lacking, there is some satisfaction in having produced a sturdy British article.

A little time ago we received another unsolicited testimonial regarding an iron similar to the one referred to above. This had been forgotten and left on circuit all night; in the morning it was found that the iron had burnt its way through a table—carpet and part of the floor. The iron was dropped into a bucketful of water, but after drying out the element and insulation were perfect.

In case your correspondent has missed the point of this also, we mention that the incident shows that a modern well-constructed iron like the "Revo" will withstand more than a little ill usage, but it is not our intention to recommend the "adaptability" of electric irons for other purposes than ironing.

In conclusion, we may say the originals of either of the testimonials referred to may be seen on application.—We are, &c.,

Tipton, Staffs. The Cable Accessories Company, Ltd,
February 6. P. W. Davis (Engineer).

North Lancashire Electricity Inquiry.

On the 1st inst., when the inquiry was resumed into the scheme for the reorganisaton of electricty supply in the North Lancashire and South Cumberland Electricity District,

Sir John Snell said he was sorry that, owing to bronchitis, he would not be able to continue to preside, and Mr. H. Booth would conduct the inquiry.

Mr H. R. Burnett, secretary to the North Lancashire and South Cumberland Joint Committee, said Barrow Corporation had agreed that Ulverston and Dalton were as far as they considered they could go with regard to area, but now they were opposing the whole scheme. There was a demand for cheap current in outlying districts, and the only hope for the scheme was for the whole district to come in. He was satisfied that a better scheme could not be devised than one that would take in the whole area. It was in the interests of the public that the whole of the generating stations in the area, and the mills and industries of those places, should be under one common scheme. The advantage of keeping the area in one was important, in view of the fact that they might take over Messrs. Vickers' plant at Cavendish Park, and also the Projectile Factory at Lancaster.

In cross-examination, Mr. Burnett said there was no reason why towns so far apart as Barrow and Lancaster should not be in one scheme, but the co-operation of Barrow was essential for success. Messrs. Vickers wanted £450 000 in 6 per cent. bonds for their station, but the Vickers' plant could meet the whole of Barrow's requirements at a cheaper rate than a Joint Committee could supply.

Railway Electrification.

On the 2nd inst., Mr. Burnett was examined as to the position of Morecambe and Heysham. He thought the question of railway electrification would not arise until after 1925, but there was a prospect that it would be considered before 1930, and, if so, current could be obtained from the transmission line en route. He did not agree that the scheme was unworkable as far as Kendal was considered, but the demand for current in the Kendal district was so small that a separate generating station was not thought necessary. He was agreeable to Windermere, Ambleside and Grasmere Urban Councils being left out of the scheme, but the committee desired to include these areas. The Lunesdale, South Westmorland and Ulverston rural districts were not important from a supply point of view, and he did not mind them being also excluded, if they desired.

Councillor T. Morton, a member of the Barrow Electricity Committee, said Barrow had decided against the scheme until they could get Government assistance. They had also decided that the Barrow plant should be taken over and compensation allowed for it. The Council had considered an alternative scheme, which would include Barrow, Dalton, Ulverston and certain rural parts of the Ulverston district. The supply for this smaller area could be produced at Barrow, and by arrangement they could also draw upon Messrs. Vickers' power-house.

Mr. S. E. Britton, City Electrical Engineer of Chester, said he had inspected the area of the Joint Committee's scheme, and thought the estimated expenditure was too low. He also considered that Barrow Corporation would be penalised financially under the schemes.

Questions of Area.

The inquiry was concluded on Friday, Mr. H. Booth being in the chair. Mr. A. Page attended as second commissioner.

Mr. Eastham announced that at a conference of parties representing the Windermere, Grasmere and Ambleside districts, an agreement had been arrived at to come into the suggested district if it was to be one area, but they had decided to remain outside the scheme until such time as they could derive any benefit from it. They would be put under no financial obligation, but if at any time it could be shown that they would benefit, then terms could be arranged with the Joint Electricity Committee or Board. The Windermere, Ambleside and Grasmere urban districts were willing, and also the Windermere and District Electricity Supply Company to contribute five guineas each each year to the Joint Electricity Authority, and they would be represented on the authority. The Lunesdale, South Westmorland and rural districts of Ulverston took up the same attitude, with the same contribution if it was one area, but if the area was split then Lancaster and Lunesdale would desire to be in a Lancaster area.

Mr. Kennedy proceeded with his cross-examination of Mr. S. E. Britton, who had given evidence on behalf of Barrow Corporation against the scheme. The witness did not agree with many of the figures in the scheme as it affected Barrow, and replying to Mr. Page, he said he had been struck with the large areas in the Joint Committee's scheme where no supply would be required.

The Chairman said he understood that in the whole scheme Barrow would not be charged with any transmission main past Backbarrow.

Mr. Kennedy said that was so, and Mr. Procter said that Kendal quite understood that.

Mr. Wooll, for Barrow Corporation, said the main objection of Barrow was to be included in the area, but another objection was that Barrow did not want to lose control of its plant. The Barrow proposal to include Ulverston and Dalton was not a piece of mere window dressing. Without Barrow no general scheme could go on.

Mr. Procter said Kendal had agreed to take up the same position as the Windermere group, and contribute five guineas to the administration costs. If the new scheme would represent a cheaper supply then Kendal would would come in. In the meantime they would be represented on the Joint Committee.

Mr. Alfred Taylor, on behalf of the London and North-Western, the Midland and the Furness Railways, said the immediate or early electrification of any part of the railway systems was not very probable. There were no plans for such electrification, and, judging by the present traffic, the capital cost would not be justified. The policy of the railways was to purchase supply in the cheapest market, whether from a Joint Committee or a private firm.

Major G. C. Milnes, electrical engineer of Lancaster, said he did not think there was any justification for including the Lancaster district in the scheme. For the purely local demand their own supply was sufficient.

Mr. J. Abady opposed the Committee's scheme on behalf of Millom and Bootle, and said Millom desired powers of its own to supply electricity; and Mr. H. Kirby, secretary of the Millom and Askham Hematite Iron Company, said there were gases at their furnaces which could be utilised.

After evidence by Mr. G. H. Cheetham and Mr. W. Lewthwaite against South Cumberland's inclusion, the inquiry was concluded.

Forty Years Ago.

(The Electrician, Feb. 11, 1882.)

Coalition.—The Ripon Town Council have been invited by the Birmingham Town Council to join them in protecting the interests of the corporations having gas works under their control against the Electric Lighting Bills.

The Telegraph and the Arabs.—In a lecture delivered recently before the Victoria Institute Mr. Rassam explained the Arab word "Tel" means "wire," and "Araph" "to know" or "expound"; hence "to know by wire" or "obtain knowledge by wire" is the Arab's explanation of the use of the telegraph.

The City Commissioners of Sewers.—At the first meeting of the newly-appointed commissioners, Mr. Felton, the chairman for this year, said that, "with regard to the electric lighting, he hoped that by the end of the year they would have extended it to all the principal thoroughfares in the east and west districts of the City."

Water Power and Electric Lighting.—It is stated that M Lortet, of Lyons, France, has made a preliminary trial of a system of generating electricity for lighting the house belonging to the Faculty of Medicine in that town by means of water wheels driven by the current of the Rhone. It is also stated that he is endeavouring to obtain permission from the authorities to enable him to permanently establish this system of obtaining power for electric light purposes.

The Electrical Wholesalers' Federation.

The annual dinner of the ELECTRICAL WHOLESALERS' FEDERATION was held at the Trocadero Restaurant, London, on Thursday, Feb. 2, under the chairmanship of Mr. H. Bowden-How.

The Need of Closer Co-operation.

Mr. R. ALBRECHT, in proposing the toast of the "Kindred Associations," said that the first few years of the Electrical Wholesalers' Federation's existence had been spent in settling the principles of living and working. They were now able to take stock, and were conscious that out of individual weakness had come co-operative strength. But the added sense of responsibility had brought the discovery that they were only a cog in a large machine. They had sought to get into closer touch with the other electrical associations, and most of their work had been in the direction of the B.E.A.M.A., though there they had made little progress. Now they asked for a lead which would help to bring the two associations more into harmony. Failing a proper selling organisation the manufacturers had organised something for themselves. But the duty of the factor and contractor was to build up better organisation than the manufacturers, and the manufacturers would then be only too pleased to come into line. This was the first step towards betterment of trading conditions.

Mr. Dunlop on the Electrical Industry.

Mr. D. N. DUNLOP, in reply, said that the initial experiences of the B.E.A.M.A. had been very similar to those of the Electrical Wholesalers' Federation. Many complications had to be met before the electrical industry could be placed on a level with similar industries in the United States and Germany. They had to face cartels and price cutting, which affected every branch of the industry, and their first work, therefore, was to make the whole body more healthy, and to establish the different branches of the industry in a position where it could pay decent wages and have something left over for research. In doing this they had come up against certain prejudices and difficulties, owing not a little to the multiplicity of articles with which they dealt. Now, however, their endeavours had been partly successful, and there were committees co-operating with all the other bodies in the industry.

The Reticence of the B.E.A.M.A.

It was obvious that a national industry could not be built up on losses, but efforts to obtain profits and reasonable conditions of contract had met with opposition. The B.E.A.M.A. had often been criticised for its reticence, but in such negotiations as he had mentioned secret diplomacy was necessary. A drawback to closer relationship was the national characteristic of individualism. But there were many points upon which they could co-operate, and at any rate the industry must not be allowed to get into so decrepit a state that it would have to be subsidised. Manufacturers should not have selling organisations, but should arrange with wholesalers and contractors to work for them, except for the largest products. Every contractors' window should be a display of the manufacturers' goods, so that in the end there was no opening for foreign products.

How to Brighten the Future.

He thought they must recognise they would have to face competition from foreign countries working with an exchange in their favour at full speed, and flooding the English market with cheap goods at a price at which, to give labour a decent living wage, we could not afford to sell. No manufacturer wanted to cut down labour charges, but if he was faced with competition from abroad at prices at which he could not afford to make, he could not go on without assistance from all those concerned. Some way must be found out of these difficulties. We were not going to shut up shop, but every branch of the industry must work to get all the advantages, and none of the disadvantages, of co-operation. With the help of the Press and the backing of the Electrical Wholesalers' Federation and other associations they should be able to stabilise the home market, increase production, and fight this competition. Help was wanted to solve the problems which alone would make the electrical industry of Great Britain second to none in the world.

The Gasfilled Lamp Case.

Mr. J. Y. FLETCHER, who also responded to this toast, said that the gasfilled lamp case had not been fought to bind the Electrical Wholesalers' Federation, but to enable further agreements to be made in their favour. The result of this case gave a reasonable chance of business in legitimate markets. The lamp market made it easy to have a factoring policy, and that was the permanent policy of the Electrical Lamp Manufacturers' Association. The E.L.M.A. was also wedded to a contractors' policy, and they had entered into satisfactory arrangements with both the Electrical Contractors' Association and Electrical Wholesalers' Federation to everyone's benefit.

Co-operation with Labour.

Mr. J. MCGREGOR, in supporting the toast, said that the Cable Makers' Association had started a general industrial council to solve labour troubles, and it had solved them. From that had grown the idea of bringing in every branch of the industry into those councils. He agreed that existing difficulties could only be solved by bringing parties together round the table. Such co-operation was necessary for mutual defence and support.

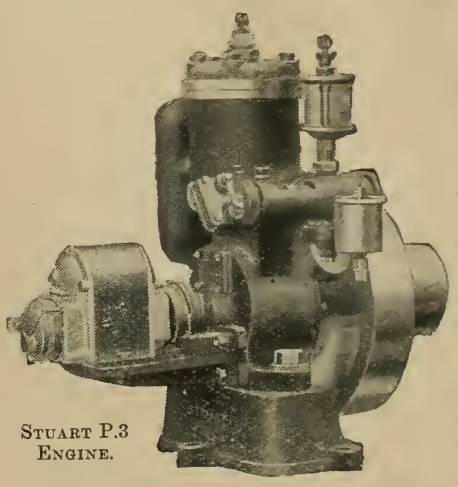
The toast was also supported by Mr. L. G. TATE, who said the contractors wished to get into closer touch with other bodies of the electrical industry, and Mr J. W. BEAUCHAMP, who said that a sort of reservoir was required between manufacturer and user, so that the manufacturer could pump out his product continuously and the user take it as he required. The wholesalers should be able to fulfil this useful function. In England the ideal to work for was a reasonable percentage of co-operation on top of the national initiative.

In the course of the evening a presentation was made to Mr. A. G. Beaver, the late general secretary of the Association, of a handsome silver tea and coffee service and tray, with a cheque for £100, as a mark of the appreciation of the members for the work he had conducted in initiating and organising the Association.

Farmhouse Lighting Plant.

Owing to the convenience and economy of electric lighting the demand for small independent lighting plants for farmhouses and isolated country houses is increasing steadily. Though several firms cater for this class of business there is probably no firm who have made a closer study of the subject, and who have such wide experience of farmhouse requirements as STUART TURNER, engineers, of Henley-on-Thames. Consequently the firm claim that their "Stuart" electric light plant is one of the best on the market. The plant is made in three sizes to meet varying requirements.

The ½ kW plant is designed for any house or farm using up to a maximum 900 c.p., or say thirty-30 c.p. lamps. The standard voltage (25) permits the use of gasfilled lamps of moderate size in the living rooms, whilst for passages and offices quite small metallic filament lamps may be employed. It is claimed that a plant of this size has ample capacity for the suggested output, and the cost of fuel and oil is rather less than that of gas light. The ½ kW plant will give all the conveniences of abundant electric light at a very moderate cost, and fans and small motors are quite within its capacity. For those who wish to do heating and cooking by electricity the firm supply larger sets of 1½ and 3 kW. The plant is claimed to be as near fool-proof as well designed and constructed machinery can be.



STUART P.3 ENGINE.

The engine is rated at 1 H.P., with bore 2¼ in. and stroke 2¼ in. It is of the two-stroke three-port type and has no valves, tappets or valve gear to get out of order.

The engine is completely enclosed and gas tight, cannot leak or throw oil about. It will run equally well on petrol, benzol or gas. The firm also manufacture the F.S. 1 (1½ kW) and F.S. 2 (3 kW) lighting sets.

Patent Reversible Toaster.

The "Universal" patent reversible toaster, which we illustrate, entirely obviates the necessity of touching the bread. It is merely necessary to touch a tiny lever and the bread rack automatically

"UNIVERSAL" REVERSIBLE TOASTER.

reverses, so that both sides can be toasted without handling. The rack has a half-way position, which is handy for removing the toast when finished. The consumption is only 340 W. This "Universal" appliance is supplied by L. G. HAWKINS.

Legal Intelligence.

An Electrician's Fraud.

Last week an electrician was sent to prison for four months by the Liverpool Stipendiary, for stealing two sums—£7 5s. and £5 5s., which had been entrusted to him to pay a lighting deposit to the Liverpool Corporation. It was stated that in January, 1920, a local draper employed defendant to wire his premises, paying him for the work. Three months after a sum of £7 5s. was paid to him to obtain a meter from the Corporation electric lighting department and to pay the lighting deposit. He was also given a further £5 5s. to perform a similar service for another consumer. The stipendiary described the case as one of gross and deliberate fraud.

Re Cordoba Light, Power and Traction Company.

On Tuesday Mr. Justice Astbury sanctioned a scheme of arrangement between the Cordoba Light, Power & Traction Company, Ltd., and its debenture stockholders, loan creditors who held promissory notes, and the preference shareholders. Mr. Jenkins, K.C. (for the company), said it was a sound undertaking, but it had been hampered of late years by reason of the increase in the cost of materials. It was formed in 1908 for carrying on in Cordoba and the Argentine an electric power undertaking and the operating of tramways. It acquired the undertaking by purchasing the shares of two companies, one registered in the United States and the other in the Argentine. The present authorised share capital was £1 000 000 in £1 shares. The company had carried on business very successfully. It had to spend its cash on its undertaking, and there was a sum of £106 205 standing to undivided profits account. It had performed all its obligations and it paid its preference dividend down to Sept. 30, 1915. Since then, although making large profits, the company had had to use its cash in other directions, and there were six years' arrears of the preference dividend, amounting to £75 000. In order to put the company on a sound basis the scheme of arrangement had been prepared.

Licence Duty on Tramway Repair Wagons.

In the Falkirk Sheriff Court, last week, the Falkirk and District Tramways Company were summoned by Stirling County Council for having, on June 6 last, used a motor tower-repair wagon for which a licence was not in force. The Council maintained that the duty payable on the vehicle was £25, but the company contended that they were not bound to pay more than 5s., as the vehicle came under the category of a tractor carrying only its own gear, and used solely for repair purposes, and not for commercial purposes.

Mr. D. Hays, the manager of the Tramways Company, admitted that the company had no licence for the vehicle. Through an oversight the 5s. duty which was due had not been paid at the time; but as the County Council demanded £25 for a licence the case was considered one of considerable importance, and pending a legal decision no tender was made. Glasgow Corporation, who possessed several vehicles similar to the one owned by the company, had refused to pay the higher licence.

The Procurator-Fiscal argued that the case depended entirely on the interpretation of the Finance Act and the Roads Act of 1920, and the vehicle was one for which a £25 licence should be taken out.

Sheriff Robertson said the question was one for the High Court, and should be settled by judgment there. It would be better to have the question settled by a special case to the Court of Exchequer or something of that kind. There was no question, however, that the company ought to have had a licence, and he must convict them. A penalty of £2 2s. was imposed.

Electric Coal Cutters in Gassy Mines.

Last week Sheriff Fyfe, of Glasgow, delivered his considered judgment in a test case against Nimmo & Co. by an injured miner, who claimed damages at common law or, alternatively, under the Employers' Liability Act of 1880, in respect of an explosion on June 1, 1920, when two men were killed and several were injured. The Sheriff dismissed the action, but reserved it for assessment (if need be) of compensation under the Workmen's Compensation Acts.

In his written judgment the Sheriff examined the various statutory regulations, and concluded that the pursuer had not established any cause-and-effect relationship between negligence of the mineowners and his injury, and so no claim at common law had been established; and that, even had it been, the claim was barred by the doctrine of common employment, the accident having been proved to have been caused by the negligence of fellow workmen in failing to screw down the cover of the switch-box of an electric coalcutter which was being used in the mine, and so permitting a flame to emanate from the coalcutter and ignite the gas in the mine. The Sheriff found that the coalcutter itself and its cable connection were in perfect working order, and that taking off the switch-box cover and replacing it, as occasion may require, was not a skilled electrician's job, but an ordinary mechanical operation in using the coalcutter, the responsibility for doing which efficiently was with the machinemen, as part of their duty of operating the machine.

In regard to the suggestion that a coalcutter should not have been used at all in the mine because of the presence of gas, the Sheriff said there was no evidence in the case to support such a proposition; and he was, fortunately, not called upon to pronounce any opinion upon that large question. It would be a very serious proposition for the coal industry in Scotland if it was to be regarded as unsafe to use a coalcutter, merely because there was more or less gas found in a mine. There were coalcutters specially designed for use in gassy mines, and the evidence in the case showed that the machine in question was a flame-proof machine of modern type, and was in perfect working order.

Leave to appeal was granted, it being understood that the case was regarded by the Miners' Federation as a test case, involving important questions as to safety in mine working, and that it would be carried to the higher courts.

Anglo-German Tribunal Decisions.

On Monday the Anglo-German Mixed Arbitral Tribunal gave its reserved judgment on the claim of Chamberlain & Hookham, of Birmingham, against the Solar Zählerwerke Ges. (m. b. H.), a subsidiary company in Hamburg in which they held all the shares. Before the war the claimants supplied the German company with parts of electricity meters, which were assembled in Hamburg and sold in Germany, and at the outbreak of war there was a debt of £23 921 due to the English company by the subsidiary company. A claim for this amount in sterling (with interest) had been lodged with the Clearing Office for Enemy Debts, but was rejected by the German Office on the grounds that the creditor and debtor were the same persons, that there was never an obligation to pay the debt, and that the German company was not a German national within the meaning of the Treaty.

Delivering judgment in favour of the claimants, the President of the Tribunal (M. Borel), said it was clear that both in English and in German law a company was a legal entity, distinct from its shareholders, and that in the event of a liquidation of the German company before the war the claimants could only have ranked as creditors, and could not have claimed the whole assets as shareholders. On the point of nationality, both the Treaty of Peace Orders 1919 to 1921 and the corresponding German orders of Aug. 31, 1919 and April 13, 1920, defined "nationals" of any State as including any company or corporation incorporated therein according to the law of that State. On this point also the contentions of the German Clearing Office failed. There were certain items in dispute, and on some of these the claimants had given way. Judgment was given for the claimants for £20 438, with £100 costs.

The Tribunal has also given its decision on the claim made by Isaac Spencer & Company, of Aberdeen, against G. Schlotterhaus & Company, a German firm, for the repayment of £600 paid for extraction plant costing 36 000 marks. At the outbreak of war the machinery was ready for shipment, but was not delivered, and claimants had already paid one-third of the purchase money (12 000 marks). M. Borel said that the contract was dissolved in August, 1914, and the consequences of such dissolution were not expressly regulated by the Treaty. The question in dispute had, therefore, to be decided according to the principles of equity. The debtors had spent a considerable sum of money in manufacturing the machinery, and that loss did not appear to have been covered by the value of the machinery. The Tribunal thought it equitable that the creditors should receive £400 in respect of their claim, and no order was made as to costs.

Electrical Company's Contract Claim.

Sir H. Courthope-Munroe, K.C., as Arbitrator appointed by the President of the Institution of Electrical Engineers, sitting at the Surveyor's Institution, Westminster, held a preliminary hearing on Monday to determine certain questions of law in a claim by the Metropolitan-Vickers Electrical Company against the Chinese Engineering & Mining Company. The claim was for £2 750, alleged to be due in respect of two contracts, dated March 16, 1915, and May 15, 1915, for the supply of turbo-generators, condensing plant, transformers, and spare parts. The total of the contracts was £31 364. The Arbitrator had to deal with questions of law in the construction of the contracts before entering into questions of fact as to an alleged interference by the Government with the claimant's workmen and factory.

The purchasers, by way of defence, relied upon the provisions of a schedule to the specification contained in the contract of March 16, 1915, which was as follows :—"The contractors undertake to deliver the first set f.o.b. British port, after testing, within twenty-eight weeks from March 16, namely, by Sept. 28, 1915, and to deliver the second set, together with the other parts, f.o.b. British port, after testing, within thirty-two weeks from the said date, namely, Oct. 27, 1915, and on these deliveries being effected at the dates stated the purchasers will pay the contractors the sum of £25 426 18s. Should the delivery of either set be effected at a later date than that stated above, then the purchasers will pay a reduced amount, which will be computed by subtracting £250 per week for each week's delay from the £25 426 18s. The number of weeks' delay for this purpose shall be taken as the quarter of the two numbers representing the number of weeks' delay in delivery of the first set and the number of weeks' delay in the delivery of the second set, and the maximum deduction for the purpose of this computation shall not exceed £2 750, being a reduction equivalent to a delay of eleven weeks." The purchasers alleged that the claimants did not deliver the first set by Sept. 28, 1915, nor the second set by Oct. 27, 1915, and did not deliver them until after a delay of more than eleven weeks. Therefore, it was submitted, the contract price payable by the purchasers for the two sets was less than the sum claimed by £2 750.

The claimants, in reply, alleged that the schedule was in the nature of a penalty clause, and that the purchasers were not entitled to the benefit of it or to make any deduction except on proof of

damage caused by delay on the part of the claimants in making deliveries under the first contract, and that no damage was or could be alleged by the purchasers. Secondly, it was provided by the schedule that the purchasers should grant under their hand such extension of time for the completion of the works as might seem reasonable to them in the event of the Government at any date subsequent to March 16, 1915, by virtue of the Defence of the Realm Act or any amendment of it, interfering with or commandeering the employees or portion of the contractors' or subcontractors' factory, either or both of which were essential for the construction and due delivery of the works. In the construction and delivery of the works, it was pleaded, the claimants' workmen and factory were interfered with by the Government within the terms of the clause, the purchasers had notice thereof, and in consequence the claimants became entitled to an extension of time for the delivery of the works. The purchasers, it was submitted, did not comply with a covenant as to granting an extension of time or giving notice of any limited extension, and in consequence the claimants became released from all liability to deliver the goods or any of them by any fixed date. Thirdly, it was pleaded, on the true construction of the contract, the claimants could not be called upon to commence any work which was of the nature required—building or structure—for the reception or efficient installation of the works, and which building or structure had to be provided by the purchasers unless and until such building or structure should be in a condition sufficient for the reception or efficient installation of the plant; and that the contract should be extended *pari passu* with the delay in providing any such building or structure. In fact, it was submitted, at the time it was claimed the plant should have been delivered the buildings for its reception had not been completed, and that therefore the claimants were not liable for the delay in delivery. Finally, it was said, the purchasers had expressly or impliedly waived compliance by the claimants with the terms of the schedule as to the dates of delivery.

The ARBITRATOR reserved his award, which is to be stated in the form of a special case.

Electric Lamp Patent Litigation.

On Monday Mr. Justice Astbury commenced the trial of an action by the British Thomson-Houston Company against the Corona Lamp Works, for an injunction to restrain an alleged infringement of patent.

Sir A. COLEFAX, K.C., appeared with Mr. J. C. Gray, K.C., Mr. Whitehead and Mr. Trevor Watson, for the plaintiffs; and Sir D. KERLY, K.C., and Mr. Frost for the defendants.

Sir ARTHUR COLEFAX said the patent (No. 23 775 of 1912) was for improvements in and relating to evacuated vitreous containers having sealed-in conductors. The patent had been sometimes referred to, he thought rather erroneously, as the leading-in wire patent; at any rate it was a patent which was concerned with the seal between the glass and the leading-in wires in an incandescent electric lamp. So far as the infringement went there were certain admissions of fact. As regarded the alleged infringement, there was no question, so far as the facts outside that issue, of whether this was an infringement or not, were concerned.

Sir D. KERLY : We sold the lamps.

Sir A. COLEFAX said there were two cases, one of one lamp and the other of twelve lamps. With respect to the issues raised by way of defence, and so far as the particulars of objection went, they were the usual issues. The defendants denied novelty, subject matter and utility, and they pleaded prior user. As to the subject matter of the invention, counsel said electric lamps dated back forty years, or rather more, and from the early days in their history until the days of gasfilled lamps (about which they had been talking recently in another place) the effort had been consistently to obtain a better and better vacuum. Incidental to that, it was important that they should have a perfect seal to the bulb, and it was also necessary to be able to conduct the current to the filament that they were to render incandescent. For a very long period of time platinum was alone used. Platinum had a co-efficient of expansion somewhere near the glass used, but what was more important it was non-oxidising. It was used for a very long time, but it had throughout been very expensive, and from the early nineties one proposal after another was made to obviate the use of platinum for the leading-in wire in the incandescent lamp. Notwithstanding those proposals, until the date of the patent in question, with one or two exceptions, platinum was universally used, and since the date of the patent plaintiffs' invention had steadily displaced platinum, until to-day among the biggest manufacturers of lamps plaintiffs' invention was employed and platinum was no longer used. The embodiment of the invention as practised to-day was this :—An alloy was taken in the form in which it was most generally used; it had got a co-efficient of expansion which, in fact, was less than glass, and with it a composition wire was made. This core was then coated with something that, in fact, was independent of any question of expansion or contraction, it was given a sheath which presumably had a different co-efficient of expansion (in the form and embodiment in which it was used copper was taken, which had a higher co-efficient of expansion than glass), but whatever was selected for the sheath it was something which was oxidising, and whose oxide was easily soluble in the glass into which the leading-in wire was used in the operation of sealing. In the specification of the patent the alloy was nickel-iron, the ratio being 46 per cent. nickel and 54 iron. In the alleged infringing lamps the alloy in the composite wire was 29 per cent. copper, 28·43 per cent. nickel, and 42·4 per cent. iron—99·83 per cent., there being a little [illegible] in analysis.

Evidence in support of the plaintiffs' case was given by Mr. JAS SWINBURNE, ex-President of the Institute of Electrical Engineers, who said that, platinum being expensive, the object of the inventor in the case was to get some other metal with the advantages of platinum. In the case of platinum they must have a bright surface and a co-efficient of expansion the same as glass. If they got away from platinum they must have a base metal and use it in such a way that the glass would adhere, and that the expansion would not break the glass. These two properties were found in the metal in those lamps.

On Tuesday the witness was cross-examined, and in reply to Sir D. Kerby, who asked if it was common knowledge at the date of the patent that if one wanted to use any leading-in wire, the co-efficient of expansion of the wire and of the glass they were using must be approximately the same, Mr. Swinburne said he should hardly say it was common knowledge. If the wire was small they could seal such a thing as copper in. It was only when they got wire fairly large that the co-efficiency of expansion played an important part. How far it was general knowledge he did not know. He thought everybody at this date would suppose that it was an advantage to get it exactly the same, and that they ought to have it certainly the same. Not only in the case of leading-in wires, but in many kinds of scientific instruments it is necessary to seal metal and glass together. In many other things besides lamps, although lamps may be and are the most important, a glass vessel had metal wires sealed into it, and had to be subjected to variations of temperature. The variations of temperature were not really the important thing; the real variation of temperature was a difference of temperature between the time of sealing and the atmosphere; it was very seldom it was raised above or came anywhere near those limits afterwards in practice.

The hearing was adjourned.

Public Works in Batavia.

The Public Works Department of BATAVIA has officially announced that all work temporarily suspended for reasons of economy is to be resumed immediately. The resumption of this work foreshadows a considerable demand for constructional material and engineering accessories, and while no official authority has been given for starting on new works planned, it would appear, the Department of Overseas Trade states, that there may be important openings for United Kingdom firms. In the case of contracts for materials for public works, dredging plant, cables, &c., United Kingdom firms may lodge tenders with the Colonial Office at The Hague without the necessity for local representation in Holland.

Water Power in Jugo Slavia.

H.M. Commercial Secretary at Belgrade reports that the Zagreb journal, " Agramer Tagblatt " recently published an article concerning the FORMATION OF A SYNDICATE for the development of hydro-electric power schemes which would be worked in collaboration with the Government. This syndicate was formed at Vinkovci in November for investigating the water power of the Bosna and Drina, and it has been decided to erect, near Modric, a water-power station of 8 000 H.P., and to construct another station on the lower Drina between Kovilјaca and Janje of 29 000 H.P. The projected power stations are intended to provide electricity for Posavina, Podrinje, Slavonia Syrmia, Backa, Djakovstina and Osijek, and will be linked up with the projected overhead electrical system of the State. It is also intended to connect these systems, via Zabgreb, with the power system of Fala, so that the project of the central Government to provide an organised network of electric power lines in an east to west direction could be accomplished without great delay. The undertakings are assured of State co-operation, and the participation of foreign capital will only be permitted if native resources are insufficient.

Electricians' Wages.

At a conference between the National Federated Electrical Association and the Electrical Trades Union, held on Jan. 26 the following clauses were added to the NATIONAL STANDARDISED WAGES AGREEMENT :—

Ship Work.—The N.F.E.A. rate for electrical work on ships to be the ship rate of the district for the same class of work.

Shore Work.—Wiring or installation of any new work in new or old buildings not to be undertaken at less than the N.F.E.A. rate. The rates agreed between the E.T.U. and the Engineering and the Shipbuilders Employers Federations to be restricted to maintenance work and to exclude all new wiring or installation work.

In accordance with the National Wages Agreements, it has been agreed that the variation in the cost of living justifies a 16 per cent. reduction in wages in lieu of the previous reduction of 10 per cent., and the net hourly rates of pay applicable to the respective grades of the agreements are as follows :—Grade A. 2s. 1½d.; Grade B. 1s. 10¾d.; Grade C. 1s. 9d., and Grade D. 1s. 7¼d. an hour. These rates came into effect this week, and remain current up to the first pay day in June next

Electricity Supply.

The Minister of Transport has revoked the RICHMOND (SURREY) ELECTRICITY (TEMPORARY INCREASE OF CHARGES) ORDER, 1919, as from Jan. 31 last.

PONTYPRIDD Chamber of Trade has accepted an invitation from Mr. J. E. Teasdell, the electrical engineer, to inspect the new sub-station and electrical power works of the Council.

MARLBOROUGH Town Council has decided to apply for the revocation of the Provisional Order granted in 1913 to the Marlborough Electric Supply Co., who have failed to carry out their obligations.

The Borough Electrical Engineer and Manager of BLACKBURN (Mr. P. P. Wheelwright) has been instructed to prepare, in three months' time, a report of the working of the new WHITEBIRK ELECTRICITY STATION.

SITTINGBOURNE Gas Company has applied for authority to charge a maximum of 25s. per quarter where premises are lighted by electricity and gas is laid on merely as a stand-by. The Urban Council has referred the matter to a committee for a report.

The new electric light plant on BANGOR Pier was formally started last week by Mr. W. R. Jones, chairman of the Pier and Ferries Committee. The installation, which replaces the old gas lamps, consists of twenty lights of 100 c.p. each.

The Minister of Transport proposes to confirm the SHOREHAM-BY-SEA AND LANCING SPECIAL ORDER, 1922, made by the Electricity Commissioners to be granted to Mr. Frank Gibbs, Beach Shipyard, Shoreham. Any objections should be sent to the Ministry of Transport by March 2.

A petition has been circulated in Wimbledon for signature by burgesses asking the Mayor to call a town's meeting to discuss the Corporation's action in connection with the dismissal of Mr. H. TOMLINSON LEE, chief engineer to the Corporation for over twenty years. Many ratepayers have signed the petition.

London County Council, having considered the proposals of HAMPSTEAD Borough Council to take electricity in bulk from Marylebone Council, have decided to offer no objection to the scheme. Hampstead Council propose to shut down their Lithos-road generating station, and three-phase current at 6 600 V, 50 periods, will be supplied by Marylebone to Hampstead and transformed down to 105 and 210 V for local distribution.

The Electricity Commissioners have prepared analyses and summaries from the four-weekly returns of FUEL CONSUMPTION, &c., rendered by 501 ELECTRICITY STATIONS in GREAT BRITAIN during the year ended March 31, 1921. A tabular statement embodying the summaries, with an explanatory letter, was issued to the engineers of all the power stations in question. The general position during the year is indicated in four tables.

At the monthly meeting of the BELFAST Corporation, last week, a recommendation of the Electricity Committee that the electricity staff should be reorganised, and that, in view of the increased responsibility owing to the enlargement of the undertaking, a chief electrical engineer of experience in the management of large undertakings, and of greater administrative ability than Mr. Bloxam be appointed. It was further recommended that Mr. Bloxam be granted a retiring allowance of £480 per annum. There was a very warm debate over the recommendation of the committee; finally it was carried, by thirty-three votes to twelve, an amendment to delete the name of the chief engineer having been first defeated by the same vote. Several members of the Corporation said that Mr. Bloxam was being made a "scapegoat."

At the last meeting of the directors of EDINBURGH Chamber of Commerce, a communication was read from an important manufacturing firm in Edinburgh, drawing attention to the increase which had been made in the charge to consumers of electric current from 1⅞d. per unit to 2d. per unit, and complaining that the raising of the charge constituted a serious grievance and handicap to manufacturing industries using electric power. The directors were of opinion that rather than maintain the increased price the Electricity Committee should bear the burden of a temporary small loss, and they strongly recommend that in any case an assurance should be given by the Electricity Committee that six months hence a reduction in the charge for current would be made. The matter was before the Council at its meeting on Thursday last.

New Schemes and Mains Extensions.

All the houses on the Welling Estate, BEXLEY, are to be wired for electric lighting, the cost per house chargeable to the scheme not to exceed £6.

LEEDS Corporation has received sanction to borrow £38 500 for the provision of overhead wires and electric service for the municipal housing scheme.

It is proposed to erect electricity works in BALLYMENA, Ireland, at a cost of £5 500. A limited liability company is to be formed, and the prospectus is in course of preparation.

WALMER Urban Council has, subject to proper protection being afforded, decided to support a proposal to establish electric supply works by a local company about to be formed.

There are thirty-five petitions against the GRAMPIANS ELECTRICITY SUPPLY ORDER, but the majority of them are by landowners in order to get protective clauses. The opponents, however, include five electric supply and power companies, five county councils, and the Glasgow, Dundee, and Perth Corporations, besides several minor local authorities.

CREWE Town Council has applied for a loan of £10 000 for additional plant at the electricity works and for cables. It is proposed to establish a department for wiring private houses.

A motion that the Electricity Committee be instructed to prepare a scheme for the wiring of premises and the fitting of electric fittings at cost price was defeated at last week's meeting of DERBY Town Council.

At a meeting last week of the ratepayers of SLEIGHTS (Yorks) a committee was appointed to ascertain the cost of lighting the village by electricity. The village is also to be canvassed to obtain the number of prospective consumers.

The Minister of Transport gives notice that he proposes to confirm the BLACKBURN ELECTRICITY (EXTENSION) SPECIAL ORDER, 1922. Objections may be sent to the Secretary, Ministry of Transport, 6, Whitehall-gardens, London, S.W. 1, until Feb. 25.

BURNLEY Electricity Committee, who recently postponed the supply of electricity to the Rosegrove and Lowerhouse districts pending the erection of a sub-station, have now authorised the Electrical Engineer to prepare a report of the estimated cost.

TUNBRIDGE WELLS Council have decided to apply for a loan of £12 975 for extensions of mains, services, transformers, sub-stations, and sub-station pillars for the ensuing three years, and for £4 378 to cover the increased cost of the installation of the new turbo-alternator, condensing plant, pipe-work and switchboard.

ACCRINGTON Corporation has received the consent of the Electricity Commissioners to extend the plant at the electricity works. The Electricity Committee have authorised the borough surveyor to proceed with the work, and tenders for the plant are to be invited. Blackburn Electricity Committee is considering the proposals for linking up Blackburn and Accrington stations.

BLACKPOOL Finance Committee have sanctioned an application to the Ministry of Health for a loan of £5 000 in respect of mains and services for the housing estates. The Electricity Committee recommend application for sanction to borrow £220 000 for new generating plant, high tension transmission mains and other plant required in connection with the electricity undertaking.

The LIVERPOOL Electric Power Committee has received sanction to borrow £17 082 for mains and services and sub-station equipment in connection with the Cherry-lane housing scheme addition, subject to the applicants paying a portion of the cost. Nine mains extensions are to be proceeded with. The Works Sub-committee of the Health Committee has authorised the City Engineer to order three ELECTRIC PUMPS, with CABLES AND STARTERS.

A proposal to introduce electricity supply for lighting and industrial purposes was discussed on Friday at a joint meeting of the HOLYWELL Urban and Rural Councils. It was reported that the North Wales Power Company would shortly be laying a cable from Dolgarrog generating station in Carnarvonshire, through Flintshire, to Wrexham, and if the Holywell area agreed, provision would be made for a transformer station near the town. A joint committee was appointed to make further inquiries into the proposal, and to present a report at the earliest possible date.

Alteration of Charges.

As from the December, 1921, readings, CROYDON Town Council have decided to reduce the electricity charges for power, heating, and cooking from 125 per cent. to 100 per cent. over pre-war rates.

DARWEN Town Council have reduced the charges for electricity as follows: Lighting, 8d. to 7½d.; power, up to 100 units 5½d. to 4¾d.; 100 to 500 units, 4½d. to 4d.; second 500 per quarter, 3d. to 2¾d.; over 1 000, 3d. to 2¾d., and over 2 000 per quarter, 1¾d. to 1½d.; for domestic purposes, for first 30 units, 4½d. to 4d.; in excess of 30, 2½d. to 2¼d.; public lighting, 6d. to 5½d.; theatres, 6d. to 5½d.

SALFORD electricity charges are to be reduced from 75 per cent. to 40 per cent. for lighting, and from 100 per cent. to 65 per cent. over pre-war rates for power, heat, and bulk supplies. This reduction has been made possible owing to the decreased cost of coal and the improvement in its quality, to the existence of the new plant, and the improvement in the condensing facilities. This is the second reduction which has been made by the Department in three months, and is undoubtedly the right course to adopt in view of the present industrial depression.

The following reductions in the charges for electricity, as from the end of the December, 1921, quarter, have been approved by the LIVERPOOL Tramways Electric Power and Lighting Committee, and the recommendation will come before the City Council: Ordinary consumers 25 per cent. off the increased charge of 100 per cent.; special consumers having agreements containing coal clause, &c., 25 per cent. instead of 40 per cent. increase; rateable value consumers, 50 per cent. off the increased charge of 100 per cent. on the rateable value charge, and 25 per cent. off the increased charge of 100 per cent. on the basic rate per unit.

On Saturday the Cardiff magistrates sentenced a man named Sullivan to a month's imprisonment for OBTAINING TWELVE ELECTRIC LAMPS (valued at £4 10s.) BY FALSE PRETENCES from Messrs. Simpson and Baker, a local firm of electrical engineers.

Electric Traction.

Darwen Town Council have reduced the charges for electricity for the tramways from 2½d. per unit to 2¼d.

Accrington Tramways Committee have acceded to a request for a reversion to the original guaranteed week of forty-eight hours.

Application to the Ministry of Transport is to be made by Hull City Corporation for authority to extend their electric tramway to Hessle.

Rishton Urban Council will oppose the Bill of Blackburn Corporation for the extension of the borough and for constructing new tramways and running omnibuses.

Leeds Corporation have decided to lay a double tramway track along Belvidere-road and Devonshire-road, instead of a single track as recommended by the Tramways Committee.

Ald. Higham, chairman of Blackburn Tramways Committee, holds out no hope for a reduction in tram fares in the near future as the rate of wages are still considerably higher than the revenue per mile.

Glasgow Corporation have adopted the proposal of the Tramways Committee that in the interests of public safety pedestrians should be instructed to keep to the left. Notices to this effect are to be affixed to the lamp posts and in the tramcars.

The amalgamation of the London & North-Western and Lancashire & Yorkshire Railway Companies having been completed, it is announced that the directors of the L. & N.-W. Company are now occupied with the question of bringing the Midland Railway Company into the group.

The Scottish Commercial Motor Users' Association are opposing the Aberdeen Corporation Provisional Order, the Glasgow Corporation Provisional Order and the Ayr Burgh Provisional Order, under which the Corporations are taking powers to run omnibus services beyond the Corporation or burgh boundaries.

Barrow Town Council are opposing the Bill promoted by the London & North-Western, Midland, and Furness Railway Companies for powers to run road vehicles. At a meeting of the Town Council on Monday it was stated that the tram service was losing £200 a week. Penny fares for shorter stages were advocated.

Lewisham Borough Council have resolved to oppose the L.C.C. Bill for the construction of railless trolley trams from the boundary of the borough at Sydenham to Lee-green via Catford. Hackney Borough Council are also opposing the Bill in order to get certain conditions inserted, but the general principles of the Bill have been approved.

In the Bill of the Nottinghamshire and Derbyshire Tramways Company power is sought to construct a double line of tramway, in order to connect up its existing system at Heanor with the Ilkeston tramways, which have now been transferred to the company. It is proposed to give a through service, and for this purpose it is proposed to alter the gauge of the Ilkeston Tramways from 3 ft. 6 in. to 4 ft. 8½ in. The capital required is to be provided by empowering the company to raise the balance of its unissued capital of £96 470 as preference capital, and to borrow upon its issued capital the sum of £126 765.

The subject of omnibus stop signs has been under the consideration of the Road Department of the Ministry of Transport, and owing to the divergent views of Borough Councils, efforts are being made to adopt a uniform, standardised pattern. Some councils demand £1 per sign, others require that tramcar and omnibus stopping places be at least 30 yards apart and others that the sign be illuminated by electricity or gas by night. The Metropolitan Boroughs Standing Joint Committee have approved of the principle of erecting signs in the interest of public safety, and urge councils to adopt a similar attitude.

The accounts of Exeter Tramways for the past year show a surplus of about £3 000 on the year's working. Expenditure on general repairs and maintenance for the year is estimated at £4 922, compared with £9 366 and £8 862 for the two preceding years. In view of the expenditure that will be further required and the reduction of the reserve fund in the past two years, it has been decided that £2 000 of the £4 000 carried into the district rate for the current year be paid into the reserve fund. Mr. F. Chick, moving the adoption of the report at the Council meeting last week, said the committee had not made a profit of £3 000, but they had saved that amount on maintenance charges. Perhaps it was false economy. An amendment that the committee's recommendation be re-considered was defeated, and the report adopted.

For several months omnibuses have been running between Hanley and Burslem and Hanley and Stoke, with the result that the traffic on the tramcars has been affected, and the Potteries Electric Traction Company have reduced their fares. Some time ago the fare on the route between Hanley and Stoke, which is the most important and busiest in the district, was cut down to 1½d., but the omnibuses and chars-a-bancs continued to be well patronised at 2d. On the other sections, where there is no omnibus competition, the Tramway Company have made no reduction of fares. Now, however, they have still further reduced the fares on the Hanley-Burslem-Stoke sections to 1d. for the journey, which is roughly two miles. Several of the omnibus proprietors have declared their intention to transfer for the time being their competition to the sections where the Tramway Company have not reduced fares if they are forced by the 1d. fare to abandon the Hanley and Burslem and Hanley and Stoke routes.

Personal and Appointments.

Sir Charles Parsons has been elected Master of the Shipwrights Company.

Mr. E. E. Pope has been appointed mains superintendent of the Maidstone Municipal Electricity Works.

Mr. P. C. Larkin has been appointed High Commissioner for Canada in London, in succession to Sir George Perley.

Mr. H. W. Huntington Richards, electric traction engineer of the L.B. and S.C. Railway, has been elected a member of the Institute of Transport.

The present secretary of the South African Institute of Electrical Engineers is Mr. H. C. Luke, and his address is P.O., Box 5 907, 94, Cullinan-buildings, Simmonds- and Main-streets, Johannesburg.

Hackney Borough Council have appointed Councillor H. J. Mead, Chairman of the Works and Open Spaces Committee, and the Borough Engineer and Surveyor their representatives on the London "Safety First" Council for the current year.

We are pleased to learn that Sir John Snell, Chairman of the Electricity Commissioners, had so far recovered from the attack of bronchitis from which he has been suffering that he was able to return from Barrow-in-Furness to London on Monday, and, if no unforeseen relapse occurs, it is believed that he will be able to resume his duties about the end of the present week.

The International Commission on Illumination has appointed an Editing Committee, composed of the following:—English language, Major K. Edgcumbe (to represent the U.S.A. and Great Britain); French language, MM. Laporte and Blondin. The following officers have been appointed for the ensuing three years:—President, Dr. E. P. Hyde; vice-presidents, M. F. Rouland (France), M. G. Semenza (Italy), and Major K. Edgcumbe (Great Britain); hon. secretary and treasurer, Mr. C. C. Paterson.

The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., announces that Mr. T. H. Hays has been appointed manager of the Indianapolis (Indiana) office of the company. Until further notice Mr. Hitchner, assistant to the manager. Industrial Department, in general charge of the mining and electrochemical industries, will have general charge of the sections formerly handled by Mr. W. H. Patterson, who, as we announced in our last issue, has resigned his position to become vice-president of of the Kaestner & Hecht Company.

After thirty-seven years' service in the City and Guilds (Engineering) College, following two years' service at the Finsbury Technical College, Prof. T. Mather is retiring at the end of the present session. Prof. Mather succeeded to the Chair in Electrical Engineering on the death of the late Prof. W. E. Ayrton, with whom he had been closely associated in the organisation of the department. The City and Guilds (Engineering) College forms the engineering section of the Imperial College of Science and Technology under the Delegacy, representing the Imperial College, the City and Guilds of London Institute and the Goldsmiths' Company. The Delegacy will proceed shortly to consider the appointment of a successor to Prof. Mather, and are inviting applications.

The following re-arrangements in the staff of Liverpool Electricity Department have been approved by the City Council:—Mr. E. L. Morland, mains superintendent, to be distribution engineer, at £525 per annum and bonus; Mr. C. M. Lucas, assistant electrical engineer, to be assistant distribution engineer, at £350 per annum and bonus; Mr. A. E. Aird, assistant engineer, to be assistant electrical engineeer, at £270 per annum and bonus; Mr. W. Mayhew, h.t. inspector, to be assistant engineer, at £205 per annum and bonus; Mr. T. B. Owens, h.t. switchboard inspector, to be assistant engineer, at £210 per annum and bonus; Mr. J. B. Higgins, mains engineer, to be h.t. engineer, at £235 per annum and bonus; Mr. J. H. Murray, mains engineer, to be district mains engineer, at £215 per annum and bonus; Mr. C. F. Reid, mains engineer, to be service mains engineer, at £190 per annum and bonus; Mr. C. L. Eagle, assistant mains engineer, to be district mains assistant, at £125 per annum and bonus; Mr. F. C. Carmen, mains assistant, to be senior mains assistant, at £235 per annum and bonus; Mr. A. E. Lewis, mains assistant, to be senior mains assistant, at £230 per annum and bonus; Mr. S. R. Holliway, station engineer, to be shift engineer, at £220 per annum, plus the E.P.E.A. bonus; and Mr. T. Herbert Thomas, shift engineer, at £220 per annum and bonus.

Exhibition Notes.

The Second International Samples Fair to be held at Trieste is to take place from Sept. 3 to 18.

Plans are being made to hold an International Exhibition at the White City at Shepherd's Bush, London, in 1924.

Stand 201, Block O, Building B, has been secured by A. Reyrolle & Company, of Hebburn-on-Tyne, at the forthcoming British Industries Fair to be held at Birmingham from Feb. 27 to March 10. Their exhibits will include their well-known armour-clad switchgear and switch pillars for use in fiery and non-fiery mines.

The Second Orient Fair (Pressburg) will be held from July 9 to 16. The Fair, which is international in character, is intended to foster the Balkan trade in conjunction with the efforts now in progress to develop the importance of Bratislava as a Danube port. Applications for space should be sent by May 31 to Secretariat, II. Orient Fair, Bratislava (Pressburg), Czecho-Slovakia.

Institution Notes.

The fifth Silvanus Thompson memorial lecture of the Röntgen Society will be delivered by Sir Oliver Lodge at the Institution of Electrical Engineers on Tuesday, March 21.

The second annual meeting of the British Electrical Development Association, on Wednesday, Feb. 22, will be followed by the annual luncheon at the Hotel Cecil, Strand, W.C., at 1 for 1.15 p.m. The chair will be taken by Councillor E. C. Ransome (President-Elect, E.D.A.; I.M.E.A. Council; Chairman, Ransomes, Sims & Jefferies, Ltd.). Other speakers will be: Mr. Arthur Neal, M.P. (Parliamentary Secretary of the Ministry of Transport), Mr. Hugo Hirst (President, E.D.A., 1921-22, and Chairman of the General Electric Company, Ltd.), Mr. J. S. Highfield (President of the Institution of Electrical Engineers), Sir Archibald Denny (Chairman, William Denny and Bros., Ltd.), and Mr. A. F. Berry (Chairman of Council, E.D.A., 1919-20-21-22).

At a meeting of the Chelmsford Engineering Society last week Mr. A. Haskins in the chair, Mr. G. H. Ayres, of Industrial Waste Eliminators Ltd., gave an illustrated lecture on "The Reclamation and Utilization of Waste in Factories." Various methods of recovering oil from metal turnings, dirty wipers, and cotton waste were dealt with. The apparatus recommended was the turbine type of centrifugal extractor. The peripheral speed of the extractor should be 6 000 to 7 000ft. per min., and by having the turbine blades fastened direct to the under side of the cage, this could be easily obtained. One manufacturing firm in six months treated 834 cwt. of metal turnings, 8 cwt. of rags, and 134 gross of sponge cloths, and recovered 2 440 gallons of oil. Another concern was stated to recover 1 200 gallons of cutting oil per week, while the Lancashire and Yorkshire Railway, using 6½ millions of sponge cloths per annum for cleaning purposes, recover more than a gallon of oil from each gross of cloths.

Under the chairmanship of Dr. C. S. Desch, Mr. A. Glynn Lobley, Lecturer in Electro-Metallurgy in the University of Sheffield, and Reader in Electro-Chemistry in the University of Manchester, last week gave a lecture on electric furnaces before the Sheffield section of the Institute of Metals. The lecturer gave a brief survey of the basic principles involved, the classification, and the evolution of electric furnaces, showing slides of the pioneer types. He followed this with a review of the characteristics of the furnaces used for non-ferrous metals, contrasting the merits and demerits of the three chief types, arc, induction, resistance. A comparison of the electrical load with the ordinary power station load was given, showing the advantage of the electric furnace from the power station viewpoint. He made a plea for a more extended use of the simple and reliable wire-wound furnace In order to dispel the notion that electric furnaces are necessarily expensive, he quoted examples from his experience in which electric furnaces of his own design, not only proved economical in use, but were often cheaper to install than fuel furnaces. He urged that furnaces should be made as simple as possible in order to reduce the first cost. A comparison of the thermal efficiencies of various types of fuel and electric furnaces was given.

Business Items, &c.

Dieny & Lucas, 329, High Holborn, London, W.C. 1, have been appointed exclusive agents in Great Britain and the Colonies for the Société Alsacienne de Constructions Mecaniques of Belfort and Mulhouse, manufacturers of electrical machinery.

Mr. S. Utting, 82, Victoria-street, London, has received the order for the equipment of two large Babcock C.T.M. type boilers for the Hague electricity works. The "Prat" draft system is to be installed, and the air heaters are of the "Thermix" type. This order is the fourth received by Mr. Utting for these important works, and is the outcome of the success of the first contract.

The Baroda State Railways have placed an order with Hollings & Guest, Ltd., for a horizontal four-throw chain-driven hydraulic pump, and a large hydraulic accumulator, for use at the Baroda workshops. The East Indian Railways also have recently ordered a hydraulic press from the firm. In addition, many other British and Foreign railway companies have installed similar presses for various purposes, such as solid tyre fitting, wheel forcing, scrap metal bundling, and forging.

Simplex Conduits, Ltd., announce that they have completed arrangements for a joint sales service with their associate company, Credenda Conduits Company, Ltd., whereby all Simplex and Credenda productions will be available throughout the branches and depots of both companies. The arrangement is essentially one of sales organisation, but as such deals only with actual productions of the companies, leaving untouched the usual factored lines, in which each will continue its own course of action as before. The manufacturing policy of neither company will be effected.

A series of novel electrical appliances, known by the trade name of "Adix," have been placed upon the market by Mr. Chas. Soukup, 15, Farringdon-avenue, E.C. 4. These include boilers, tea kettles, coffee percolators, irons, &c. The heating element and the vessel being separate, so that no contacts are attached to the container, forms a special feature. Should the element burn out it can easily be replaced by removing a few screws. The appliances are constructed for use on universal voltages and are designed to pack into a small compass. Mr. Soukup is sole agent for the appliances and factors, and others are invited to apply for fuller particulars.

Imperial Notes.

Westbury (Tasmania) Council have engaged Mr. H. A. Masters to report on the subject of electricity supply for the town.

It is understood that tenders for Grahamstown's (S. Africa) electric lighting scheme, estimated to cost £65 000, will be called for in June or July next.

Ballarat (Victoria) Finance Committee recommend that the City Council send a deputation to the State Electricity Commissioners to discuss the subject of the supply of electrical energy in Ballarat.

Negotiations are in progress for the supply of electrical energy by the Mount Lyell Company from their Lake Margaret power station to the Tasmanian State Hydro-Electric Department, and for its re-sale by them to Zeehan Municipality.

Imports of electrical goods and machinery in South Africa continue to increase, states the "British and South African Export Gazette." The value of elevators and lifts imported last year amounted to £75 000, compared with only £27 271 in 1920.

Amongst revised charges for electricity recently recommended by Sydney (N.S.W.) Electric Supply Committee was a proposal that where a supply of current is required continuously for water heating the charge shall be 5s. 3d. per month per 100 W of demand.

Singapore Municipal Commission have approved a scheme, involving the expenditure during the next ten years of 100 million dollars, for the provision of public utilities on the island, including the provision of further tramway facilities, and public and private electric lighting.

It is proposed to erect a h.t. transmission line from New South Wales State power-house, Port Kembla, to Moss Vale, and a supply from this line having been offered to Mittagong Council, the Council have decided to borrow £4 800 for the distribution, network, &c.

Adelaide (South Australia) Tramways Trust have just installed a 6 000 kW Curtis turbo-alternator, made by the British Thomson-Houston Company, and a condenser, manufactured by G. W. Kelly & Lewis, of Melbourne, and capable of condensing 75 000 lbs. of steam per hour.

Benalla (Victoria) Shire Council are considering the advisability of establishing electricity works for the town, with plant driven by suction gas, crude oil, or steam, and also a proposal for hydro-electric works, which would obtain power from the Holland's branch of the Broken river.

Up to the end of December last, 75 miles of the Melbourne Suburban Railways, or slightly more than three-fourths of the lines, had been converted to electric traction. Automatic substations are now being equipped, each of which will render its own section of line dead when not in use, and re-establish the circuit when a train approaches.

The Electrical Federation (Victoria) has been formed to take over the work of the Electrical Traders' & Contractors' Association of Victoria, and the latter association is being wound-up. The officers of the new Federation include T. M. Ritchie, President; L. G. Henwood, Vice-President; G. L. Just, Hon. Treasurer; and, for the time being, Messrs. Rankin, Marrison and Company, 314, Collins-street, Melbourne, are acting as secretaries.

The elimination of double taxation of income as between Australia and the United Kingdom has now been achieved. The arrangement is that where the British tax is greater than the Commonwealth and State taxes combined, the taxpayer will in future pay in the aggregate only the British rate, but where the combined Australian rates exceed the British rate he will pay only at the combined Australian rates. The higher rate will always be charged, and the lower tax will be rebated.

A manufacturers' agent in Halifax, Nova Scotia, representing several Canadian firms for telephones, electrical heating appliances, bells, &c., desires to represent United Kingdom manufacturers of electric, incandescent lamps, transformers, Wh meters, galvanised iron wire, stranded steel guy wire, and pole line material, on a commission basis, for New Brunswick, Prince Edward Island, Nova Scotia, and Newfoundland. Applications for names and addresses must be sent to the Department of Overseas Trade. (Ref. No. 127.)

In connection with the bann on German engineers to supervise the erection of briquetting machinery at Morwell brown coal mines, the Victorian Attorney-General recently stated that it was impossible to obtain the plant from any other country than Germany. The Federation of British Industries have been investigating the matter, and find that not only could the type of briquetting plant required be obtained in this country, but that a Birmingham firm actually quoted for this particular order. The Federation is taking every possible step to rectify the erroneous statement.

In a statement on the financial position of the Tasmanian State Hydro-Electric Department, made in the Tasmanian Parliament by the Hon. J. B. Hayes, it is explained that the estimate, given in 1919 as £2 500 000, of the cost of carrying out the Great Lake scheme to the point of being able to supply 57 200 h.p. of electrical energy had now to be amended by the addition of 25 per cent., due to increased cost of labour, plant, interest on loans, &c. In addition to the supplies to the Electrolytic Zinc Company and the Carbide Company, a supply has been provided for Messrs. Cadbury's chocolate works at Claremont, and applications have been received from two companies for large quantities of power for new industries.

Foreign Notes.

The Chinese Ministry of Communications has approved the registration of the PEKING TRAMWAY COMPANY.

The Arizona Bureau of Mines is patenting an ELECTRIC PROCESS for LOCATING UNDERGROUND ORE BODIES. The director, Dr. G. M. Butler, states that it indicates the depth, size, and other information regarding concealed copper ore. The device has, it is stated, proved accurate by tests in the mining regions in Arizona.

What is probably the HIGHEST VOLTAGE ever employed in URBAN DISTRIBUTION is used in BERLIN, where 100 000 V overhead lines have been erected in the centre of the city. High voltage is also used in some American towns, as at Seattle and Niagara Falls, where the lines run across the cities, but the pressure employed is much lower than in Berlin.

A scheme for the distribution of electricity for lighting and power throughout EAST FLANDERS has been prepared. The existing generating stations will be utilised as far as possible; but for new works and h.t. lines the Provincial Council will advance money to the communes and the local companies. The cost of the distribution network is estimated at about 10 000 000 francs.

The electrical manufacturers and contractors of HOLLAND are complaining of the serious effect of German competition, and the Vereeniging van Fabrikanten op Electrotechnisch Gebied has asked the Minister of Industry and Commerce to restrict the imports of electrical goods and to make the present five per cent. duty caluculable on the intrinsic value of the money of the country of origin.

A meeting of the UNION INTERNATIONALE DE TRAMWAYS ET DE CHEMINS DE FER D'INTERET LOCAL will be held at the rooms of the Société Générale de Belgique, 34, Rue Royale, Brussels, at 3 o'clock on February 18, to consider changes in the constitution of the Association which has been rendered necessary by the war. Among these changes are the addition to the title of the words "Transports Publics Automobiles," and the restriction of the membership to undertakings in friendly or neutral countries.

An AMERICAN ELECTRICAL (the BUCK-HEWLETT SUSPENSION INSULATOR) PATENT, which has been the subject of litigation for eleven years, has recently been declared invalid by the U.S. Circuit Court of Appeals. The patent related to a freely suspended system operating at 60 000 to 10 000 V, periodically dead-ended to cross-arms using a special disc insulator and a freely suspended jumper. It was held that the invention was anticipated by a line erected in 1900, and that an insulator of a special type and an insulator of a more general type in combination with expedients appropriated for the art were not inventions.

We learn from the "Electrical World" that the Lockwood Legislation Committee has ordered an INVESTIGATION of the AFFAIRS of the GENERAL ELECTRIC COMPANY of New York, to ascertain if it has violated any Federal laws. If any violations are discovered the company will be proceeded against. The Department will investigate the following questions:—Whether the company maintains an unlawful monopoly of tungsten incandescent lamps, whether it has made unlawful contracts, whether it has manipulated its accounts and evaded payment of excess profits taxes, and whether it has been operating in violation of a 1911 decree of the Federal courts.

Openings for Trade in the Netherlands.

The "Handelsbelangen" for Dec. 28 gives particulars of the following contracts for which tenders are likely to be invited in the near future:—

The firm of P. Hildebrandt, Bergen n/Oss, meat preserve manufacturers, intend to build a new factory on modern lines. The date of commencement of the building will probably be March or April.

Plans have been prepared for the erection of a new large pumping station at Boonersluis, probably in the coming summer. Plans have been designed by Ir. A. C. Loeff, who is attached to the Hoogheemraadschap (High District Council) van Delfland, Oude Delft 167, Delft. Plans for the Gouda-Boskoop-Alphen Railway are in the hands of Engineer Ch. W. Ankersmit, afd. W. 12, Weg en Werken, Nederlandsche Spoorwegen at Utrecht, and will probably be put into execution at the end of this year.

G. P. Larsen & Zn., shoe and leather manufacturers, of Keulschevaart, Amsterdam, intend building extensive works, and commencement with the building may be expected in March or April.

Plans have also been prepared for the extension of the refuse destructor installation at Amsterdam. (A. W. Bos, Director of Public Works, Town Hall, Amsterdam.) N. V. Hollandsche Hout en Bouwbedrijf voorheen Louis Mohrmann en Zn. (Asterweg, Amsterdam) intend to extend their wood-working factory; and Scholten en v. Heek, of Bandstraat, Enschede, will shortly commence the construction of their new textile mills.

In connection with the above and other projected works, H. M. Consul-General of Rotterdam points out that United Kingdom firms interested in supplying material likely to be required should communicate direct with the firm or individuals named, and, if necessary, apply to the Consulate-General at Rotterdam or to the Commercial Secretary at The Hague for further information.

Telegraph and Telephone Notes.

An automatic telephone exchange is being established at DURBAN.

The new automatic telephone exchange at HULL, which is capable of accommodating 1 000 subscribers, was opened on Monday.

The Spanish Government took over the BARCELONA TELEPHONE SYSTEM of the Campañia Peninsular de Telefonos in December last. The company's employees working the service were taken over by the State.

The Lisbon "O Seculo" announces that the United States Minister has been discussing with the Portuguese Minister of Commerce the question of a concession for laying a NEW SUBMARINE CABLE from NEW YORK, *via* the Azores, to EMDEN, GERMANY. The representative of the Commercial Cable Company is also in Lisbon on the same business.

The "Times" MELBOURNE correspondent states that the Postmaster-General proposes to ask Parliament next Session to sanction a loan for £8 000 000 to improve and expand the telephone system throughout Australia and to build trunk lines. His idea is to adopt a continuous scheme which will be independent for three or four years of the annual Parliamentary Votes. There are now 12 000 unsatisfied applications in the principal cities for telephone connection, besides thousands in the country districts for communication with the main systems. The Cabinet has made available £200 000 as the first instalment.

In a communication to "Lloyd's List" a correspondent calls attention to the delay in CABLE COMMUNICATION BETWEEN THIS COUNTRY AND INDIA, and complains that the method of obviating the delay by paying three times the usual rate for urgent messages is an abuse, for as long as senders are willing to pay treble rate there will be no desire on the part of the Cable Company to expedite ordinary rate messages. We desire to point out, however, that urgent messages were not introduced by the Telegraph Company, which is totally opposed to the system. It is recognised by all the members of the International Telegraph Union, of which telegraph companies are not members, and the correspondent's best course is to communicate with the Postmaster-General.

Wireless Notes.

METEOROLOGICAL FORECASTS to twelve districts in France are now being sent daily from the Eiffel Tower FOR THE BENEFIT OF FARMERS. They will indicate the weather for the following day, the direction of the wind, the state of the sky, and the possibilities of dangerous phenomena for agriculture, such as frost, storms, hail, &c., and the variation of temperature. The messages will be transmitted at half-past four daily, and in summer, the "Daily Telegraph" correspondent states, it is intended to send a second message at daybreak. This will contain the same information, only the minimum temperature of the night will be replaced by the maximum temperature of the day.

Mr. Fisk, of Amalgamated Wireless, Ltd., stated at a recent luncheon at the National Club, Sydney, that his company would be prepared to give a first-class service of COMMUNICATION BETWEEN AUSTRALIA AND ENGLAND at one-third less than the cost of cable communication. The cost of establishing the service would be £1 000 000, of which the company already had £450 000. They could obtain the balance, but preferred that the Government should have the control.

Obituary.

The death is announced of MR. P. MARSHALL, local manager of the Eastern Extension Telegraph Company at Shanghai.

ERNEST JAGGER, an electrical apprentice to the Mansfield Engineering Company, became entangled in the shafting of an electri motor motor last week, and died from his injuries.

SIR FRANCIS BARKER, whose death we announced in our last issue, received his early business training in his father's bank in Constantinople, and subsequently became private and confidential secretary to Sir Edgar Vincent (the present Lord D'Abernon), at that time Director-General of the Imperial Ottoman Bank at Constantinople. During this period he travelled extensivly in Syria and other parts of Asia Minor. In 1899 the Parsons' Foreign Patents Company, Ltd., was formed to exploit on the Continent of Europe Sir Charles Parsons' patents for marine and land turbine work. Sir Francis was appointed manager of this company, and as such was instrumental in forming subsidiary companies in various foreign countries, and in establishing works under the Parsons' Patents for the manufacture of land and marine turbines in those countries. He maintained his association with the Parsons Foreign Patents Company, Ltd., and at the time of his death was a director of the company.

The LATEST ELECTRICAL HEATING DEVICE, as might be expected, hails from America, and is intended for the use of those who fear forgery of their cheques. The device consists of a stylographic pen which contains a heating element instead of ink. The current passing through the element is sufficient to make a stylus hot enough to scorch the paper so that an indelible record is made.

Miscellaneous.

The will of the late Mr. ARTHUR BARRETT, managing director of Bailey, Grundy and Barrett, Ltd., shows gross estate of £7 909.

The eleventh annual dinner of the BIRMINGHAM AND DISTRICT ELECTRIC CLUB will be held at the Grand Hotel, Colmore-row, Birmingham, on Friday, Feb. 24, at 6.30 for 7 p.m. The chair will be taken by the President, Mr. Norman Deykin.

Johann Kremenezky has applied for the RESTORATION OF PATENT No. 18 278/1908, for "Improvements in the process of sealing the filament carrier into the bulb of electric incandescent lamps," which expired on Aug. 31, 1915, owing to non-payment of renewal fee.

Mr. C. ATKINSON, K.C., the arbitrator appointed to deal with the claim that CALCIUM CARBIDE should be brought within the SAFEGUARDING OF INDUSTRIES ACT, has come to the conclusion that the substance is not a synthetic organic chemical, and is not improperly excluded from the Act.

William Aaron Davis, electrician, of Farnley, Leeds, has, after several hearings, been remanded on EIGHT CHARGES of OBTAINING SUMS OF MONEY, ranging from £100 to £250, from persons in various parts of the country in connection with partnerships and alleged bogus companies. The alleged frauds involve about £10 000 in all, and complaints are still being received from persons who have been victims. Since 1919 accused has been carrying on business under different names in Leeds as an electrician, as the Leeds Battery Company, the Alliance Cycle and Motor Company, &c.

An important conference of representatives of commercial, industrial, and financial organisations, convened by the Association of British Chambers of Commerce, was held last Friday to consider the REDUCTIONS NECESSARY IN EXISTING POSTAL CHARGES. A suggested list of reductions, drawn up by a special committee of the Association, recommending a return to pre-war rates by three instalments by the end of the year, and the immediate restoration of the Sunday collection of letters, was adopted. If the present rates are continued next year it is estimated that they will produce a surplus income of £10 000 000. This surplus Sir Robert Horne wants to annex for the reduction of taxation, but Mr. Kellaway proposes instead to reduce the rates. There is no doubt as to the public wish in the matter.

In an ADDRESS ON ELECTRICITY, which he gave to the members of the Manchester Rotary Club last week, Mr. E. O. Walker pointed out that it was difficult to make electricity pay, even at 8d. a unit, in suburban districts, where there was little or no demand for it for power purposes. In the case of householders who merely turned on a few lights for a few hours in the winter, a shilling a unit would not be too high a charge. Referring to the multiplicity of uses to which electricity is now put, Mr. Walker said that this country was still very far behind the Continent and America. One catalogue in his possession contained forty pages of advertisements of electric washing machines alone. Electric cooking was cheaper than gas, because there was no waste of heat in the process and no loss of weight in the food.

"RADIO BROADCASTING NEWS," a weekly newspaper, has been established to mark the first anniversary of KDKA, the radio telephone broadcasting station of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa. The newspaper is believed to be the first of its kind in the United States. About one year ago the Westinghouse Electric & Manufacturing Company broadcasted its first programme from KDKA, which was the first station in the world to give nightly broadcasting programmes. Interest in the programmes became so great that, in the latter months of 1921, there was an insistent demand on the part of "listeners in" that they be informed "in advance" of the programmes to be broadcasted from KDKA. With this demand, "Radio Broadcasting News" was born. To-day, with only a few issues off the press, it is stated to be a fixture.

Books Received.

"The Microscope." By Conrad Beck. (London: R. & J. Beck.) Pp. 144. 2s. 6d. net.

"Mechanical World Year Book, 1922." (Manchester: Emmott & Co.) Pp. 266. 2s. 6d. net.

"Is Trade Unionism Sound?" By J. H. Bunting. (London: Benn Brothers.) Pp. x. + 98. 2s. 6d.

"Lexique Technique Anglais-Français." By G. Malgorn. (Paris: Gauthier Villars et Cie.) Pp. 216. 10 fr.

"Heat." Part I. By G. Thompson and G. H. Leslie. (London: Cassell & Company.) Pp. xii. + 160.

"Chemistry." Part I. By G. Thompson and G. H. Leslie. (London: Cassell & Company.) Pp. xi. + 160.

"Mechanical Appliances for Handling Railway Traffic." By G. Bulkeley. (London: "The Railway Gazette.") Pp. 132. 5s. net.

"Parallaxes of 260 Stars." By S. A. Mitchell, Ph.D. (New York: Columbia University Press.) Pp. 695. $3.00.

"Calcolo delle Condutture Trifasi per la Trasmissione dell' Energia." (Milan: Ulrico Hoepli.) Pp. xv+250. L.20.

"Costruzioni Elettromeccaniche." By E. Morelli. Vol. III., Part 14. (Turin: Unione Tip Editrice.) Pp. 256. Lire 20.

"Die Krankheiten des Blei-Akkumulators." By F. E. Kretzschmar. (Munich: R. Oldenburg.) Pp viii+176. M. 165.

"Real Mathematics." By Ernest G. Beck, Wh. Ex. (London: Henry Frowde and Hodder & Stoughton.) Pp. ix.+306. 15s. net

Catalogues, Price Lists, &c.

BAXTER & CAUNTER, LTD., have issued their February price list of electrical accessories, and will be pleased to send a copy on application.

SIEMENS BROTHERS & COMPANY have published a new edition of their Catalogue No. 106, "Twin Flexible Cords," in which the prices show considerable reductions.

The advantages claimed for the "New System" automatic intercommunication telephones are set forth in a circular issued by the NEW SYSTEM PRIVATE TELEPHONE COMPANY.

We have received from A. HINDERLECH two leaflets, E. 2015 and E. 2030, dealing respectively with asbestos woven resistance nets and grids, and wrought copper cable soldering sockets.

The LUBRICINE OIL & TRADING COMPANY, 168, Regent-street, W. 1, have issued their current price list of lubricating oils. The company supply dynamos and high-class machinery oils and lubricants for all purposes.

"Guarding the minute," the latest pamphlet circulated by the INTERNATIONAL TIME RECORDING COMPANY contains details and coloured illustrations of the latest models of time recorders manufactured by the firm.

A thirty-five page booklet published by Griffiths Brothers & Company, London, Ltd., gives brief descriptions of the various INSULATING VARNISHES and COMPOUNDS manufactured by the firm, and the purposes for which they are suitable.

THE GENERAL ELECTRIC COMPANY have just issued Catalogue Section X (4) dealing with condenser protective gear for dissipating voltage surges. This section has been issued to cover the apparatus, the use of which is described in the firm's Bulletin No. 10.

The B. E. Company (of London and Birmingham), Ltd., have sent us a leaflet giving some details of the "J. H. M. PERFECTO" TIME SWITCH. The clock is claimed to be absolutely reliable, and is mounted above the switch, which is 10A double pole, ironclad.

Twenty-three additional leaflets, illustrating their various types of iron-clad switchboards, distributing boxes, a.c. starting panels, h.t. truck type switch gear, and h.t. cubicle type switch gear, have been issued by MAJOR & COULSON for inclusion in their last switchgear catalogue.

A striking showcard of the ROYAL "EDISWAN" FULLOLITE GAS-FILLED LAMP has been sent us by the Edison Swan Electric Company. The card, which measures 16 by 12 in., is dark purple and black, with bold white letters. A picture of the lamp, which is also white, stands out in bold relief.

Payment on the instalment system is announced by L. G. Hawkins & Company in regard to their "Universal" washing machines, heavy ranges, and vacuum cleaners. Under the title of the UNIVERSAL DEFERRED PAYMENTS PLAN the company have made arrangements with the Financial Trust Company to finance time payments for the above appliances.

HOLLINGS & GUEST, LTD., have just put on the market a new hydraulic 50-ton tyre press for fixing solid rubber tyres of motor-bus and other commercial vehicle wheels. This press has been designed to meet the demand for a smaller and less expensive press than the standard tyre presses of 150-200 tons. It embodies all the features of the larger and more powerful presses; it has four columns with close-fitting guides to prevent tipping of the table; and it has also the divided head, so that wheels can be carried right into the press.

The February issue of HIGGS BROTHERS' monthly magazine contains the usual mixture of powder and jam, the powder being the information regarding the various types of motors made by the firm, and the jam the lighter literary efforts, a perusal of which should assist in the increased sale of these same motors. It is human to love a joke, and human also to deduce that a firm who can make good jokes must also make good motors. Special attention may be drawn to the stirring story of a terribly tall tragedy, which we fear may land the firm in a libel suit. Of more direct use to those employing motors, Higgs or otherwise, are hints and tips on ball bearings.

The issue of the seventh edition of "LEKTRIK" LIGHTING CONNECTIONS, by A. P. Lundberg & Sons, is sufficient indication of the usefulness of this booklet. It contains illustrations and descriptions of no fewer than 119 circuits. These are in general designed to obtain lighting effects of various kinds, though there are a few circuits which refer to fire alarms. Various types of switches and accessories are also illustrated and described, as are the methods which have been designed to demonstrate the changes that take place in the circuits when various switches are used. We notice that in 1912 we remarked that "the control of lighting circuits is a matter which needs greater attention at the hands of electrical contractors, and wiring consultants." If in the intervening years it has not received that attention, it is no fault of Lundberg & Sons, for this is a book which should be in the hands of every wireman and most electrical engineers.

One of the most useful wall calendars we have received this year has been sent us by HOLLINGS & GUEST, LTD. The monthly slips are placed below a photograph of one of the firm's erecting shops, taken from a 20-ton overhead electric travelling crane, and the black figures, which are nearly 1 in. in depth, stand out clearly on a pale-tinted background.

Tenders Invited and Accepted.

UNITED KINGDOM.

Walton-on-Thames Urban Council. Feb. 13.—Electric wiring and fitting in "Elm Grove," Hersham-road, Walton. Specifications can be seen at the Council Offices.

Manchester Tramways Committee. Feb. 14.—Tramcar type Ah meters, armature and field coils, lamps, bells, and cells, insulation material, overhead equipment material, power and lighting cable, &c. Particulars from Mr. J. M. McElroy, General Manager, Corporation Tramways, 55, Piccadilly, Manchester.

Gloucester Corporation. Feb. 14.—Two 1 500 kW geared d.c high-pressure steam turbo-generators, with surface condensing plant. Specification, &c., from the Town Clerk.

Cardiff Corporation. Feb. 15.—400 tons of steel tram rails. Specifications, &c., from the City Engineer.

Edinburgh Corporation. Feb. 15.—Auxiliary circuits and electric lighting and earthing for Westbank power station. Specification, &c., from the Electrical Engineer, Dewar-place, Edinburgh.

Islington (London) Borough Council. Feb. 16.—One year's supply of stores, including cables, electricity meters, fuse boxes, compounds, lamps, wires, electrical sundries, transformers, carbons, arc lamp globes, insulators, &c. Specification, &c., can be obtained at the Town Hall.

Oldbury Urban Council. Feb. 18.—Wiring and fitting the public buildings and library. Specification, &c., from the Council's Engineer and Surveyor.

Bradford Corporation. Feb. 18.—Steel girder tram rails. Particulars from Mr. F. Marsden, City Engineer and Surveyor, Town Hall, Bradford.

Hull Corporation. Feb. 20.—500 or 1 000 tons girder tramway rails. Forms of tender, &c., from the City Engineer.

Dublin Electricity Committee. Feb. 20.—Transformers for one or two years. Specifications, &c., from the City Electrical Engineer, Fleet-street, Dublin.

Great Western Railway. Feb. 20.—Stores for three months from March 1st, including telegraph instruments, electrical apparatus (insulators), &c., electrical wires and cables, telegraph ironwork, and tools, telegraph drysalteries, and electric lamps.

Hammersmith Borough Council. Feb. 22.—Stores for 3, 6, or 12 months, commencing on April 1, including electric light sundries, insulated wire, metals, packing and jointing materials, tools, joint boxes and connections, and meters. Particulars from Mr. G. G. Bell, Borough Electrical Engineer, 85, Fulham Palace Road, W. 6.

Burton-on-Trent Corporation. Feb. 22. 6 000 kW three-phase turbo-alternator, with condenser and switchboard; and two 40 000 lb. water-tube boilers, with economisers, coal-handling plant, &c. Specifications from the Borough Electrical Engineer.

Metropolitan Water Board. Feb. 23.—Electric lamps, &c., for three, six, or twelve months. Forms of tender from the Chief Engineer, 173, Rosebery-avenue, London, E.C. 1.

East Grinstead Urban Council. Feb. 24.—Oil engine driven generators, motor balancer, motor booster, steam engine and dynamo, storage batteries, main switchboard, super-heater, feed-water heater, cable system, street lamps and travelling crane. Specification from the Clerk of the Council, 102, London-road, East Grinstead.

Skipton Urban Council. Feb. 25.—Supply, laying, &c., of four core, paper insulated, lead covered, steel tape armoured cable. Specification, &c., from Mr. W. Emmott, 35, Commercial-street, Halifax.

Leeds Corporation. Feb. 27.—One year's supply of stores and materials to the Tramways and Highways Departments, including copper bands, electrodes, electrical sundries, engineers' furnishings, ironmongery, &c. Specifications from the General Manager, Tramways Department, 1, Swinegate, Leeds.

Eston. Feb. 28.—The erecting and providing of plant in connection with the overhead lines, underground cables, transformers, sub-station equipment, and public lighting fittings required under Eston Electricity Special Order, 1921. Particulars from the Clerk, Mr. T. Belk, Cleveland House, Grangetown, S.O., Yorks.

Hampstead (London) Borough Council. March 15.—Supply of various stores for six or twelve months, including electrical engineers' stores and oils for the electricity station. Form of tender, &c., from the Town Clerk.

Aylesbury Corporation.—300 kW converter, with e.h.t. and l.t. switchgear. Specifications, &c., from the Borough Electrical Engineer.

Aylesbury Corporation.—1 500 kW or 1 000 kW turbo-alternator, condenser and switchboard. Specification from the Borough Electrical Engineer.

Accrington Corporation.—Supply, delivery, and complete erection of 25 000 lb. water-tube boilers, economisers and brickwork. Particulars from Mr. A. W. Clegg, Engineer and Works Manager.

AUSTRALIA.

Commonwealth of Australia. March 8.—Switchboard apparatus and parts (schedule 545). Particulars from the Supply Officer, Room 101, Australia House, Strand, London, W.C. 2.

Victorian Railway Commissioners. March 8.—*Thirty-five cabin transformers for power signalling. (Contract No. 34 863.)

Postmaster-General's Department, Brisbane. March 8.—*Telephone switchboard apparatus and parts, including calculagraphs, caps, plane convex lens, retardation coils, cords, generators, indicators, jacks, keys, lamps, pegs, plugs, meters, relays, telephone sets &c. (Stores schedule No. 545.)

Deputy Postmaster-General, Brisbane. March 15.—*Protective apparatus, including arresters, carbon blocks, fibre fuses, protectors and terminals. (Stores schedule No. 546.)

Commonwealth of Australia. March 15.—Protective apparatus. Particulars from the Supply Officer, Room 101, Australia House, Strand, London, W.C. 2.

Postmaster-General's Department, Adelaide. April 5.—*Twelve adjustable condensers for use on telegraph duplex circuits. (Schedule No. 613.)

NEW ZEALAND.

Public Works Tenders Board, Waikato Power Scheme. March 6.—*(Section 45) two 2 500 kWa alternators, three-phase, 50 cycle, 5 000 V, at 166⅔rds rev. per min., with a power factor of .8. Excitation at 220 V. (Section 46) two 3 100 H.P. water turbines of the double-runner Francis type to operate the generators mentioned in Section 45. (Section 47) two exciter sets, each consisting of one 200 kW d.c. generator, and one 350 H.P. asynchronous motor, together with a Tirrill regulator. The generator shall have an output of 220 V, with a full-load current of 7 000 A. The motor shall be of 350 H.P., with a power supply of 400 V, three-phase, 60 cycle. The synchronous speed of the sets shall be 750. (Section 48) four Stoney sluice gates for the pits, appertaining to the turbines mentioned in Section 46. Tenders to the Secretary, Public Works Tenders Board, Government Buildings, Wellington.

Dunedin City Council. March 31.—*Supply and delivery of one 150 H.P. three-phase induction motor and reduction gear for the Mornington Cable Service.

Auckland Harbour Board. April 25.—Four double-barrel electric winches for the Central Wharf, Auckland. Specifications from W. & A. McArthur, 18-19, Silk-street, Cripplegate, London, E.C. 2.

SOUTH AMERICA.

State Electric Power House, Montevideo. March 21.—*Diesel set, comprising a 4-stroke Diesel engine directly coupled to a d.c. generator of 125 kW for a three-wire system at 2x235 V. Local representation is essential.

Ayrshire Education Committee has accepted the tender of Mr. W. G. Dodd, Ayr, for wiring St. Margaret's Schools at £115.

Orders for five "Straker-Clough" trolley omnibuses for Bloemfontein and four for the Teeside Railless Traction Board have been received by Clough, Smith & Co.

The managers of the Central London School District have accepted the tender of the Metropolitan Electric Supply Company to lay l.t. mains in the central block of the school, at an approximate cost of £356.

London County Council have accepted the tender of A. Hawkins & Sons (lowest tender received) for wiring and fitting Belleville-road, Battersea, school, £718 10s. (Seven tenders were received, the highest being £1 060.)

Despite the fact that there was a difference of nearly £4 000 in the tenders, the Worthing Town Council have decided by twenty votes to three to accept the tender of the British firm of Mirlees, Bickerton & Day in preference to that of a German firm, for the supply of a new Diesel engine and generator for the borough's electricity generating station. The net inclusive price of the accepted tender was £11 375, as against £7 810.

The following tenders have been accepted by Manchester Corporation:—Alliance Electrical Company, electric wiring at Chester-street school; Building Guild, Ltd., electric wiring at Thomas-street school; Allen, West & Company, transformer neutral earth resistance; Nalder Bros. & Thompson, indicating instruments; Metropolitan-Vickers Electrical Company, W.R. meters; W. H. Henley's Telegraph Works Company, adhesive tape; Connollys (Blackley), Blackley tape; Siemens Bros. & Company, dry batteries for flash lamps; Callender's Cable & Construction Company, box compound and bittite tape; Dussel Bitumen Company, box compound; Le Carbone, Ltd., and Morgan Crucible Company, carbon brushes; W. Patterson, Ltd., dynamo brushes; Siemens Bros. & Company, fuse boxes; W. T. Glover & Company and W. T. Henley's Telegraph Works Company, rubber tape, &c.; General Electric Company, Ltd., auto-transformers and auto-balances; British Insulated and Helsby Cables, Ltd., e.h.t. trifurcating boxes; Johnson & Phillips, l.t. trifurcating boxes; Siemens Bros. & Company l.t. trough box; London Electric Wire Company and Smith's, wire; Brotherton Ediswan Tubes and Conduits, tubing and accessories; Hawkins Bros. & Company, tinned copper and pure tin fuse wire; Titan Trackwork Company, manganese steel crossings; E. M. Evans & Sons, electric light wiring and subsidiary service wiring of certain houses on the Gorton, Catterick Hall and Newton Heath estates. Callender's Company have been permitted to sub-let their conduits contract to J. Place & Sons, and A. Reyrolle & Company to sub-let to Siemens Bros. Dynamo Works, Ltd., a contract for trip-circuit batteries.

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* *Particulars from the Department of Overseas Trade.*

Companies' Meetings, Reports, &c.

The total revenue of the Anglo-Argentine Tramway Company in 1921 amounted to £4 203 369, compared with £3 997 565 in 1920, an increase of £205 824.

Smithfields Market Electric Supply Corporation have declared a dividend at the rate of 5 per cent. for 1921. The sum of about £1 550 is carried forward.

The Westminster Electric Supply Corporation has declared a final dividend for the half-year to Dec. 31 at the rate of 12 per cent. per annum, making 10 per cent. for the year 1921.

After transferring £37 545 to the depreciation fund, the accounts for 1921 of the Central Electric Supply Company show a loss of £7, and the surplus brought forward is reduced to £8.

An extraordinary meeting and a separate meeting of the holders of the preference shares of J. G. White & Company are to be held to-day (Friday) to consider a scheme of capital reorganisation.

Fairbairn, Lawson, Combe, Barbour, Ltd., are this week offering for subscription £350 000 7½ per cent. 15 year notes at 94, in registered notes of £50, £100, and £500, and 150 000 ordinary shares of £1 each at par.

After deducting dividends amounting to £2 10s. per share, free of tax (including 15s. 3d. per share from equalisation of dividends fund), the accounts of the Indo-European Telegraph Company for 1920 show a credit balance of £16 620, which is to be carried forward.

The directors of St. James' & Pall Mall Electric Light Company recommend a balance dividend on the 7 per cent. preference shares for the half-year ending Dec. 31 1921, of 3s. 6d. per share, and 8s. 6d. per share on the ordinary shares, making, with the interim dividend paid thereon, a total distribution of 12 per cent. for the year.

The accounts of the Yorkshire (West Riding) Electric Tramways Co. for 1921, after providing for debenture interest, show profit of £33 071, which has been appropriated as follows: Dividend of 6 per cent. on preference shares, £9 715; to renewals, depreciation and reserve fund in lieu of accident insurance, £19 126; carried forward, £4 230.

The accounts of the Tyneside Tramways and Tramroads Company for the half year ended December last show a surplus of receipts over expenditure of £4 971, to which is added £140 brought in. A dividend of 2½ per cent. on the ordinary shares for the year, less tax, is declared. The sum of £500 is placed to reserve and depreciation, leaving £591 to be carried forward.

The Stock Exchange Committee have ordered the following securities to be quoted in the Official List:—$1 500 common stock of Consolidated Gas, Electric Light & Power Company of Baltimore; £200 000 4 per cent. debenture stock of London Electric Railway Company; 40 000 £1 fully paid ordinary shares of Waygood-Otis, Ltd. Dealings in £823 300 7 per cent. 50-year prior lien A bonds of the Barcelona Traction Light & Power Company have been specially allowed.

The Metropolitan Railway Co. have declared a final dividend for the half-year ended Dec. 31, at rate of 3 per cent. per annum, making 2¼ per cent. for the year. The sum of £50 000 is placed to general renewals reserve, and £17 800 is carried forward. For the second half of 1920 the dividend was at the rate of 2 per cent. per annum (making 1½ per cent. for the year), a similar sum was placed to general renewals reserve, and about £15 416 was carried forward. The dividend on the surplus land stock is again 3 per cent. for the year, and £1 320 is carried forward (against £1 940). In 1920 the sum of £1 000 was placed to reserve.

The adjourned twenty-first and twenty-second annual meetings, and the twenty-third annual meeting of Chadburn's (Ship) Telegraph Company were held last week, Mr. William Chadburn, Chairman of the company presiding. After explaining fully the present position of the company, Mr. Chadburn said he hoped they might now be able to resume their pre-war programme and hold their annual meeting within the few months of the termination of the financial year. He assured the shareholders that every effort was being made to reduce expenditure and bring figures back to as near pre-war values as possible. An abstract of the report and accounts was given in our issue of Jan. 27.

The report for 1921 of the City of Buenos Ayres Tramway Company (1904) states that the annuity payable by the Anglo-Argentine Tramways Company has been received. The net revenue for the year, including £3 940 brought in, was £71 339. A balance dividend of 1s. 3d. per share is recommended, making 5 per cent., less tax, for the year, or the same as for 1920. The sum of £2 000 (against £3 000 last year) is placed to general amortisation fund, and the "carry forward" is increased by £3 399 to £7 339. The amortisation fund for the debenture stock, with accrued interest to date, amounts to £20 235, and the general amortisation fund for the redemption of the share capital now amounts to £79 396.

The directors of the Electric & Railway Finance Corporation, which was registered in December, with a nominal capital of £500 000, in £1 shares, are: Mr. Frank Dudley Docker, Sir Edward Ernest Pearson, Mr. D. Heineman, and Mr. Bernard D. F. Docker. Among the shareholders are Mr. F. D. Docker (235 000 shares), Whitehall Securities Corporation (100 000), Sir Algernon Firth (48 997), Sir Edward Pearson (25 000), Mr. Heineman (20 000), and the Société Financière de Transports et d'Enterprises Industrielles (20 000). The registered office is 4, Central-buildings, Westminster. The company will be interested chiefly in railway electrification, but it will carry on all or any of the businesses usually carried on by trust, land, mortgage and agency companies.

The accounts of the Sunderland District Electric Tramways, Ltd., for the year ended October 31, 1921, show, after providing for depreciation, &c., a balance of £11 051, to which was added £1 542 brought in. After deducting interest on the prior lien bonds and first mortgage debentures, £7 100; sinking fund instalment, £500; a balance of £4 993 10s. remains. From this the directors recommend the payment of interest at the rate of 5 per cent. per annum (less income-tax) on the first and second income bonds, which will absorb £4 065, leaving a sum of £928 to be carried forward to the credit of the current year. Capital expenditure amounting to £13 739 was incurred during the year in the purchase of new cars, additional plant and machinery, extension of car sheds, and other works. The net result of the year's operation shows a decrease in the operating profit of £3 758 over last year.

After providing £149 712 for depreciation, &c., and £29 000 for corporation tax, the net revenue of The British Colombia Electric Railway Company for the year ended June 30 last amounted to £421 277, which compares with £412 827 for the previous year. A final dividend at the rate of £1 3s. 8d. per cent. per annum (tax free) is recommended on the preferred ordinary stock, making £4 13s. 8d. (tax free) for the year, against £4 13s., while the deferred ordinary stock receives a balance dividend at the rate of £2 14s. 2d. per cent. per annum (tax free), which makes £6 4s. 2d. (tax free) for the year, against £6 4s. at this time last year. The balance of £23 999 carried forward compares with £12 646 brought into the accounts. Notwithstanding the depression which has existed for some time past, the indications from traffic returns and from light and power department results are that the earnings of the company will be maintained during the year to June next. The demand for light, power and gas continues to be brisk in consequence of the large amount of building now going on in various districts. While there has been a falling off in the consumption of some power customers, particularly in the lumber industry, this appears to be only temporary, and with a renewal of the demand for lumber by the prairie markets the mills may soon be expected to resume operation. There have been many valuable power customers added during the year.

The total net income of the London Brighton & South Coast Railway Company for the year 1921 amounted to £1 344 256, which, with £35 512 brought forward and an appropriation from railways compensation suspense account, being part of £720 971 received under an allocation scheme prescribed by the Railways Act, 1921, of £205 000, gives a total of £1 584 768. The balance available is £479 672, and enables the board to recommend dividends of £4 5s. per cent. on the undivided ordinary shares (making 5¼ per cent. for the year), £97 384; £4 per cent. on the preferred ordinary shares (making 6 per cent.), £163 114; £4 10s. per cent. for the year on the deferred ordinary shares, £183 503; leaving £35 671 to be carried forward. The capital account for the year shows a net expenditure of £149 893. In the report the directors call attention to the fact that at the outbreak of the war active progress was being made towards the completion of a scheme for the electrical equipment and working of a large part of the suburban railways of the company, and that although it became necessary to cancel the main contracts for the work it was found possible to proceed with certain portions of it. This course was followed because the board was and still is convinced from its experience of electrical working, so far as it has been brought into operation, that no better policy can be pursued, at the proper time, than to extend that mode of working. The work now in progress, namely, the equipment of the railway between Balham and West Croydon, is approaching completion, and relying upon the assent of the proprietors the board proposes to proceed to complete the surburban scheme interrupted by the war so soon as financial and other conditions permit.

The advantages of electric traction on suburban services were clearly brought out in the course of the proceedings at the annual meeting of the East London Railway Company last week. Though there was a decline in the number of passengers carried and in gross receipts, this was not more than was expected. The line was electrified just before the war, but the development of traffic that ensued accrued to the Government. The Board made four unsuccessful attempts during the control to obtain some financial concession, having regard to the large increase in receipts due to the adoption of electric traction, but an application for compensation is being drawn up for submission to the Railways Amalgamation Tribunal.

Replying to a series of questions by Mr. Olsson, the chairman (Lord Claud Hamilton) stated that having regard to sect. 76 of the Railways Act of 1921 the amount payable to leased undertakings in the form of a percentage of gross receipts was limited to rates and fares in operation in 1913. Leaving out of consideration the arrears on electrification interest, but taking into account the annual amount that had to be provided for on that score, about £130 000 gross earnings were required to pay all dividends down to and including the full 4 per cent. on the third debentures and the annual interest on capital to lessee companies. To pay full interest on all debenture stock gross receipts amounting to £171 500 would be required. The approximate amount of arrears of interest to Dec. 31, 1921, was £18 772, and after liquidating that electrification amount the future annual payment would be approximately £3 320. From Aug. 15 any excess of earnings (calculated at 1913 rates and fares) over and above the minimum rental would go in reduction of arrears of interest on electrification.

New Companies.

CLARKE'S (MANCHESTER), LTD. (179 362). Private company. Registered Jan. 31. Capital, £500 in £1 shares. Electrical and general engineers, &c. First directors: H. C. Bagshaw, Mrs. E. M. A. Leslie, G. W. Leslie, and C. E. Warren Roberts. Qualification, 100 shares. Secretary, M. Leslie. Registered office: 134, Wellington-road, Eccles, Lancs

COLLIERY EXPLOSIVES COMPANY, LTD. (179 341). Private company. Registered Jan. 30. Capital, £6 000 in £1 shares. To acquire and turn to account any inventions for improved explosive compounds and processes for moulding cartridges and apparatus therefor, and for protecting, preserving or packing explosives, &c., and to carry on the business of manufacturers of explosives, electric fuses and detonators, &c. First directors: T. Abbott, A. J. Jordan, and G. A. Jordan. Registered office: 112, Market-street, Earlestown, Lancs.

COOPER & SMITH, LTD. (179 462). Private company. Registered Feb. 3. Capital £12 500 in £1 shares. To acquire the business of electric motor and cutter manufacturers and dealers lately carried on by the Portable Electric Motors (1919) Ltd., at 121, Victoria-street, S.W., and elsewhere. First directors: J. Cooper and J. W. F. Smith. Registered office: Station-row, Maldon, Essex.

CHARLES JONES, JUNIOR, LTD.—Private Company. Registered in Dublin, Jan. 26. Capital, £2 000 in £1 shares. Electrical and mechanical engineers, contractors, manufacturers. &c. The first directors: C. Jones, Junr., C. F. Beckett. Secretary, C. Jones, Junr. Registered office: 3, Astons-quay, Dublin.

NEWCASTLE GENERAL SUPPLY COMPANY, LTD. (179 438). Private company. Registered Feb. 2. Capital, £500 in £1 shares. To take over the business and assets (but not liabilities) of C. Jack, trading as the "Newcastle & General Supply Company," at 156, Northumberland-street, Newcastle-on-Tyne, and to carry on the business of factors of and agents for electric lamps, and all kinds of electric or similar goods, electrical engineers, agents, publishers of books dealing with electrical engineering, &c. Permanent directors: R. J. J. Bigley, J. McDonald, and G. B. Pawson. The directors may borrow up to the amount of the paid-up capital. Qualification, 50 shares. Registered office: 156, Northumberland-street, Newcastle-on-Tyne.

PARKINSON, POLSON & COMPANY, LTD. (179 414). Private company. Registered Feb. 1. Capital, £2 000 in £1 shares (500 7 per cent. cumulative preference and 1 500 ordinary). To take over the business of automobile engineers and electricians, carried on by H. E. F. Parkinson and C. J. Polson at 30, Commercial-road, Eastbourne, as "Parkinson, Polson & Company." First directors: H. E. F. Parkinson, C. Polson and J. G. Enoch (all permanent). Solicitors: Billinghurst, Wood & Pope, 7, Bucklersbury, E.C. 4.

H. E. WEATHERLEY & COMPANY, LTD. (179 402).. Private company. Registered Feb. 1. Capital £500, in 450 6 per cent. cumulative preference shares of £1, and 1 000 ordinary shares of 1s. each. Electrical and mechanical engineers, manufacturers of, and dealers in, engines of all kinds, &c. Permanent directors: A. E. Showell, A. L. Pailthorpe and H. E. Weatherley. Qualification, £1. Solicitor: Kenneth E. Bartlett, 9-10, Fenchurch-street, E.C.

WESTERN RUBBER & BRATTICE CLOTH COMPANY, LTD. (179 356). Private company. Registered Jan. 30. Capital £3 000, in £1 shares. Manufacturers of and dealers in electrical goods and appliances, colliery requisites, &c. First directors: (Permanent) R. P. Kilminster, managing director, and J. Stevens, works manager. The subscribers have power within the first twelve months to appoint other directors. Registered by W. B. Porter, 10, Commercial-street, Newport, Mon.

WHEATLEY BROTHERS (ALDINGTON), LTD. (179 357). Private company. Registered Jan. 30 Capital £3 000. in £1 shares. To take over the business of motor, agricultural and general engineers and electricians carried on by Wheatley Brothers at Aldington, Kent, and to carry on the same and the business of engineers, &c. First directors: D. Y. Wheatley, manager, and J. W. Pickering. Qualification. £500. Registered office: Goldenhurst Works, Aldington, Kent.

FREYN, BRASSERT & COMPANY, LTD., has been registered as a "private" company with a nominal capital of £5 000 in £1 shares, to take over the business carried on in England by Freyn, Brassert & Company, a company incorporated under the laws of the State of Maine, U.S.A., and to carry on the business of designers, equippers and erectors of blast furnaces, steel plants, rolling mills and all classes of engineering works (particularly in connection with the iron and steel industry), iron and brass founders, engineers, electrical engineers, &c. The signatories to the memorandum of association (each signing for one share) are: W. A. Walber and H. B. Robinson. The signatories are to appoint the first directors. Secretary: H. B. Robinson. Registered office: 38, Victoria-street, S.W. File number: 179 435.

ELWORTHY-SADET, LTD., has been registered as a "private" company with a nominal capital of £1 100 in 1s. shares. The objects are: To acquire all or any of the shares of the Russian companies, M. Helfferich Sadet, Ltd., of Kharkoff, and R. and T. Elworthy, Ltd., of Elizabethgrad, and the businesses of these Russian companies, to acquire and hold shares, stocks, debentures, and obligations of any company in any part of the world, and to carry on in Russia or elsewhere the business of electrical and general engineers, &c. First directors: R. P. Elworthy (Chairman), W. R. Elworthy, A. J. Youngman, J. R. Caoul, C. Blakey, P. W. Robson, W. F. A. Fletcher, and J. Gillespie, each of whom may retain office till 1927 unless otherwise determined by the company. Solicitors: Johnson, Weatherall & Company, 7, King's Bench-walk, Temple, E.C. File number 179 465.

Arrangements for the Week.

FRIDAY, Feb. 10th (to-day).

PHYSICAL SOCIETY.

5 p.m. At the Imperial College of Science, London, S.W. Papers "On the Measurement of the Radium Content of Sealed Metal Tubes," by Dr. E. A. Owen and Bertha Naylor, B.Sc.; "The Crystal Structure of Ice," by Sir William Bragg, F.R.S.; and "A Method of Exciting Vibrations in Plates, Membranes, &c., based on Bernouilli's Principle," by Dr. Kerr Grant.

INSTITUTION OF ELECTRICAL ENGINEERS.
(SCOTTISH CENTRE. STUDENTS' SECTION.)

7.30 p.m. At the Royal Technical College, Glasgow. Paper on "The Sperry Gyro Compass," by Mr. H. M'Comb.

ELECTRO HARMONIC SOCIETY.

8 p.m. At Cannon-street Hotel, London, E.C. Concert. (Ladies' Night.)

INSTITUTION OF ELECTRICAL ENGINEERS.
(IRISH CENTRE.)

8 p.m. At the Royal College of Science, Upper Merrion-street, Dublin. Paper on "A Method of Regulating the Voltages on the Two Sides of a Three-Wire C.C. System Equalised by Static Balancers," by Mr. R. D. Archibald.

SATURDAY, Feb. 11th.

BIRMINGHAM AND DISTRICT ELECTRIC CLUB.

7. p.m. At the Grand Hotel, Birmingham. Lecture on "Illumination," by Mr. C. G. A. McDonald.

MONDAY, Feb. 13th.

INSTITUTION OF ELECTRICAL ENGINEERS.
(INFORMAL MEETING.)

7 p.m. At Savoy-place, London, W.C. Subject, "The Evolution of a Staff Trade Union," opened by Mr. J. H. Parker.

(NORTH-EASTERN CENTRE.)

7.15 p.m. At Armstrong College, Newcastle. Paper on "Rotary Converters, with special reference to Railway Electrification," by Mr. F. P. Whitaker.

(DUNDEE SUB-CENTRE.)

7.30 p.m. At University College, Dundee. Paper on "Publicity and Electrical Development," by Mr. J. W. Beauchamp. (To be read by Mr. G. Fowler.)

TUESDAY, Feb. 14th.

(EAST MIDLAND SUB-CENTRE.)

6.45 p.m. At the College, Loughborough. Paper on "High Power Mercury Arc Rectifiers," by Mr. R. L. Morrison.

(NORTH MIDLAND CENTRE.)

7 p.m. At the Hotel Metropole, King-street, Leeds. Paper on "The Cyc-Arc Process of Automatic Electric Welding," by Messrs. L. J. Steele and H. Martin.

JUNIOR INSTITUTION OF ENGINEERS.
(NORTH-EASTERN SECTION.)

7 p.m. At Armstrong College, Newcastle-on-Tyne. Paper on "Steam Locomotive Economy," by Mr. T. Grime.

INSTITUTION OF ELECTRICAL ENGINEERS.
(SCOTTISH CENTRE.)

7.30 p.m. At 207, Bath-street, Glasgow. Lecture on "The Uses of Wireless, Past and Future," by Major J. Erskine-Murray.

(NORTH-WESTERN STUDENTS' CENTRE.)

7.30 p.m. At Houldsworth Hall, Deansgate, Manchester. Paper on "Hydro-Electric Power Supply," by Mr. A. Tustin.

WEDNESDAY, Feb. 15th.

INSTITUTION OF RAILWAY SIGNAL ENGINEERS.

3 p.m. At the Institution of Electrical Engineers, Victoria Embankment, London, W.C. Annual General Meeting and Presidential Address by Mr. W. C. Acfield, O.B.E.

INDUSTRIAL LEAGUE AND COUNCIL.

7.30 p.m. At Caxton Hall, Westminster, London, S.W. Lecture on "Industry and Its Relation to Finance," by Sir George Paish.

THURSDAY, Feb. 16th.

INSTITUTION OF ELECTRICAL ENGINEERS.

6 p.m. At Savoy-place, London, W.C. Paper on "Rotary Converters, with Special Reference to Railway Electrification," by Mr. F. P. Whitaker.

NATIONAL LIBERAL CLUB. POLITICAL AND ECONOMIC CIRCLE.

8 p.m. At Whitehall-place, London, S.W. Lecture on "The Provision of Capital and Finance," by Mr. H. Ward, J.P

FRIDAY, Feb. 17th.

INSTITUTION OF MECHANICAL ENGINEERS.

6 p.m. At Storey's-gate, St. James's Park, London, S.W. Annual General Meeting and Paper on "Electric Welding Applied to Steel Construction, with Special Reference to Ships," by Mr. A. T. Wall.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION.

7.30 p.m. At the Chartered Institute of Patent Agents, Staple Inn-buildings, W.C. Salesmanship Conference. (No. 4.) "Salesmanship in Relation to Electric Lighting." Speaker, Mr. H. Harrison.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Lecture on "Water Purification for Boiler Feed Purposes," by Mr. W. J. Leaton.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Partnerships Dissolved.

INMAN, William Hodgson, INMAN, Joseph Edward, and INMAN, Dick, electrical engineers, 38 and 40, North-road, Lancaster, under the style of W. H. INMAN, by mutual consent as from Dec. 31, 1921. Debts received and paid by W. H. Inman, who will continue the business.

MITCHELL, George, MYERS, Frederick Stephen, and ROSCOE, Daniel, electricians, at Market Bridge Mill, Burnley, under the style of GEORGE MITCHELL & COMPANY, by mutual consent as from Feb. 1, 1922. Debts received and paid by G. Mitchell and F. S. Myers, who will continue the business.

SMEAD, Ernest, and BORLACE, Walter John, electricians, &c., at 6A, The Avenue, Ealing, Middlesex, under the style of THE HOUSEHOLD WORK COMPANY, by mutual consent as from Oct. 31, 1921. Debts received and paid by E. Smead, who will continue the business.

WALKER, Percy, and FERRIER, Frederick Charles, electrical engineers and contractors, 283, New King's-road, Fulham, London, under the style of the HURLINGHAM ELECTRIC COMPANY, by mutual consent as from Dec. 12, 1921. Debts received and paid by P. Walker, who will continue the business.

WATSON, Frederick, WATSON, George Parker, and BENNETT, George, electrical engineers and electrical factors, 11, Northumberland-alley, E.C. 1, under the style of F. WATSON & COMPANY & ADVANCE ELECTRIC LAMP & ACCESSORIES COMPANY, by mutual consent as from Jan. 23, 1922. Debts received and paid by F. Watson and G. Bennett.

Bankruptcy Information.

SCOTT, Thomas, and CAMPBELL, James, under the style of T. SCOTT & COMPANY, 42, Handyside's-arcade, Percy-street, Newcastle-upon-Tyne, wholesale electrical suppliers. Receiving order, Feb. 2. Debtor's petition. First meeting, Feb. 21, 11 a.m., Official Receiver's Office, Pearl-buildings, 4, Northumberland-street, Newcastle-upon-Tyne. Public examination, Feb. 23, 11 a.m., County Court, Westgate-road, Newcastle-upon-Tyne.

WATMOUGH, Arthur Appleby, 41, Town-street, Horsforth, and 1, Back James-street, Harrogate, Co. York, electrical engineer. Receiving order, Jan. 31. Debtor's petition.

Companies Winding-up Voluntarily.

FREEMAN, J., & COMPANY, LTD. R. H. Bridgwater, 3, New-street, Birmingham, appointed liquidator. Meeting of creditors at Birmingham Chamber of Commerce, 95, New-street, Birmingham, on Tuesday, Feb. 14, at 2.30 p.m. Particulars of claims to the liquidator by Feb. 28.

GOODALL ELECTRIC, LTD. A. G. Turner, Liberty-buildings, School-lane, Liverpool, appointed liquidator. Meeting of creditors at 64, County-road, Walton, Liverpool, Wednesday, Feb. 15, at 2.30 p.m.

RAWCLIFFE, FRANK, & COMPANY, LTD. W. Brittain, 15, Pilgrim-street, Newcastle-upon-Tyne, appointed liquidator.

Winding-Up Petition.

GILLITT & COMPANY, LTD. A petition for winding up of this company has been presented by Fenwick, Ltd., and is to be heard at the Court House, Westgate-road, Newcastle-upon-Tyne, on Feb. 16. Blacket Gill, 26, Northumberland-street, Newcastle-upon-Tyne, solicitor for the petitioners.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

FROST, Ernest W., 15, Herbert-street, Loughborough, electrical engineer. £24 13s. Aug. 22.

LOWTHER & CO., Gradua Works, Porthcawl-road, Lower Sydenham, electrical engineers. £47 19s. 3d. Nov. 30.

PLANET ELECTRIC COMPANY, LTD., registered office, 5, St. George's-road, S.E. 1, electrical engineers. £16 11s. 4d. Nov. 24.

TROWEL, William Puckhaw, Nutfield, electrical engineer. £11 1s. 6d. Oct. 24.

WOLSTENHOLME, Alfred, 25, Meadow-road, Pinner, electrical engineer. £16 12s. Nov. 24.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1903 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

ELECTRICAL SPECIALITIES COMPANY, LTD., Sheffield. Registered Jan. 30, £2 500 debentures, to Mrs. J. Dunkerley, 12, Oakdale-road, Sheffield; general charge; also registered Jan. 30, £12 500 debentures (filed under Sec. 93 (3) of the Companies' (Consolidation) Act, 1908), present issue £4 000; general charge. *Nil. Feb. 2, 1920.

JONES & PORDES, LTD., London, W., manufacturers of electrical batteries. Registered Jan. 25, £1 000 debentures, to Mrs. J. Jones, 6, Stanley-road, Broadstairs; general charge.

OSWESTRY ELECTRIC LIGHTING & POWER COMPANY, LTD. Registered Jan. 25, £1 500 debentures (filed under Sec. 93 (3) of the Companies (Consolidation) Act, 1908), present issue £800; general charge. *£1 800 overdraft at bank not to exceed £1 500 secured by debenture £788 15s. 7d. Oct. 25, 1921.

SHEERNESS & DISTRICT ELECTRIC POWER & TRACTION COMPANY, LTD. (late COUNTY OF KENT ELECTRICAL POWER DISTRIBUTION COMPANY, LTD.). Registered Jan. 27, £200 second debentures, part of £12 500; general charge. *£28 280. June 21, 1921.

Satisfactions.

BANBURY & DISTRICT ELECTRIC SUPPLY COMPANY, LTD. Satisfaction registered Jan. 27, £100, part of amount registered March 31, 1913.

SHEERNESS & DISTRICT ELECTRIC POWER & TRACTION COMPANY, LTD. (late COUNTY OF KENT ELECTRICAL POWER DISTRIBUTION COMPANY, LTD.). Satisfaction registered Jan. 27, £200, part of amount registered Feb. 15, 1915.

Receiverships.

HOWARD PNEUMATIC ENGINEERING COMPANY, LTD. S. Nugent, of 33, Upperton-gardens, Eastbourne, was appointed receiver on Jan. 23, 1922, under powers contained in mortgage debentures dated Jan. 13 and 20, 1913, and March 4 and May 4, 1920.

RUSHMORES (1919), LTD. Sir Basil E. Mayhew, K.B.E., of 20, Alderman's House, E.C., was appointed as receiver on Jan. 27, 1922, under powers contained in debentures dated Nov. 30, 1920.

SUTTON-IN-ASHFIELD MOTOR AND ELECTRICAL ENGINEERING COMPANY, LTD. A. G. Mellors, of 1, King John's Chambers, Nottingham, ceased to act as receiver on Jan. 22, 1922.

SWIFT ELECTRICAL, LTD. Louisa Butler, of 94, Woodlands Gardens, N. 10, was appointed receiver and manager on Jan. 21, 1922, under powers contained in debenture dated Oct. 18, 1921.

Bankruptcy Proceedings.

DEPLEDGE, Robert Adrian, 53, late 102, Frodingham-road, Scunthorpe, Lincolnshire, electrical engineer. The public examination of this debtor was held on Feb. 2. The statement of affairs showed gross liabilities of £3 017, of which £1 545 was expected to rank for dividend, and there was a deficiency of £814. Debtor attributed his failure to bad trade, want of capital, and loss on forced sales under executions. The following are creditors:—Baxendale & Company, Ltd, Manchester, £76; Crossley Bros., Ltd., Manchester, £158; Callenders Cable Company, Ltd., Nottingham, £105; General Electric, Newcastle-on-Tyne, £103; Morley, T. B., & Company, Hull, £139; Premier Accumulator Company, Ltd., Northampton, £52 Quibel, D. J. K. Scunthorpe, £457; Thursfield, C. J., Birmingham, £13; Verity, E., Leeds, £33.

FAWCETT, Ernest, 20, St. Anne-street, Liverpool, electrical and heating engineer. The first meeting of creditors was held last week. The receiving order was made on debtor's own petition. The statement of affairs showed unsecured liabilities of £348, while the net assets were estimated to realise 14s. 11d. Debtor served an apprenticeship to an electrical, heating, and hydraulic engineer, and was for a number of years in the employ of various engineering firms. In August, 1920, he invested in and became one of the directors of an electrical company, and in the following November he guaranteed jointly and severally with the other two directors the bank overdraft of £500. Owing to the slump in trade the company went into voluntary liquidation on June 1, 1921. On July 21 last year debtor entered into partnership with another person, and the two carried on business at 20, St. Anne-street, Liverpool, as electrical and heating engineers. His partner provided the whole of the partnership capital, and the agreement was that the partnership should be dissolved on the bankruptcy of either

partner. The debtor estimated that his interest in the partnership was at present valueless. In connection with the partnership a firm of business agents had obtained judgment against the debtor personally for £25 and costs for commission in introducing the partner with capital. No books of account were kept by the debtor in connection with his private estate. He became aware of his position in June last. The matter was left in the hands of the Official Receiver as trustee.

HEATH, Edward Fuller, trading as FULLER, HEATH & COMPANY, electrical and mechanical engineer, 26, Buckingham Gate, S.W. The receiving order in this case was made on Jan. 18, on the petition of the Danish Machine Company, creditors for £300, and the statutory first meeting of creditors was held last week at the London Bankruptcy Court. Mr. F. T. Garton, official receiver, who presided, said that the debtor began business as an electrical engineer in January, 1919, at Cannon Street House, E.C. Owing to the liquidation of a large electrical company, through which he lost £1 000, he executed a deed of assignment. Six months later he recommenced business as an electrical and mechanical engineer at 26, Buckingham Gate, with a capital of £100. Owing to strikes and other difficulties he was unable to carry on successfully. His failure was also due to ill-health and lack of capital. No statement of affairs had been lodged, but the liabilities were estimated at £2 000, and assets £135. The case was left in the hands of the official receiver for administration in bankruptcy.

PHONOPORE CONSTRUCTION COMPANY (THE), LTD., Phonopore Works, Scott's-road, Southall, Middlesex. The winding-up order in this matter was made on Nov. 10, 1921, and the statement of affairs shows liabilities £6 019, of which £2 445 is due to unsecured creditors. The assets are estimated to realise £1 957, from which preferential claims of £1 000 have to be deducted, leaving net assets £957, which are not sufficient to meet the claims of the debenture holders, which amount to £4 531. The company was registered as a private company March, 1916, and was formed generally to carry on the business of manufacturing telephones, &c., and to take over interests under an agreement with the New Phonopore Telephone Company, Ltd. The company is stated to have carried on the business of manufacturing telephones for the army until June, 1917, when the works were commandeered by the War Office, being restored only in Jan. 1919. On Oct. 19, 1921, a resolution for the voluntary liquidation of the company was passed, and a liquidator appointed, but that appointment has been superseded by the winding-up order. The following are creditors :—Canning, W., & Company, Ltd., London, £40; Caversham Motors, Ltd, Reading, £35; Collins Electrical Company, Ltd., London, £14; Hatcham Mfg. Company, London, £43; Micanite & Insulators, Ltd., Walthamstow, £24; Mica & Micanite Supplies, Ltd., London, £470; Phœnix Telephone Works, Ltd., London, £180; Sheath Bros., London, £20; Submersible Motors, Ltd., Southall, £24; Sterling Telephone Company, London, £22; Telegraph Condenser Company, Ltd., London, £102; Varley Magnet & Company, London, £203.

SMITH, James Joseph, trading as J. SMITH & SON, electrical engineer, 1, Central-street, E.C. 1. The above-named debtor appeared for his public examination at the London Bankruptcy Court on Feb. 7, and his statement of affairs showed ranking liabilities £321, and assets nil. Debtor stated that he was born in London in 1885, and was in employment as an electrical engineer until about 1910, and from that date until 1919 he carried out electrical work from his private address at 130, Chestnut-avenue, Walthamstow. In March, 1919, he took premises at 1, Central-street, St. Luke's, E.C., and commenced to trade there with a capital of about £60, under the style of J. Smith & Son. The business was at first profitable, but owing to strikes in the coal and electrical trades it fell off. Although he had traded as J. Smith & Son, he did not have a partner. He carried on the same sort of work as he did when trading as an electrical engineer from his private address. His work was nearly all for the trade. In May, 1921, execution was levied at 1, Central-street, his effects being valued at £10, and his father-in-law paid that sum to the sheriff. The tenancy was transferred to his wife in October, 1921, and his father-in-law having given the goods which he purchased from the sheriff to her, she had since carried on business there under his management. He attributed his insolvency to loss of business owing to strikes, and to slump in trade. Examination was concluded.

WILLCOX, Albert John, The Garage, Farnham Common, Bucks, electrical engineer, &c. The statement of affairs shows liabilities £2 190, while the assets are estimated to realise £928, from which preferential claims of £58 have to be deducted, leaving net assets of £870, or a deficiency of £1 320. Debtor attributes his failure to shortness of capital, and borrowing money at a high rate of interest. He commenced trading on his own account in Sept., 1917, when he purchased for £1 318 his present business, in which he had for some time previously been employed as manager. He borrowed £600, giving a charge on the lease and fixed machinery as security, and paid £518 on account of the purchase, arranging to pay the balance of £800 by four yearly instalments, with 6 per cent. interest, but has paid £204 and interest to Oct., 1919. Having no capital, he, some time ago, had recourse to moneylenders. He became aware of his position about twelve months ago.

Private Meeting.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

STOCKWELL & OHMS, LTD. (in voluntary liquidation), electrical power contractors, 164A, Pentonville-road, N. A meeting of creditors took place on Friday, at the offices of Haissen Wilson & Co., 2, Fenchurch-avenue, E.C. A statement of affairs was submitted, showing the position of the company as at Jan. 13, 1922, the date of the resolution for winding up. The liabilities amounted to £2 268, all due to unsecured trade creditors, while the assets were estimated to produce £468, and there was thus a deficiency disclosed of £1 800. Mr. Holmes, the liquidator of the company, stated that the company had only been in existence a comparatively short time, and the present position had been brought about in consequence of the drop in values, and the falling market generally. The directors of the company were Mr. Mepsted and Mr. Hayward, while Mr. Stockwell was the managing director. It appeared that the managing director had given out contracts to Crompton & Co. and Siemens Bros. to the extent of £5 000 for machines, and the deliveries were to be arranged over a subsequent twelve months. From October, 1920, however, the market prices were continually falling, and to such an extent that it was impossible to realise the purchase price of the goods. In these circumstances the managing director asked the various creditors concerned to delay deliveries. Eventually it was found that the company could not go on, and the matter was brought to a head by Siemens' obtaining a judgment against the company for the amount of their debt. Questions were asked with regard to the deliveries made by certain creditors, and it was stated that the last balance-sheet of the company was got out in October, 1920, and this showed a profit of £380. Asked as to the stock which was held, it was stated that this included various Siemens' machines, D.C. motor, while Hurst had supplied two machines which they claimed were sold on sale or return. The sales of the business since October, 1921, had been £1 107, while the payments to creditors and other expenses of the business were £950. The opinion was expressed that the position was very unsatisfactory, and several creditors urged that the trade should be represented in the liquidation. In the result it was decided that Mr. W. Osborne, of Corfield & Cripwell, should be appointed as joint liquidator with Mr. Holmes, with a committee of inspection consisting of the representatives of Crompton & Company, English Electric Company, and the General Electric Company. The following are creditors :—General Electric Company, £136; Siemens Bros., £25; Simplex Conduits, Ltd., £12; Crompton & Company, Ltd., £1 270; Edison-Swan Electric Company, £15; English Electric Company, £908; English Electric & Siemens Company, £69; Marshall & Plumtree, Ltd.; £40; Tucker, J. H., & Company, Ltd., £30.

Prices of Metals, Chemicals, &c.

TUESDAY, FEB. 7.

		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£65 10 0	—	£2 10s.
Electro Wirebars ..	„	£70 0 0	—	£2 10s.
H.C. wire, basis.....	per lb.	0s. 10$\frac{11}{16}$d.	—	$\frac{3}{16}$d.
Sheet	„	0s. 10$\frac{5}{8}$d.	—	$\frac{3}{16}$d.
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze wire, basis.....	„	1s. 2$\frac{1}{16}$d.	—	$\frac{3}{16}$d.
Brass 60/40—				
Rod, basis	„	0s. 7$\frac{1}{2}$d.	—	—
Sheet, basis.....	„	0s. 10$\frac{1}{2}$d.	—	—
Wire, basis	„	0s. 10$\frac{5}{8}$d.	—	—
Pig Iron—				
Cleveland Warrants	per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 SWG	„	£22 0 0	—	—
Lead Pig—				
English	„	£22 5 0	—	£2 5s.
Foreign or Colonial ..	„	£20 17 6	—	£2 5s.
Tin—				
Ingot	„	£154 10 0	—	£3 5s.
Wire, basis	per lb.	2s. 1$\frac{1}{4}$d.	—	$\frac{1}{2}$d.
Aluminium Ingots		£120 0 0	—	—

Salammoniac.—Per cwt. 65s.-60s.
Sulphur (Flowers).—Ton £10 10s.
„ (Roll-Brimstone).—Per ton £10 10s.
Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.
Copper Sulphate.—Per ton £28 5s.
Boric Acid (Crystals) —Per ton £65.
Sodium Bichromate.—Per lb. 5$\frac{1}{2}$d.
Sodium Chlorate.—Per lb. 3$\frac{1}{2}$d.
Rubber.—Para fine, 11$\frac{1}{4}$d.; plantation 1st latex 8$\frac{1}{2}$d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Company, Ltd.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Complete Specifications.

141 354 Hammabrack, L. S. Adjustable standard for electric lamps. (4/4/19.)
142 090 Wilson, Welder, & Metals Co., Inc. Process and apparatus for electric welding. (4/4/19.)
144 669 Soc. Anon. des Etablissements L. Bleriot. Means for automatically controlling the temperature of electric heating apparatus. (5/2/19.)
145 034 Western Electric Co., Ltd. Telephone systems. (14/6/19.)
145 066 Western Electric Co., Ltd. Electric signalling systems specially applicable to telephone systems. (31/8/15.)
145 423 Siemens-Schuckertwerke Ges. Vacuum rectifiers with rotating electric arc. (23/10/15.)
147 431 Ges Für Drahtlöse Telegraphie. Production of high-power currents of constant frequency. (31/12/15.)
147 462 Latour, M. Electro-magnetic wave signalling systems. (11/11/15.)
147 879 Siemens-Schuckertwerke Ges. Electricity meters. (15/3/18.)
148 317 Huth Ges, Dr. E. F. Arrangement for carrying wireless stations. (30/10/13.)
148 359 Soissan, L. de. Electric heating apparatus. (19/12/13.)
158 842 Festa Akt.-Ges. Electric liquid heaters. (11/2/20.)
168 568 Hastings, R. C. M. Party line telephone systems. (1/3/20.) (Divided Application on 168 377.)
168 611 Crowe, D. C. Automatic or semi-automatic telephone systems. (4/3/21.)
168 630 Harris, H. K. Recording mechanism for use with electric sign telegraphs. (6/5/20.)
168 641 Crabtree, J. A. Electrical plug socket and switch combinations. (1/6/20.)
168 642 Dodgson, F. L. Relay contacts and method of making same. (1/6/20.)
168 649 Woodell, S. F. Indicating or adjusting devices for wireless direction finding coils and other devices. (2/6/20.)
168 650 Petersen, H. M. Method of and means for electrically synchronising apparatus over a long distance. (2/6/20.)
168 660 Lea, N., & Radio Communication Co., Ltd. Modulated signalling systems particularly applicable to wireless signalling. (4/6/20.)
168 661 Edwards, L. A. Electric foot and food heater and vapouriser. (4/6/20.)
168 669 British Thomson-Houston Co., Ltd. (General Electric Co.). Filaments and like bodies. (5/6/20.)
168 697 Aoyagi, E. Electro-metallurgical process for manufacture of ductile bodies of high fusing metals and alloys of same. (17/6/20.)
168 706 Austin Motor Co., Ltd., & Walker, C. B. Automatic electric switches for use more especially in relay circuits. (22/6/20.)
168 707 Coates, W. A., Gittins, G. E., Davies, D. R., & Metropolitan Vickers Electrical Co., Ltd. Electrical switch gear. (22/6/20.)

APPLICATIONS FOR PATENTS

November 7, 1921.

29 545 Butler & Chinn. Voltmeters and ammeters.
29 558 Crowe. Portable electric lamps.
29 559 Foxton. Dynamos for lighting sets of motor vehicles.
29 579 Caley & Talbot. Commutators of electric ignition systems.
29 581 Reyrolle & Co. & Owen. Lightning, &c., arresters for electric conductors.
20 614 Vinolto (Lorrain). Electric lighte-.
29 625 Falk, Stadelmann & Co. Globes, &c., for electric lamps.
29 634 Siemens-Schuckertwerke. Means of regulating electric motor cascades. (9/12/20, Germany.)
29 635 Siemens-Schuckertwerke. Starting 3-phase induction motors. (30/12/20, Germany.)
29 642 Naamlooze Venootschap Hengelosche Elektrische &c., Fabriek. Induction motors. (12/5/21, Holland.)
29 663 Farrar & Longbottom. Devices for containing electrical conductors, &c.

November 8, 1921.

29 677 Sullivan. Submarine, &c., cables.
29 702 Morgan, Elsmere, Williams & Evans. Electro-magnetic driven generator and switching arrangement
29 707 Paterson. Electric beer engine and air compressor.
29 732 Bennett. Switch bolders for electric lamps.
29 752 Henley's Telegraph Works Co. & Moor. Fuse carriers, &c.
29 754 B. T.-H. Co. (G. E. Co.). Switches
29 777 Béthenod. Electric installations. (8/11/20, France.)
29 793 Allgemeine Elektricitäts Ges. High tension cable with paper insulation. (8/11/20, Germany.)

November 9, 1921.

29 822 Cowper-Coles. Electrolytic production of tubes, &c.
29 848 Austin. Electric cables.
29 865 Sayers. Electric conductors.
29 868 Bunch. Motor vehicle electric lamps.
29 874 Mawdsley. Dynamo electric machines
29 882 B. T.-H. Co. & Whittaker. Systems of electric distribution.
29 883 B. T.-H. Co. Illuminating devices.
29 885 B. T.-H. Co. (G. E. Co.). Circuit breakers.
29 895 Angus. Apparatus for supplying electricity to instruments or circuits.
29 906 McKenzie, Holland & Westinghouse Power Signal Co. Signalling systems employing light-emitting devices. (2/3/21, U.S.)
29 918 Preston & Shearing. Signalling in wireless telegraphy.

November 10, 1921.

29 929 Waterhouse. Electric adaptor fitting
29 973 Blake. Carriers for storage batteries
29 979 Donisthorpe. Thermionic valves.
29 989 B. T.-H. Co. (G. E. Co.). Insulating elements.
29 993 White. Mounting and driving magnetos.
29 997 Somajni. Dynamo-electric machines. (10/11/20, Italy.)
30 016 Best & Lloyd. Chains for electroliers, &c.
30 036 Pollak (Siemens & Halske A. G.). Telephone instruments.

November 11, 1921.

30 059 Bosch (R.) Akt. Ges. Magneto-electric ignition apparatus. (14/5/21, Germany.)
30 065 Cuppleditch. Means for handling loads on electrically driven trucks.
30 073 Hadwen & Willis. Slings for supporting electric cables.
30 087 Neyret. Dynamos. (3/3/20, France.)
30 107 Bailey. Coupling dynamos, &c., to internal combustion engines.
30 109 Mackay & Shimwell. Wind-driven electric generators.
30 114 Nalder Bros. & Thompson & Lipman. Alternating current instruments for indicating synchronism, power factor, phase difference, &c.
30 118 Penfold. Electric cut-outs.
30 136 Angus. Devices for causing electricity to be supplied to instruments or circuits.
30 139 Cambridge & Paul Instrument Co. & Collins. High-speed recording indicators.
30 140 Measurement, Ltd. & Holden. Electricity meters.
30 152 & 30 153 Johnson & Phillips, Barton, Scase & Stigant. Tapping switches for changing voltage ratios of transformers, &c.
30 158 Ehrich & Graetz. Electric cooking utensils.
30 159 Ehrich & Graetz. Electrically heated coffee-making machine.
30 160 Curtis. Electric switches or controllers for vehicle head-lamps.
30 183 Maschinenfabrik Oerlikon. Clamping arrangements for sheet metal stator teeth of electrical machines. (17/11/20, Switzerland.)
30 185 Brown. Relays.
30 189 Preston & Shuttleworth. High-frequency coils.

November 12, 1921.

30 192 Miller. Electric cycle lamps.
30 193 Miller. Bulb holders for electric cycle lamps.
30 194 Miller. Electric lighting dynamos.
30 195 Miller. Friction driven electric lighting dynamos for bicycles.
30 197 Davis. Electric lamps for road vehicles
30 227 Western Electric Co. Telephone receiver. (2/12/20, U.S.)
30 239 Cox. Electric generator.
30 242 Hannah. Apparatus for rendering electric system on motor-cycles inoperative.
30 245 Sterling Telephone, &c., Co., Bell & Clark. Indicating ringing of electric bells, &c., to operators.
30 248 Savidge & Terrey. Current economiser and regulator.
30 251 Mackay & Shimwell. Switch gear for battery charging circuits.

November 14, 1921.

30 268 Barlow. Slab inductances for wireless telegraphy or telephony.
30 275 Cowan & Goodwin. Electric lighting of vehicles, &c.
30 296 Morrison. Electrolytic engine.
30 302 Mead. Electrical apparatus for locating faults in ignition circuits.
30 303 Baddeley. Machine for converting a.c. into d.c.
30 327 B. T.-H. Co. (G. E. Co.). Electric terminals.
30 337 Mackley. Switches.
30 338 Sayers. Dynamo-electric machines.
30 357 Johnsen & Rahbek. Relay, oscillograph, telephone, automatic current regulator, &c.
30 371 Automatic Telephone Mfg. Co. Automatic switches for telephone, &c., systems. (23/11/20, U.S.)
30 372 Contell. Alternator.
30 353 Norbs. Electric heating and cooking apparatus
30 397 Roberts. Electric cables, &c.

November 15, 1921.

30 424 Automatic Telephone Mfg. Co. & Remington. Mine signalling systems, &c.
30 434 Krupp (F.) Akt. Ges. Arc lamps for projection. (22/10/21. Germany.)
30 445 Young. Electrical transmitter microphones.
30 461 Lodge Fume Co. (Metallbank u. Metallurgische Ges.). Method of working electrical gas-purifiers.
30 464 Cackemaille (Westinghouse Lamp Co.). Voltage regulating systems.
30 508 Pointer. Electric water-heaters.

November 16, 1921.

30 520 Morris. Electrolysis of acetone solutions.
30 523 Buckley, Saunders & Co., Readett & Poole. Electric rivet heating machines.
30 548 Lodge-Cottrell, Ltd. (Metallbank u. Mettallurgische Ges.). Insulators.
30 555 Drysdale & Young. Electric rotary pumps.
30 588 Sullivan. Duplex, &c., telegraphic systems.
30 591 B. T.-H. Co. (G. E. Co.). Switches.
30 596 Beck & Taneforne. Electric washing and wringing machine.
30 599 Welch. Holders for thermionic valves.
30 623 Metropolitan-Vickers Electrical Co. Radiators. (29/11/20, U.S.)
30 630 Siemens & Halske A. G. Meters for telephone systems. (26/11/20, Germany.)
30 635 Skaupy. Incandescent lamps. (4/12/20, Germany.)
30 636 Skaupy. Incandescent lamps

November 17, 1921.

30 646 Cowper-Coles. Electrolytic manufacture of tubes, &c.
30 654 Cooper. Device for grinding commutators.
30 670 Bergeon. Electric heating apparatus. (25/11/20. France.)
30 685 North. Self-producing motive power for generating electricity.
30 692 Gee. Four-way foot control for electric motors for dentistry, &c.
30 702 Quain. Electric gas lighter.
30 704 Weld-Blundell. Electric adaptors and wall sockets.
30 725 Goldsmith. Ceiling roses.
30 730 Angus. Devices for causing electricity to be supplied to instruments or circuits.
30 740 Stone & Co. & Darker. Electric heaters.
30 751 Albano & de Mattei. Electric heating apparatus of thermo-siphon type. (10/5/21, Italy.)
30 752 Akt. Ges. Brown, Boveri & Cie. High voltage slot windings of electrical machines. (16/12/20, Switzerland.)
30 757 Siemens & Halske A. G. Telephone systems. (23/11/20. Germany.)
30 759 Relay Automatic Telephone Co. (Cie. Gen. de Telegraphie et de Telephonie Sans Fils.). Telephone systems.

November 18, 1921.

30 783 Brown & Scott. Electric connectors.
30 801 Clear-Hooters, Ltd. Supporting means for electric horns.
30 803 Pemberton. Portable standard or table fittings for electric lamps.
30 843 Beaton. Transformer for wireless telegraphy.
30 850 Western Electric Co. Printing telegraphy.
30 852 Waldberg. Electro-metallurgy or electro-deposition of metals.
30 860 Burnham. Self-supporting electric coils.
30 861 Burnham. Induction coils.
30 877 Siemens & Halske A. G.
30 879 Norman. Apparatus for transforming a.c. into d.c and rice *versâ*.
30 885 B. T.-H. Co. (G. E. C.). Electric instruments.

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Notes of the Week.

The Geddes Reports.

We assume that, in the days intervening since last Saturday, electrical engineers have not been behind other classes of the community in studying and discussing the Geddes Reports. These documents are, indeed, of the highest national interest, and we are not surprised that the demand for them has only been equalled by that for the most popular of novels. If they were novels we should commend their directness of style; as it is, the matter is much more important than the manner of presentation. From the reports two things stand out clearly: That we are paying out of all proportion more than we were paying for similar services in 1913, and that the birth of new Departments for effecting all sorts of possible and impossible improvements in the social habits of the people has added a burden to the taxpayer which he cannot bear without undue strain. That is the keynote which cannot be too clearly sounded in any discussion of these important documents.

Specific Instances of Waste.

As a specific instance of both classes of over-payment, it may be mentioned that the cost of education to the taxpayer rose from £17 200 000 in 1913-14 to £60 500 000 in 1921-22. This increase, which does not take into account the equally large increases in the rates due to the same service, is mainly caused by the rise in teachers' salaries, by special facilities connected with the children's welfare, by administration, and more than all by the pernicious system of grants-in-aid, whereby the Board of Education has little or no control over the expenditure for which it is nominally responsible. In addition, the school age has been extended at each end of the scale, State scholarships have been augmented, and a non-contributory pensions scheme for teachers has been started. Other examples of the same dual expansion are to be found in the egregious finance of the housing schemes, in the electronic emission from the larger Departments of self-contained branches, such as the Power, Transport, and Economic Department of the Board of Trade, in the many divisions of that grandiose and moribund conception, the Ministry of Transport, and in such excrescences as the staff employed in connection with the Registration of Business Names, the Census of Production, and in the Mercantile Marine Office.

The Taxpayers' Duty.

It might be, and is already being, argued by interested parties that expenditure in certain of the branches of Government activity which are scheduled for deforestation by the Geddes axe is essential for the well-being of the community. We confess that, as far as some of the educational proposals are concerned we are in sympathy with this view. But, in our present financial straits, personal predilections and theories must be sunk, every way of reducing national expenditure must be explored, and the suggestions for economy that this exploration brings to light loyally supported. In the face of enormous difficulties, Sir Eric Geddes and his Committee have produced documents which are worthy of the highest rank in British history for their fearlessness, enterprise, and insight. They are designed to provide the taxpayer with a much-needed relief. It is the taxpayer's interest, no less than his duty, to take the course these reports open up, and to force the Government to follow. There is a clear-cut issue. It must not be allowed to become clouded.

The B.O.T. Unit Redivivus.

There are two minor recommendations in the Geddes Report to which some attention may be drawn. The first is that the Electricity Commissioners should not be abolished (we never thought they should), but should return to the fold of the Board of Trade, or, more precisely, should remain a separate entity, with the President of the Board of Trade as their representative in Parliament. The chief difference that this will make is that those who prefer to use the term

" Board of Trade unit " will now have some justification for doing so. The other is that the subsidy of £2 800 per year paid to the Eastern Extension, Australasia and China Telegraph Company in respect of the cost of maintaining the cable from Chefoo to Wei-hai-Wei, should be discontinued, especially as the Government is to give up Wei-hai-Wei. There is little doubt that the company will accept this philosophically, as the cost of running the cable amounted to more than the subsidy they received. They would prefer, in fact, that the cable should be shut down altogether, as it probably will be. This is not surprising.

Power-Station Economy in Great Britain.

An interesting analysis of the fuel consumed at, and the units generated in, the 501 electricity supply stations of Great Britain, during the year ending March 31, 1921, has been issued by the Electricity Commissioners. The figures are based on the returns made under Section 27 of the Electricity (Supply) Act, by authorised undertakers, and on the voluntary returns from stations owned by railway and tramway authorities and non-statutory undertakings. The analysis is made in four Tables. In the first the stations are classified according to output, and it is interesting to note that, by a short head, the station with the lowest coal consumption is in the group which generates less than 3 000 000 kWh per annum. This is due to the fact that it is one of those phenomenal cases where anthracite and producer gas are successfully used. When it comes to thermal efficiency, however, the largest stations are easy winners, though here again the smallest stations come off second-best. Even so, the figure given for the best of the largest stations, 17·75 per cent., shows how large is the gap between unit and station efficiency, if we take the figure of 25·87 per cent., which was recently stated to have been obtained by one set at Carville, as a measure. This gap, it is fair to add, is decreasing, and is likely to decrease. A more important point, however, is the need for making every effort to increase the figures of thermal efficiency, as these, when expressed in percentages of the total energy cost, are still pitiably small.

Coal and Fuel Consumption.

Returning to fuel statistics, the coal consumption in lbs. per unit generated varies from 2·71 in the largest stations to 6·42 in the smallest, which indicates the advantages of using modern machinery. A classification by areas is also made. As might be expected, Northumberland leads with a consumption of 2·08 lbs. per unit, while one station reaches the low figure of 1·78 lbs. In aggregate, nearly 8 000 000 000 units were generated from 463 steam stations, 161 500 000 from waste heat stations, and 23 700 000 from oil-engine stations, while water power only accounted for 4 700 000 units and gas-driven stations for rather less. We are glad to learn that the new form will enable data on the use and thermal efficiency of oil fuel to be obtained, but in these days of economy it may well be asked whether it is necessary that the returns upon which this interesting summary is based should be required as often as once a month. In that period the changes that will have taken place in most of the data will be very small, and the compilation will, therefore, mean work which is out of all proportion to the useful information provided.

Temperatures Attained in Gasfilled Lamps.

It is common knowledge that the temperatures reached in gasfilled lamps cause inconvenience if the latter are injudiciously employed. Particularly is this the case in respect to the charring of insulation round the wires entering the sockets of the ordinary bayonet lamp. An interesting study of the temperature attained is given in a recent contribution by Messrs. C. L. Dows and W. C. Brown to the " Transactions " of the American Illuminating Engineering Society. It is rather curious that, according to the author's analysis, the percentage of energy radiated in the form of light is not very different in the vacuum and the gasfilled lamp; in one it is about 6 per cent. and in the other 8 per cent. The chief difference is the much greater loss by heat gas-convection in the latter (20 per cent. as compared with 8 per cent.), the proportion of ordinary heat-radiation being correspondingly reduced. Values are given for the temperature attained in various lighting units, bulb-temperatures approaching 500° F. being recorded.

Charring and Heating Temperatures.

Naturally, therefore, charring occurs if draperies, silks or other materials are wrapped closely round the bulb and deposits of certain varieties of dust may also lead to " smoke." But it is suggested that the higher consumption and the greater brightness of filament have caused inspectors to form erroneous ideas on the danger of fire when such lamps are used, leading them in certain cases to impose conditions so severe that the use of gasfilled lamps has been greatly hindered. Inflammable films, it is mentioned, curl at 172° F., melt at 320°, and ignite at 365°; wood tends to char at temperatures much over 400°. Hence the obvious desirability of avoiding bringing any such materials into contact with the bulb. Much attention has also been given to ventilation of fittings. It is interesting to note that ordinary ventilation, while cooling the bulb, may actually increase the temperature of the wire and the socket parts. The idea that a surrounding high temperature shortens the life of the lamps has apparently little justification. Totally enclosed and unventilated units have been designed for use in munition works, &c., and there is a good deal to be said for the non-ventilation theory. Units so designed are cooled by radiation rather than by ventilation.

An Argument for Regenerative Braking.

It is a little significant that in the frequent discussions on the advantages of electric traction so little is made of economies obtainable by the employment of regenerative braking. This, as is well known, has been successfully and economically employed on long-falling gradients in the United States and elsewhere, but it is not so generally realised that it could with equal advantage be used on many of our electric railways. Take the section of the London Underground Railway between South Kensington and Mansion House as an example. On this section there are normally eight station stops in a distance of four miles. In addition there are, at busy times, at least, frequent inter-station stops. To maintain a service with the headway now usual, therefore, means rapid acceleration and equally rapid retardation, or, in other words, braking. This being the case, it is not surprising to learn that the watt hours per ton mile on this section have increased considerably since the line was first converted to electric traction. Such increase is indeed a natural corollary to an increased service conducted by present-day methods. But this rise could be avoided and the original energy consumption probably reduced by fitting the free axles on a train with regenerative braking equipment as a supplement to the present devices. To obtain full advantage from this

arrangement it would be necessary to begin braking somewhat earlier than is now usual, and so reduce the average speed slightly. But from an economic point of view it would be certainly worth it. We hope the directors will consider the matter, and at least the possibility of giving the system a trial.

Rating of Machinery.

That hardy annual, the Rating of Machinery Bill, is, we are informed, to make its appearance in the present session of Parliament. Except during the period of the war, the Bill has been regularly introduced into the House of Commons every year for many years, but, like the majority of private members' legislative efforts, it has always been among the slaughtered innocents. If the Bill is to succeed, greater efforts will have to be made by the engineering and trade organisations to impress upon the Government the necessity for a reform of the law relating to the assessment of property, and more particularly of machinery, for rating purposes. At least one member of the Government, Sir Alfred Mond, who happens to be a business man, seems to have a proper appreciation of the disadvantages of the present system, for he recently informed the Association of British Chambers of Commerce that he had brought the question of the reform of methods of valuation and rating to the attention of the Cabinet.

Organised Effort Required.

This is good news for the promoters of the Rating of Machinery Bill, and a little pressure from the Federation of British Industries, the B.E.A.M.A., and similar associations, might induce the Government to take up the matter, or to give facilities for passing the Bill. No one disputes that there is urgent need for a drastic reform of the law, but the agricultural interests, who fear that if industry be relieved by the exemption of machinery from rating they would have to bear an extra burden, are opposed to the proposed Bill, and the Government will, therefore, have to be persuaded that it is for the good of industry and for the nation as a whole before they will deal with the matter. At present Scottish and Irish manufacturers have an advantage over their English brothers, and apart from the inherent justice of the demands of machinery users, there is no reason why this inequality should be allowed to continue. In Scotland the Lands Valuation (Scotland) Amendment Act, 1902, excludes from the valuation of a building used for business, manufacture or trade any machinery which can be removed without necessitating the removal of any part of the building, with the exception of machinery for producing or transmitting primary motive power or for heating or lighting the building. Even in Ireland, under the Valuation (Ireland) Act, 1860, the value of machinery in a mill, factory or building may not be taken into account in valuing the premises, except machinery used for the production of motive power. In view of the heavy burdens of taxation and rates which manufacturers have to endure nowadays, we hope that a combined and well-directed effort will now be made to put the law of rating on a more rational basis.

Quis Custodiet Ipsos Custodes?

The recently-developed zeal of the London County Council in suppressing the smoke nuisance, induces us to make use of a well-known tag in combination with a large question mark, as the heading of this Note. For the Public Control Committee of the Council have been making investigations into the smoke issuing from the chimneys of the forty-two electricity stations in London, and tell us that in only four cases have they observed anything serious enough to report. In two instances out of the four improvements have been effected as a result of representations made by the Committee and official pressure is being exerted in the other two. This will all help to the inauguration of that brighter London which is our desire; but, without being ungracious, we should like to know whether the Committee has also investigated the smoke nuisance at the Council's own stations. That they are not always blameless we know from experience. And in beautiful summer weather we have also been poisoned by black smoke issuing from fire floats on the Thames. But who hangs the public hangman?

Where a Good Example is Needed.

By law the County Council are entrusted with powers under their General Powers Act of 1910, and the Public Health (London) Act, 1891, to take proceedings against those who permit black smoke to issue from their chimney shafts, but the sanction of the Ministry of Health must first be obtained. Now that there is no restriction upon the purchase of coal, there ought to be little excuse for the commission of this sort of nuisance. But if the Council are really going to enforce the law, and Islington Borough Council are threatened with a prosecution, we think they should begin on their own departments. It would be such a good example to others.

Some Supply Companies' Dividends.

Though the annual reports of all the electricity supply companies are not yet available, it is gratifying to find in so many cases the dividends for 1921 have been maintained, and even in a few instances an increased allocation has been possible. When allowance is made for the difficult conditions prevailing, the restrictions that were imposed on supply owing to the miners' strike, the depressed condition of trade, and other troubles, the results are surprisingly good. We heartily congratulate the directors of that pioneer supply company, the London Electric Supply Corporation, upon being able to increase the ordinary dividend from 2½ to 4 per cent. The outlook for the company, particularly in regard to traction and power demands, is good, and the current year should see a further improvement. The North Metropolitan Electric Power Supply Co. is in a position to advance the ordinary dividend from 7½ to 10 per cent., the highest distribution yet made by a power company, while the Yorkshire Electric Power Co., whose net profits show an increase of nearly £10 000, again declare an 8 per cent. dividend, but its reserve and carry-forward are higher than in 1920. The Westminster Electric Supply Corporation, the St. James's and Pall Mall, and the Smithfield Markets Companies make the same distributions as in the previous year, viz., 10, 12, and 5 per cent., respectively. As we go to press we notice that the County of London Electric Supply Company, one of the most progressive and best managed of the supply companies, has decided to make the same distribution (8 per cent) on the ordinary shares as in 1920, but as the profits are greater there are increased allocations to reserve. This is a policy to which no exception can be taken.

The District Dividend.

Both the directors and shareholders of the Metropolitan District Railway are to be congratulated on the 1 per cent. dividend that, as a result of the recent increase in fares, it has been possible to pay on the ordinary stock. Small though the distribution is, it is none the less a signal

event, for it is the first time that a dividend has been paid for thirty-nine years. The holders of the stock cannot therefore either be stigmatised as profiteers or accused of living in guilty splendour on the labour of others. This distribution, which we hope is only the first term of a series, is probably the long-delayed first fruits of the electrification policy (using the term in its widest sense) which was adopted some years ago. But for the employment of electric traction the system would have become more and more derelict, while by its use it is possible to run long or short trains on short or long headways as the immediate demands of the traffic require. It is also possible to deal with rush traffic by methods of compression, and generally to conduct the system in, from the directors' point of view, the most economical way. It has been stated by high authority that it is only in this way that the railway can be made to pay. It certainly seems so.

Research Workers' Inventions.

The proper method of recompensing inventors who are paid from public funds is a subject which has been much discussed. For while the Admiralty, War Office, and Air Ministry have always had full power to forgo the commercial rights in any invenions made by their officers, on the other hand, patents for inventions made by those employed in the Department of Scientific and Industrial Research are taken out in the joint names of the inventor and of the Imperial Trust for the Encouragement of Scientific and Industrial Research, inventors undertaking to assign all their rights to the Trust. This practice is inequitable in operation, and has been greatly resented. An Inter-Departmental Committee was, therefore, appointed to consider the whole question, and to devise a uniform method of dealing with all inventions made by research workers and Government servants. The Committee's report has now been published, and the findings should go far to settle the problem on an equitable basis.

Suggested Principles.

The Committee propose that, pending a decision by a "competent authority," all rights in inventions made by Government servants should be held in trust for the Government. If the inventor can prove that he had no assistance from the Department in making the invention, he is to be entitled to all rights in his invention, except where it has to be kept secret for reasons of State. Whether an inventor should, in addition to the enjoyment of usual commercial rights, receive any other reward, is to be left to the decision of the "competent authority," and the method of dealing with inventions is to be uniform for all Government Departments. So far so good. We do not, however, like the suggestion that where the rights in an invention which is capable of commercial exploitation belong to the Government the invention should be developed for the benefit of the latter. The development of a patent involves a good deal of experimental work and an equal quantity of commercial acumen. No Government Department, therefore, is capable of doing it, and, moreover, if the suggestion were adopted, we should have a Government Department, subsidised by the taxes, competing with private enterprise. It would be much better, therefore, to either sell the patent or to grant a licence or licences to manufacture the article.

A Patents Board.

It is proposed that the "competent authority" for dealing with all patents made by research workers shall be an Inter-Departmental Patents Board, with an Exploitation Committee for arranging the commercial exploitation of inventions. We should, however, have little confidence in such a Committee, and we hope that the proposal will be dropped. On the other hand, the constitution of the Patents Board for dealing with awards, settling the rights of parties and deciding matters of administration, is sound. It would contain no representatives of the research workers, or of the Government Departments directly concerned, and it would, therefore, be likely to command general confidence. Such a board need not involve the appointment of any new officials, as the Patents Branch of the Board of Trade and other Government Departments could easily spare the necessary officials.

Workmen's Compensation in 1920.

The statistics of compensation and proceedings under the Workmen's Compensation Acts and Employers' Liability Act for the year 1920 discloses a serious increase in the number of accidents for which compensation had to be paid. There were 3 531 fatal and 381 986 non-fatal accidents, or a total of 385 517, compared with 368 469 in 1919. There was also a sharp rise in the amount of the payments to workmen and their dependents, but this was mainly due to the increased amount of compensation payable under the War Addition Act of 1917. The sum of £755 657 was paid for fatal, and £5 222 352 for other accidents, in seven specified industries, against £4 616 723 in the previous year. These figures are disquieting, and seem to show that the preventive measures, such as those recommended by the Safety First Council, are not sufficiently widely adopted. One satisfactory feature, however, is the large decrease in the amount of litigation. According to figures supplied by the Employers' Liability insurance companies to the Board of Trade in respect of employers' liability insurance, the income from premiums was £8 851 607, or, including interest from reserves, £9 047 559. Only £2 980 755, however, went in payments under policies, while £2 921 959 was spent on commission and management expenses, £1 476 869 being transferred to reserves, and £1 667 976 being set aside for profits. These administrative and management expenses seem unduly high, especially as, after transferring 16 per cent. of the receipts to reserve, 19 per cent. was allocated as profit. However, it is estimated that when the various charges and expenses are taken into account, the total charge for compensation in the seven great industries cannot be less than £8 500 000.

Railway Amalgamations and Electric Traction.

In the breasts of the cynical-minded the forthcoming amalgamation of the railway companies into a few small groups should generate feelings of unholy joy. Two groupings which, we are informed, will shortly take place are the Midland with the augmented London and North-Western system, and the South-Eastern and Chatham, London and South Western, and London and Brighton and South Coast Railways. The Lancashire and Yorkshire section of London and North-Western group use both high-tension and low-tension direct current traction with the contact rail. The Midland uses the single-phase system, with overhead equipment. In the Southern group the South-Western uses low-tension direct current with the contact rail, the Brighton Railway high-tension single-phase, with overhead equipment, and the South-Eastern wishes to use the high-tension direct-current system of a special brand due to Mr. A. Raworth, their electrical engineer. The problem is: What is going to happen?

The Birth of Magneto Optics.

THE articles, by Sir OLIVER LODGE, on the discovery of the Zeeman effect, which we are reproducing in another column from THE ELECTRICIAN of twenty-five years ago, will recall to many of our readers the birth of one of the greatest advances of modern physics. The full significance of the discovery of this phenomenon cannot be realised unless we remember that, at that time, the electron was nothing but a product of the physicist's imagination—a hypothetical entity which was indeed, suggested by various facts, but whose separate existence had never been detected. It was not until over three years later that Sir J. J. THOMSON announced the isolation of the actual electron. Bearing this in mind, we can hardly conceal our surprise and admiration at the accuracy with which the nature and properties of the electron were foreshadowed by the experimental work of Dr. ZEEMAN, a message from whom we are glad to be able to print to-day, and the theories of Sir J. LARMOR and Dr. LORENTZ. Indeed, the most striking feature of the notes with which Sir OLIVER LODGE has supplemented his original articles is the small number of modifications which, after twenty-five years of unprecedented progress in the study of radiation and atomic structure, he has found it necessary to make.

The Crowning Point of a Fascinating Research.

The Zeeman effect is, indeed, the crowning-point of one of the most fascinating researches in the history of physics —the quest after the connection between magnetism and light. We owe it to FARADAY'S unerring instinct that the problem has received the attention it deserves. Time and again it occupied his thoughts, and he succeeded at last in laying the foundation stone of magneto-optics by his discovery of the rotation of the plane of polarisation by a magnetic field—or, as he picturesquely described it, by "magnetising a ray of light and illuminating a magnetic line of force." Although he sought for what is now known as the Zeeman effect—and must, indeed, actually have obtained it—his appliances were too imperfect to show him the result he was seeking. The next definite step was made by MAXWELL, who in his electromagnetic theory of light, showed that the most intimate connection between light and magnetism was in the highest degree probable. Finally, in 1896, the discovery by Dr. ZEEMAN of the influence of a magnetic field on the actual source of light put the electromagnetic nature of light beyond doubt, and opened a new department of physical investigation.

The Effect in Practice.

Though the Zeeman effect has not as yet received any direct practical application, it has had important influences on some of the more practical branches of science. The discovery by PRESTON that lines of the same spectrum series, and of corresponding series in related elements, are similarly affected by a magnetic field, has become, in the hands of PASCHEN, a useful means of analysis of spectra. In astronomy, also, the effect has led to HALE'S great discovery of the existence of a magnetic field in a sunspot, and though the exact connection between this and the phenomena of terrestrial magnetism has not yet been traced, there can be no doubt that the connection is very close.

Important Theoretical Aspects

But it is the theoretical aspect of the effect that is at present of the greatest consequence. Sir OLIVER LODGE has described how LORENTZ, by his electron theory, was able to predict the effects which Dr. ZEEMAN brought to light Nothing adds to the prestige of a theory so much as a successful prediction; and when, as with the Zeeman effect, the verification extends to matters of detail, such as the polarisation phenomena to which Sir OLIVER LODGE refers, we are almost inclined to regard the theory as an established law of Nature.

Yet here we may notice that, despite its almost complete success in explaining the Zeeman effect, the Lorentz theory in its original form is no longer tenable. It proceeded from the assumptions that the emission of spectrum lines resulted from electronic motions whose components were simple harmonic vibrations, and that the frequencies of the lines emitted were the frequencies of such vibrations. This conception has been found totally inadequate to interpret the actual phenomena of line spectra. These, it appears, can at present only be explained by supposing that the revolutions of electrons in atoms do not result in radiation at all, but that radiation takes place when an electron suddenly changes its orbit. The frequency of the spectrum line produced is not the frequency of revolution of the electron, but is proportional to the difference of energy of the electron in the two orbits concerned. On these lines, BOHR has been able to account for the Zeeman effect for hydrogen, though the mathematical difficulties connected with more complex atoms have so far proved intractable.

The Metamorphosis of Electronic Hypotheses.

The original Lorentz theory, then, apparently so convincing and final in its account of the Zeeman effect, seems destined to share the metamorphosis which has of late years characterised the whole field of electronic hypotheses. It is possible, no doubt, to place it in the lumber-room of science, and, in moments of disinterested reflection, to marvel at one more example of the measure of truth which may issue from false premises. There is greater wisdom, however, in another attitude. Can we not see, in facts such as these, the hall-mark of fundamental things? For it is not the immediately perceived, derivative phenomena that call forth alternative explanations. The rainbow, the seasons, echoes, these things are "explained"—so far as explanation can be given—once for all. It is the profounder secrets of Nature that are many-sided. The most sublime conceptions of science, ideas that have embraced vast areas of observed facts and guided progress by their predictions—it is these that, by virtue of their own excellence have become merged into still more comprehensive views.

The Passing of Ancient Conceptions.

We have seen, or are now seeing, the passing of such conceptions as the Ptolemaic cosmogony, Newton's law of gravitation, the elastic-solid theory of light, the nebular hypothesis, Darwinism. We cannot call these conceptions "false." They have increased the sum of knowledge, and, after all, grapes do not grow upon thorns, or figs upon thistles. Perhaps we are hardly justified in placing the Zeeman effect among the phenomena embodied in such ideas as these. It has not their comprehensiveness, and is, moreover, but one aspect of the ultimate relation between magnetism and light. But it is essentially of the same nature, and we shall be surprised if, when the history of the next twenty-five years of scientific progress comes to be written, the Zeeman effect is not found to have played an even greater part than it has done in the past.

Zeeman's Discovery of the Action of a Magnetic Field on a Source of Light.

In this article are reproduced two communications by Prof. now Sir, Oliver Lodge, which appeared in The Electrician *of February* 26 *and March* 12, 1897, *respectively, commenting on and discussing the discovery by Dr. P. Zeeman of the action of a magnetic field on a source of light—the well-known Zeeman effect. The twenty-fifth anniversary of this discovery has recently been celebrated at Leyden, and we have therefore reproduced the articles, together with some interesting notes by Sir Oliver Lodge, bringing the whole matter up-to-date. At the conclusion of the article some comments by Dr. Zeeman on the modern possibilities of his discovery are given.*

At a time when the Institution of Electrical Engineers is celebrating the jubilee of its existence, it is not inappropriate that attention should be called to an event which occurred twenty-five years ago in Leyden. This event, though it has as yet received no practical application, is of the highest importance theoretically, and may be termed, without any great exaggeration, the birth of the science of magneto-optics; its conception having been begun by Faraday long ago (1845), when he rotated the plane of polarisation by a magnetic field. This event is the discovery of the Zeeman effect.

There is reason for some comment on this event, for, as pointed out by Sir Oliver Lodge in the issue of "Nature" for January 19, in the course of a review of "Verhandelijen van Dr. P. Zeeman over Magneto-Optische Verschijnelen," in a quarter of a century a new generation of physicists has arisen, "many of them so intently occupied with their own admirable investigations that perhaps the origin of much of our present knowledge of Nature is liable to be submerged. Especially may they fail to realise the anticipations of the great theorists, which enabled a little seed-fact to fit immediately into its cranny and quickly to develop magnificent blossoms." It should also be emphasised, in order that ideas on the subject may be quite clear, that Sir J. J. Thomson's isolation of the electron was not announced until the meeting of the British Association at Dover in 1899, some three and a half years later.

In the article in "Nature" to which we have referred, Sir Oliver Lodge says that the announcement of Zeeman's discovery to the Royal Academy of Sciences at Amsterdam, and its reception in this country were equally modest, and would probably not have attracted much attention had not Sir Joseph Larmor been on the look out for some such effect. He had determined theoretically that such a result was necessary, and had gone on to calculate the amount of displacement or broadening to be expected, but found the effect too small to be observed. "For, like everyone else at that time, he considered that the radiating body must be an atom or part of an atom with an $e/m = 10^4$. So directly Zeeman got an effect and found that e/m was of the order of 10^7, Larmor perceived that not the whole atom, but the charge only—the electron part of the ion, or an electron itself—was a free radiator," and suggested that Sir Oliver should confirm the result. In a week he had done so with such appliances as were to hand; though not without sufficient difficulty to make him realise the naturalness of Faraday's failure to see anything, he being wholly unguided by theory, and to admire the skill of Zeeman in detecting the effect.

Sir Oliver's results were communicated to the Royal Society, and also to The Electrician in an article which was published on February 26, 1897, under the heading of "The Latest Discovery in Physics." This matter is of such great interest that we have thought well to reproduce here this article and another of a fortnight later; and Sir Oliver Lodge has been good enough to annotate them, for, as he says, they are worthy of reference by anyone interested in scientific history.

To make what follows quite clear it should be noted that the matter in the smaller type consists of the original articles by Sir Oliver Lodge which appeared in The Electrician during February and March, 1897. The interpolated paragraphs (*e.g.*, *Note B*, 1922), in the larger type, are Sir Oliver Lodge's annotations written during the past few weeks. Sir Oliver Lodge's conclusion and the letter from Dr. Zeeman also, of course, bear the date 1922.

The Latest Discovery in Physics.*

By Prof. OLIVER LODGE, D.Sc., F.R.S. [Date, 1897.]

In the year 1862, Faraday, who never lost an opportunity of probing into the connection between magnetism and light, tried yet one more experiment, said to have been his last, to see whether the lines of the spectrum were in any way influenced when the source of light was in an intense magnetic field. He arranged a sodium flame to burn between the poles of a magnet, and then examined it spectroscopically from a direction across and also along the lines of force. He saw no effect. And anyone to-day [1897] repeating the experiment with a modern grating, without immense care, would be liable also to notice no effect, beyond perhaps a slight alteration in brightness of the lines due to the magnetic or diamagnetic motions of the flame.

Faraday's Pertinacity.

The pertinacity with which Faraday pursued, in every form, the connection between light and magnetism is very remarkable. He must have had an instinctive feeling of its importance, though he could hardly have had an intuition of the great discovery then looming in the near future—the electromagnetic nature of light (Clerk-Maxwell, 1865).

Zeeman's Discovery.

However, although the chief fact of the interaction between light and magnetism had been wrenched from Nature by Faraday in 1845, long before any niche was ready for it, and before it could be properly appreciated by his contemporaries, the latest outcome or development remained hidden till the end of last year [1896], when a young Dutch physicist, Dr. P. Zeeman, now Professor at Amsterdam University, then working in Dr. Kamerlingh Onnes' laboratory at Leyden, made another attempt of the same kind as Faraday's in 1862, and, employing modern spectroscopic appliances, succeeded in discovering a new phenomenon. The lines of the spectrum were seen to broaden when the magnet was excited.

Sodium or lithium salts introduced into a Bunsen flame between pointed poles, and the light examined by a large Rowland grating, will show the effect; but an oxyhydrogen flame is better than an ordinary Bunsen, because of the higher temperature.

Experimental Details.

Zeeman was not satisfied with examining emission spectra only, because of the danger of spurious and commonplace causes of the effect; so he arranged a porcelain tube containing sodium between magnet poles, heated it intensely by a flame, and passed a beam of electric light through it into the spectroscope; in this way he was able to see the dark absorption D lines, and to obtain them of uniform width by rotating the tube on its axis so as to avoid inequalities of density; and he was then able to observe, when the magnet was excited, the same kind of broadening in the absorption spectrum as he had seen in the emission spectrum.

Then he considered the fact established, and published it. An abstract of the communication to the Amsterdam Academy, appeared in "Nature" for December 24, 1896, p. 192.

To those who had been working in the domains of electro-optics and the connection between ether and electricity, the general meaning of the fact was clear. Dr. J. Larmor wrote to me at once that it was a result which would follow from his theory; that, indeed, he had already deduced that there must be some effect on the spectral lines, but had concluded that it was probably too small to observe. It appears also that Professor Tait, being impressed with the theoretical probability of exactly the kind of phenomenon now observed, made an attempt in 1875 to see it, but failed.

The views of Dr. Johnstone Stoney with regard to the motions of ions or electrons in a source of radiation must also be mentioned as the kind of views likely to receive confirmation and enlargement from the new fact.

Theory of Lorentz.

Independently of all this, however, Dr. Zeeman himself had at hand a mathematical physicist of the highest eminence, in his own countryman, Prof. H. A. Lorentz, of Leyden; and on mentioning his discovery to him was at once informed that it chimed in

* From The Electrician, Vol. XXXVIII., p. 568. February 26, 1897.

exactly with Prof. Lorentz's theoretical views concerning the nature of radiation, and that if he looked at the broadened edges of the lines he would find their light to be polarised. If he looked across the lines of force at the flame he would see the extreme edges of the broadened sodium lines plane-polarised, with the plane of polarisation coincident with the magnetic lines of force; but that if he used perforated poles, and looked at the flame along the lines of force, then he should find the broadened edges of the spectral lines to be composed of circularly polarised light, right-handed on one side of the line, left-handed on the other. (The analysers must be inserted before the light reaches the grating, of course, because of its depolarising action.)

The whole of this prediction has been fulfilled to the letter, and it is scarcely possible any longer to doubt the correctness of the observation.

Spurious Anticipations.

It is not, however, the first time that some such thing has been noticed. It appears that in 1885 a M. Fievez brought before the Belgian Academy of Sciences a Paper on the influence of magnetism on the character of the spectral rays, and described certain experimental results, which, if they were due to anything more important than mere magnetic disturbances of the flame, were of a very remarkable character. The lines are said not only to have widened and brightened, but reversed and doubly reversed. From the description, it appears likely that a variety of unimportant causes of disturbance must have been present, and that if the true effect was seen at all, it was so mixed up with spurious effects as to be unrecognisable in its simplicity, and so remained at that time essentially undiscovered.

The Importance of the Discovery.

The importance of the discovery lies, of course, in its theoretical bearing, in the evidence it can furnish as to the nature of the motions which enable matter at high temperature to disturb the ether, and in the conclusion that can be drawn from it as to the physical nature of a radiating or absorbing body.

It has for some time now appeared likely that radiation could only be excited by the motion of electrified particles, not by the vibration of inert particles of matter themselves, but by the vibration of the same particles when electrified, each probably with its atomic or ionic charge. Ions in vibration or in revolution have been shown to be competent to excite electromagnetic waves, and hence a source of light has been supposed to contain such ions. Some philosophers have doubted about the existence of, or necessity for, any material nucleus beyond the electric charge itself; such a charge, when in motion, would behave as if it had inertia, in accordance with well-known electrical laws, as worked out by Mr. Heaviside, Prof. J. J. Thomson, and others; and accordingly the idea of radiation excited by the motion of *electrons* pure and simple has been steadily gaining ground.

For myself, I see at present in the facts nothing which will permit one to discriminate between these two hypotheses, or, rather, these two modifications of one hypothesis; but the main idea itself, that radiation is excited by the motion of electric charges (whether associated with material particles or free), will probably be found to be substantiated and established by the discovery of Zeeman.

Note A. 1922. Radiation, though certainly due to the oscillation or rotation of an electric charge, might be caused either by the charge revolving freely like a satellite, or by a charge oscillating to and fro in a conductor, as it does in a Hertz vibrator or in a modern wireless station.

At that date (1897) the notion of a charge oscillating on a conductor seemed the most natural and likely one. And Dr. Zeeman's approximate measurement of the electrochemical equivalent of the radiating body, which he found to possess a value of e/m of the order 10^7, instead of the atomic order 10^4 for hydrogen and about 400 for sodium, showed that the radiating entity had virtually or really about one-thousandth of the mass of a hydrogen atom. That did not prove that it was a free satellite electron; for though this idea was in the minds of several people—Johnstone Stoney, Lorentz, and Larmor—and though—as appears from the preceding paragraph—I too had some notion of the kind, and therefore probably many other people, yet the real discovery of the experimental separation or isolation of an electron was announced to the British Association at Dover, three and a half years later, by Sir J. J. Thomson.

The Elementary Aspects of the Theory.

[1897] The elementary aspects of the theory of the effect are as simple as possible. Superpose a rotation upon a simple harmonic motion, after the manner of a Foucault pendulum, and not only is the path altered, so that a rectilinear path becomes a hypocycloid, and an elliptical orbit becomes a spiral or rotating ellipse, but also the period of the oscillation or revolution is slightly altered too. Not, indeed, on the average, for whereas any right-handed rotation might be accelerated, a corresponding left-handed rotation would be equally retarded, and consequently on the average motion as a whole there would be no effect. Nevertheless, the range of oscillation frequency would have been increased. In addition to all the modes of vibration which had been possible and present before the superposition of the rotation, there will now be a further set of somewhat shorter periods, and another set of correspondingly longer periods. And if we have the means of analysing the motion and sorting it out into all its grades of frequency—a means with which a diffraction-grating or a prism at once furnishes us—we shall see not only the original modes of vibration, represented as a line in the spectrum of a certain width, or of a discontinuous set of such lines, we shall also see, to the right and left of every such line, an extension, either separated from it by an intervening dark space or else merged and gradating into it, in accordance with the circumstances of the case.

If every form of possible motion with a definite frequency had been originally present, and that is what we must assume as likely in the case of an incandescent vapour, then the extensions caused by the superposed rotation will be lateral wings shading off with perfect gradualness into the original line, and with no intervening dark space at all. In other words, the line will be simply widened; it will not be tripled.

Random Molecular Motion.

Note B. 1922. This notion of the random motions of the molecules of a gas, as having any close connection with the Zeeman effect, rather obsessed me for a few weeks at this time. I evidently did not realise as clearly as Lorentz did that it was an intra-atomic phenomenon, that it was concerned with the internal parts of each individual atom, and that the motion of the atoms as a whole was insignificant.

The facing-round power of the magnetic field, spoken of in the next paragraph, is exactly what is operative; but, as the electronic orbits have kinetic inertia, the effect is not simply to tilt the orbits, in the way a disc would be tilted, but to make the orbits revolve round an axis, with a motion at right angles to the deflecting force, exactly like the precessional motion of a spinning top that is not "asleep." This kind of electronic motion—predicted by Lorentz, and also in 1891 by Johnstone Stoney—was completely verified by Zeeman.

Other Interesting Phenomena.

[1897] On the other hand, if the magnetic effect be something more than an acceleration and a retardation of right and left-handed components respectively; if, in addition to that, it has any facing-round power like that observed in diamagnetism on Weber's theory: then, if the field is intense enough, there will be other interesting phenomena to observe; but these at present are not known to have any existence.

The elementary treatment of the general idea of the Lorentz theory of the effect is so extremely simple that such of your readers as are not mathematicians may like to have it here popularised with the help of a few symbols. An electric charge e, moving with velocity v across a field of magnetic force of intensity H, experiences a force, at right angles to the lines of force and to its motion, of magnitude eHv, the effect of which is to deflect it to the right or left according to its direction of motion. This is, in fact, the electrostatic edition of the ordinary force experienced by a conductor conveying a current in a magnetic field, to which the power of every electric motor is due.

Note C. 1922. The only justification for the use of the word "electrostatic," here, is the fact that the current is analysed into e and v, that is to say, is definitely regarded as intrinsically a moving charge. It would not have been justifiable at that date to assume that *every* current—in solids, liquids, and gases—was also due to the locomotion of unit electric charges. And, indeed, the exact nature of conduction in metals can hardly be considered finally settled even now.

[1897] Any motion or component of motion which the electrified particle possesses *in the direction* of the lines of force is unaffected by this force, which does not act at all in that direction. Consequently, if we take the magnetic lines as the axis of z, the effect of the motion we have to consider lies in the plane xy; and so long as it is an undisturbed simple harmonic motion it is characterised by the equations:

$$\left.\begin{aligned} m\ddot{x} + kx &= 0 \\ m\ddot{y} + ky &= 0 \end{aligned}\right\},$$

which express the equality of the restoring force to the mass-acceleration of the particle, and give all the circular, elliptical and

rectilinear motions possible to a weight suspended by a long string, or a particle constrained by simple elasticity k about a fixed point; and the period of the motion is $2\pi\sqrt{\frac{m}{k}}$.

So far, the moving particle has only possessed inertia (m); but now confer upon it an electric charge e, and let it move with a velocity whose components are $\dot{x}$, $\dot{y}$ and $\dot{z}$ in a field H parallel to z. Then at once it experiences a new force, whose x component is $eH\dot{y}$, and whose y component is $-eH\dot{x}$. Inserting these forces into the above equations they become:

$$\left.\begin{aligned} m\ddot{x}+kx&=eH\dot{y}\\ m\ddot{y}+ky&=-eH\dot{x}\end{aligned}\right\},$$

and at once the path becomes a little more complicated, and the period of the motion is slightly altered.

The new period is given by:

$$\frac{2\pi}{\sqrt{\left\{\frac{k}{m}\pm\left(\frac{eH}{2m}\right)^2\right\}}},$$

so the modification in the frequency is:

$$\frac{eH}{4\pi m};$$

and this is the quantity to be observed.

Note D. 1922. Here I made a slip in the algebra, which I corrected in a subsequent issue, as appears below. The modification of frequency as stated in the last line is correct, except that to keep dimensions right and sensible it is always best to retain the factor μ, so as to be independent of any systems of units and true in them all. If this were done more frequently and systematically a lot of trouble would be saved when numerical interpretation in either of the main systems was desired, and there would be no need to specify the system, or the kind of units intended, except in connection with a numerical specification; for all *algebraic* expressions would be true in every unit that ever was devised—metric, British, e.g.s., electric, magnetic, thermal, &c., &c.—as they ought to be. May I ask students to save themselves and others trouble by attention to this, and to the opening paragraphs of the article, "A Few Further Notes," which immediately follows? Too few teachers even now realise the beauty and simplicity of really absolute measure, though probably none are aware of what they miss by unconscious and unsuspected inattention to it.

The Amount of Widening.

[1897] The effect is small, and a strong magnetic field is required; but what is more important is to have high dispersive power and good optical arrangements; the effect is best seen when a bright sodium flame is formed by an oxyhydrogen jet between the pointed poles of a large electromagnet, and when the spectrum is examined by a large Rowland grating, with each line well focussed and sharply defined. Under these circumstances the discoverer says that the widening may amount to one-fortieth of the distance between the D lines, but I do not know that I myself have seen it quite so much as this.

As soon as the effect has been plainly obtained, it is not difficult to examine the light for polarisation, by interposing between the flame and the grating a nicol prism, or else a quarter-wave plate and a nicol.

I found it rather more difficult to see the effect along the lines of force than across them, but that was probably only because the perforation of one of the poles interfered with the concentration of the field along the axis of vision.

The circular polarisation can be seen in several ways; *e.g.*, with the aid of a rhomb of Iceland spar, a double image of the slit can be formed so that the pair of sodium lines are doubled; the light having first passed through a quarter-wave plate; then, by rotating the spar, the two pairs can be placed end to end exactly, and on now exciting the magnet one pair moves relatively to the other slightly to the right; while on reversing the magnet it moves correspondingly slightly to the left. This is in consequence of the opposite circular polarisations.

The plane polarisation of the light which goes to form the broadened edges of the lines, in the beam *across* the lines of force, is seen with comparative ease, and it can be verified that the polarisation is such that the electric oscillations or revolutions which are most affected by the magnetism are in a plane normal to the lines of force: as, of course, is directly indicated by the elementary theory.

I hope that before long Dr. Larmor will let us have the benefit of his views as to the new phenomenon, for it is evidently of considerable interest in the light of the magnificently comprehensive theory of the physical universe which of late years he has been partially communicating to the Royal Society.

The second of Sir Oliver Lodge's articles, in which he made a few corrections in his previous argument and added some additional matter, follows.

A Few Further Notes on Zeeman's Discovery.*

By Prof. OLIVER LODGE, D.Sc., F.R.S. [Date, 1897].

Units and Dimensions.

[1897] In the article on page 569 it would have been better if B had been everywhere written instead of H. The force experienced by a moving charge is not directly dependent on the magnetic potential-gradient of field intensity, but it is directly dependent on the induction density, the number of lines per unit area across which it is moving. Introducing the factor μ therefore, wherever H occurs, everything becomes of right dimensions; μeHv or eBv is a real mechanical force, and $\mu eH/4\pi m$ or $eB/4\pi m$ is really a frequency, *i.e.*, a number per second.

In the interests of those students who may possibly have been puzzled by considerations about units and dimensions, in a way which they never need be if proper care is taken to express correctly and fully every physical quantity which occurs in an expression, you will allow me to make this apparently insignificant correction.

Correction in Formula.

One other correction. The period of the disturbed motion is not exactly as printed near the end of page 569, but, in so far as there is an exact period for a motion which may easily involve incommensurable terms having no common multiple, it is:

$$\frac{2\pi}{\sqrt{\left\{\frac{k}{m}+\left(\frac{eB}{2m}\right)^2\right\}}\pm\frac{eB}{2m}}.$$

The quantity squared under the root is too small to need taking into account in that place, and it has only the positive sign attached to it. In so far as it operates at all, it may be said to represent the disturbance of the radius vector, while the quantity outside the root, with the alternative sign, represents the chief part of the acceleration or retardation of the periodic time, or frequency, as correctly stated in the next line of page 569.

[*i e.*, in the formula just above note D.]

Numerical Significance of the Formula.

And now that I am on elementary matters I may as well indicate the numerical interpretation and significance of the formula for the change of frequency, $\pm eB/4\pi m$. First of all then, e/m is the reciprocal of the electrochemical equivalent of the substance; and for the case of sodium in the ordinary electrolytic condition it equals 1·16 ampere hours, or 4190 coulombs, per gramme. There is no guarantee that the same charge attaches to the atoms in the sodium flame, but, for lack of better information, that may be assumed as a first hypothesis, to be corrected, if necessary, by facts; and so we initially suppose e/m to equal 419 in ordinary C.G.S. units of the electromagnetic system.

A great induction density to get even between pointed poles is 30 000 lines to the square centimetre, and when we want to see a very small effect we may aim at this; if we have to put up with a weaker field it is easy to apply a proportional allowance.

Thus, then, $\pm eB/4\pi m$ comes out $419 \times 30\,000 \div 4\pi$, or, say, a million vibrations per second, increase or decrease of frequency, due to the magnetism.

Now, the natural rates of vibration corresponding to the two D lines are 509·3 and 508·8 billions per second respectively; that is to say, the distance between the D lines corresponds to a range of vibration of five hundred thousand million vibrations per second; whereas we have just calculated, on the strength of a bare assumption with regard to the value of e/m, that the widening of either line by the assumed magnetic field would only amount to one million vibrations per second either way. Such a widening, only the 1/250 000th part of the interval between the D lines, could not be seen.

Note E. 1922. This arithmetic is rather interesting historically, since it shows the prevailing uncertainty as to what inertia the radiator actually possessed. The calculation proceeds on the stated assumption that the atom is the radiator: an assumption which the Zeeman result proved to be wrong. But this must have been the *kind* of thumbnail calculation which Larmor made when he decided that the result he expected

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* From The Electrician, Vol. XXXVIII, p. 643, March 12th, 1897.

theoretically would be probably too small to observe, as mentioned near the beginning of the preceding article.

Zeeman had not then given any arithmetic of this kind, but had said that he estimated the broadening of one of the sodium lines as about one-fortieth of the distance between them. This was all the data I had to go on in what follows.

Zeeman's Estimate of e/m.

[1897] The effect observed by Zeeman is much greater than this, consequently it would appear to follow that the value of e/m in the flame is much greater than the customary electrolytic value.

Supposing his estimate correct, viz., that he has witnessed a widening of each line equivalent to one-fortieth of the D line interval, in a field which we will suppose contained 15 000 lines to the square centimetre, we should have:

$$\frac{e}{m}\cdot\frac{B}{4\pi}=\frac{5\times10^{11}}{80} \text{ vibrations per second,}$$

whence

$$\frac{e}{m}=\frac{2{\cdot}5\pi\times10^{10}}{15\,000}=\frac{1}{2}\times10^{7} \text{ C.G.S.}$$

(or fifty million coulombs per gramme).

Zeeman's own estimate for e/m is 10^7, though he does not give any details; and accordingly I suppose that he considers his field had the moderate intensity of 8 000 C.G.S.; though twice that strength would have seemed more likely to be used in so notable an attempt.

The remarkable and immense discrepancy between the order of magnitude for e/m, deduced from the first rough measurement by the discoverer, and the ordinary well-known value obtained in accordance with Faraday's law from exact experiments in the liquid state of salt solution, viz., 10^7 on the one hand and 419 on the other, seems to me at present a considerable outstanding difficulty.

[*N.B.*—The 419 is for sodium, or about 10^4 for hydrogen.]

Too Hopelessly Small to Observe.

No wonder that previous contemplators of the possibility of some such effect, led thereto by purely theoretical considerations, should, like Dr. Larmor, have come to the conclusion that it was probably too hopelessly small to observe.

The most likely direction in which to look for an explanation of the remarkably high value of e/m, as compared with the electrolytic value, is probably that which has just been suggested to me privately by Professor Fitzgerald, viz., that the whole inertia of the particle is not concerned with the radiation motions, but only a very small fraction of the whole mass.

The electric charge being supposed the usual monad ionic charge, if the effective inertia is only 4×10^{-5} or 0·00004 of the whole atomic mass, the discrepancy would be explained.

Note F. 1922. This paragraph shows that we did not then know, what everyone knows now—thanks to workers in the Cavendish Laboratory, Cambridge—what the mass of an electron was, even if it had a separate existence. It is here estimated, on the basis of the Zeeman effect alone, which had then been only known in this country for a couple of months, that the mass of the radiating part of an atom was the twenty-five-thousandth part of a sodium atom, or about the thousandth part of a hydrogen atom; which is the right order of magnitude.

Fitzgerald's Comments.

[1897] Professor Fitzgerald also adds a line which indicates how simply the theory can be put if a frankly circular orbit is assumed for the motion of the radiating particle, revolving with angular velocity $\omega=2\pi/T=2\pi n$, under the action of a force directed towards a fixed centre and proportional to the direct distance; n being the frequency. For the centrifugal force is $mr\omega^2$, while the centripetal force is in two portions, one the ordinary undisturbed force, which we may write as mk^2r, and the other the magnetic force, normal to the motion and therefore also radial, viz., $\pm eBv$, which we may write as $\pm2mc\omega r$, where $c=eB/2m$. Hence we have as the equation to express the circumstances of the motion:

$$r\omega^2=k^2r\pm2c\omega r,$$

from which r cancels, showing that the result is independent of the amplitude, *i.e.*, independent of the brightness of the light; and the solution for the angular velocity is:

$$\omega=\sqrt{(k^2+c^2)}\pm c.$$

This is approximately the same as

$$2\pi n=k\pm c;$$

so the normal frequency is $k/2\pi$, and the disturbance of frequency either way is $c/2\pi$, that is $eB/4\pi m$.

Another, and the shortest possible mode of putting the elementary theory, is to say that the radial magnetic force, $eB\omega r$, causes a change in the centripetal force, $mrd\omega^2$,

whence

$$d\omega=\frac{eB}{2m}.$$

Note G. 1922. This is certainly the simplest and shortest mode of expressing the main part of the theory of a magnetic perturbation applied to orbital motion of an electrically charged body, if it be passed as sufficiently valid for elementary exposition; and as it is intended to be absolutely simple I repeat it here rather more fully. The centripetal force that has to act on a particle m revolving in an orbit of radius r with velocity v or angular velocity ω and frequency n, so that $v=r\omega=2\pi rn$, is $m\omega^2r$; while, if the particle is charged with the quantity e, the magnetic force exerted upon it by a magnetic field of induction density B (that is to say with B lines per unit area) is eBv. This will cause a change in the centripetal force such that

$$d\,(mr\omega^2)=eBv$$

so if r is constant, or the orbit a circle, we get

$$2\,mr\omega d\omega=eBr\omega$$

$$\text{or } d\omega=\frac{eB}{2m}$$

Whence the change of frequency is

$$dn=\pm\frac{eB}{4\pi m}$$

[1897] This, indeed, applies straightway to orbits of all shapes, and emphasises the independence of the effect from radius of curvature.

The most remarkable circumstance is, as Zeeman points out, that the radiation appears to be due solely to the motion of a *positively*-charged particle; at least, in the case of such substances as sodium and lithium. This is ascertained by the sign of the circularpolarisation at either edge of the widened line; for if the magnetic force is such as to accelerate the speed of a right-handed circular positive current, then the edge of the line which is widened towards the violet consists of right-handed circularly polarised light, while the edge of the widened line facing towards the red end of the spectrum consists of left-handed polarised light.

A Curious and Instructive Error.

Note H. 1922. This is a curious and instructive error, made at first by Zeeman himself when stating the sign of the effect. It is so easy to interchange right for left, and the mistake was speedily corrected. But it shows how little certain anybody was then that the electron or radiating particle was a unit *negative* charge. It was equally easy at that time to suppose that a very light positive unit was the mobile entity, and the sign of the Zeeman effect had to be carefully attended to and re-criticised in order to give us the true fact; which elevated the negative charge into a position of importance from which only quite recent researches into the constitution of the nucleus of an atom has partially dethroned it.

[1897] If it had been a rotating *negative* charge of electricity to which the radiation was due, this state of things would have been just reversed. It is not, indeed, likely that the molecule contains no equal opposite charge, nor is it likely that this oppositely-charged portion of the molecule is perfectly stationary: but it is possible that its motions may be unconcerned with the production of the particular radiation which goes to produce the sodium lines, and although the radius *per se* does not affect acceleration, yet great mass, which accompanies small radius, does.

Here, at any rate, is ample field for experiment.

The magnetic action on an electric charge revolving in an orbit round the lines is quite analogous to the strengthening of any current flowing in a circuit coincident with the orbit and enclosing the same lines. A material circuit would have resistance, and in that case the strengthening of the current would be only temporary, and a cessation of the magnetism would be accompanied by an inverse current; but with a molecular or ideal circuit it will not be so; the rise of current caused by the magnetism will continue as long as the lines persist, and when these are removed the current will simply sink to its original undisturbed value.

There being no resistance, it is self-induction which controls the rise of the current; and the additional number of lines will equal the rise of electromagnetic momentum, in other words:

$$dN=LdC.$$

Note J. 1922. This is what happens in a lead ring at or near absolute zero, according to the remarkable recent discovery of Kamerlingh Onnes; and it may be regarded as a foreshadowing of the ring electron, to which Dr. H. S. Allen has devoted so much attention. It was evidently possible even at that date to contemplate the electric constitution of matter, so that the whole of the mass of the radiating body might be due to its electric charge. See also the concluding paragraph below, where the size of an electron is reckoned merely from the Zeeman effect.

I suspect, however, that it did not strike me, at that time, that a ring electron would not radiate, at least not by reason of its own constitutional motion, and that even two electrons situated at either end of a diameter would radiate extraordinarily less than either of them separately.

Moreover, the law of force contemplated above was that of the direct distance, whereas it is now customary to consider it as obeying the inverse square law. And the radiation responsible for spectral lines appears really not to be due to any regular orbital motion, but to a perturbation of that motion, or to a fall from one orbit to another. Nothing of that kind is here foreshadowed: though the fact that radiation is only excited by some kind of "chemical clash," or violent shock, was not by any means unsuspected, and in all probability was already known to a few; to Sir J. Larmor certainly.

Identification of the Moving Charge.

[1897] The simplest way of identifying the moving charge with a current is to suppose it distributed uniformly all round its orbit, with a linear density $\lambda = e/2\pi r$, in which case the sum of all the current elements (or moments of current, as they are sometimes called) is given by either of the two following expressions:

$$e\omega r = 2\pi r C,$$

or, what is the same thing, $$C = ne = \frac{e}{T}.$$

Introducing this into the equation of centrifugal force (see above) we get

$$d\omega = \frac{eB}{2m} = \frac{eN}{2mA} = \frac{eLdC}{2mA} = \frac{e}{m}\cdot\frac{L}{A}\cdot\frac{ed\omega}{4\pi}$$

whence

$$L = 4\pi A\frac{m}{e^2} = 4\pi^2 m\frac{r^2}{e^2} = m\left(\frac{2\pi r}{e}\right)^2 = \frac{m}{\lambda^2} = \frac{8\pi\mu}{3a}\pi r^2,$$

which gives the electromagnetic inertia coefficient; the penultimate term taking a material view, the last term an electrical view, of inertia. To check it we may observe that the energy of the current $\frac{1}{2}LC^2 = \frac{1}{2}Le^2\omega^2/4\pi^2 = \frac{1}{2}(mr^2)\omega^2$ as it ought.

The velocity of an ion or electron revolving in an orbit of molecular dimensions sufficiently fast to give sodium light is not small, for it must rotate 5×10^{14} times per second, and so its speed is $u = 2\pi an = \pi a\times10^{15}$, which, if $a = 10^{-8}$, gives 3×10^7 cm. per second, or one-thousandth of the speed of light.

Not an Ultimate Explanation.

Note K. 1922. This sort of speed for an electron is now known to be quite reasonable.

The attribution of electrical inertia to displacement currents set up in the ether, which follows a few lines lower down, is correct; and this accords with the view, which though inevitable is often masked, that the electrical explanation of inertia is not an ultimate explanation, but postulates an unknown property, akin to tremendous massiveness—a property responsible for all observed atomic inertia—as existing unexplained in the continuity of the ether of space

[1897] So long as the motion is not still more rapid than this, it was shown in 1881, by J. J. Thomson, that a moving charge behaved as if it had a constant inertia; so that, in addition to whatever inertia the body holding the charge may possess, the charge itself has an inertia which is expressible as $\frac{2\mu e^2}{3a}$, where a is the radius of the sphere holding the charge. As the speed of motion approaches the speed of light the inertia increases, and assumes a much more complicated form (see Heaviside, "Electrical Papers"; vol. 2, pp. 495, 514, &c.). But at 1/1000th the speed of light, this complication need hardly be taken into consideration.

Now it is just possible that this electrically-explained inertia, due to the displacement-currents which are set up in the dielectric by the motion of any charged body, may be the only inertia concerned in radiation at all. That is, that it is the motion of the electron only which is emitting the observed spectrum lines.

If so, Zeeman's rough measurement for e/m, viz., 10^7 C.G.S. means that

$$\frac{e\times3a}{2\mu e^2} = \frac{3a}{2\mu e} = 4{\cdot}5\times10^{21}a = 10^7,$$

since $\mu e = \frac{1}{3}\times10^{-21}$ C.G.S. units; wherefore, the size of the electron which will suffice to attain Zeeman's quantitative result, without the necessary motion of any "matter" at all, is $a = \frac{1}{4}\times10^{-14}$ cm.; about a millionth of the linear dimensions of the sphere of molecular activity commonly known as the "size" of an atom.

Conclusion by Sir Oliver Lodge. [1922.]

On seeing my article in "Nature," of Jan. 19th, 1922, reviewing the reprint of his Papers which had just been issued by his friends in Holland as a memorial of the discovery, and of which the title is given above in the editorial introduction to this historical reproduction, Dr. Zeeman favoured me with a letter, from which a few extracts will be of interest to readers of The Electrician:

> "Your announcement in 'Nature' of the reprint of my magneto-optical Papers has taken me back to a happy time, and made me feel twenty-five years younger. A reprint of your early articles on the subject, as they appeared in The Electrician, would be interesting to the younger generation of physicists. Could they not appear in a new edition of your book, 'Electrons'?
>
> "It is rather remarkable that the new theory of quanta is still at a loss to understand some of the complicated, extremely regular, magnetic separations, such as the nonet of the green mercury line, or the cadmium line 5086.
>
> "In the 'Zeitschrift für Physik," recently, important Papers on the subject, by Landé, have appeared, but there is still something wanting.
>
> "February, 1922. P. Zeeman."

It is in accordance with Dr. Zeeman's wish, therefore that the Editor of The Electrician has reproduced the twenty-five year old article above.

Telegraphy, Telephony and Wireless.*

This book forms one of a series entitled "Common Commodities and Industries." The author has had the difficult task of condensing into a small book of 120 pages the main features of telegraphy, telephony, and wireless. The difficulty was increased by the fact that the author could not assume that his readers already had a fair knowledge of electrical units and phenomena.

The first chapter necessarily deals with Elementary Electricity. It is astonishing to find that it is possible to cover so much ground in a chapter of twelve pages. The matter is concisely put and well connected together. Mechanical analogies are used at times, and were it not for the necessity for the utmost brevity it would have been desirable to extend their use when explaining the behaviour of condensers, inductances, &c.

The Telegraphy section contains brief but "pithy" descriptions of most of the important instruments and methods of working, from Cooke and Wheatstone's needle to the Baudôt. Good descriptions of the Wheatstone automatic and Baudôt systems are given in two and three pages respectively, inclusive of illustrations. The only fault to be found is in the statement that the perforated tape in the Wheatstone transmitter is fed forward in "very rapid jerks."

The information on Submarine Telegraphy is not in keeping with the rest of the book. Lord Kelvin's siphon recorder for "The newly-laid Atlantic cable" is described, the pattern being a very early one with electrified ink. No attempt has been made to indicate the modern methods of working and relaying. The above criticism does not apply to the Telephony section, which is well covered from the Bell telephone to automatic exchanges. The Wireless Telegraphy and Telephony chapters are good, and the principle that no important feature should be omitted is well upheld.

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*Telegraphy, Telephony and Wireless. By J. Poole, Wh. Sch., A.M.I.E.E. (London: Sir Isaac Pitman, & Sons). Pp. vii. + 120. 3s. net.

Flux Distribution in Air Gap and Teeth of Dynamos.

By ALFRED STILL.*

(*Concluded from page* 153.)

This article deals with the flux distribution in the air gap and teeth of dynamos from the standpoint of fundamental laws and principles, it being found that in presenting such problems to engineering students it is as well to avoid many of the methods used by the practical designer. The subject is dealt with under the headings of permeance of the air paths, the air gap, and of the conditions in highly saturated teeth. Calculations of the tooth density in terms of air gap density and m.m.f., with a correction for the tapering of the teeth are made, the whole argument being illustrated by a numerical example.

Correction for Taper of Teeth.

The assumption of parallel sides to the tooth is justified only when the diameter of the armature is large relatively to the slot pitch, or when taper slots are used in order to provide a uniform cross-section throughout the whole length of the tooth. The dimension t in formula (4) should preferably be the width at the centre of the tooth. When the field system revolves, as in most alternators, the armature teeth will usually be wider at the root than at the top, and but little error will be introduced by taking for t the average width for the purpose of calculating the average tooth density and the corresponding ampere turns required for the teeth.

The case of a tooth with considerable taper, in which the density at the root is in excess of (say) 12 000 gausses, may be dealt with by the application of *Simpson's Rule*. Owing to

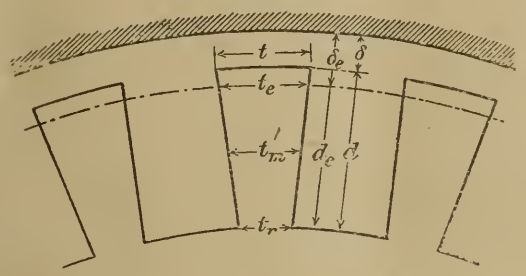


Fig. 5.

the fact that a portion of the flux enters the tooth at the sides, the flux density in the top of the teeth will not be very high, and the reluctance of the tooth over the portion of its length equal to the difference $d-d_e$ (see Fig. 5) may be neglected; the tooth will, therefore, be considered as having a total length d_e with a width t_e at the top, t_r at the root, and a mean thickness of t_m half way between these two sections. In order to simplify the calculations, the assumption is now made that the total flux in the tooth remains unaltered through all other cross sections.†

The value of the magnetizing force H (or, if preferred, the ampere turns required per unit length) can then be determined for any section of the tooth by referring to the B-H curves for the iron used in the armature. It is sufficient to determine H for three sections only. If these values are :

H_r at the narrowest section

H_e at the widest section

H_m at the centre section (*i.e.*, where the value of B_m is $\frac{B_r+B_e}{2}$)

then, on the assumption that the portion of the B-H curve involved is a parabola, *Simpson's* approximation is :

$$\text{average } H=\tfrac{1}{6}H_r+\tfrac{2}{3}H_m+\tfrac{1}{6}H_e \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Referring to Fig. 5, it will be seen that H_e is taken at the section which would be the top of the tooth if the air gap were increased from δ to the "equivalent" value δ_e. This is recommended as a good practical compromise, and the m.m.f. in gilberts required to overcome the reluctance of the tooth is $H\times d_e$ where d_e, the "equivalent" length of tooth, must be expressed in centimetres. Obviously, the formula (7) can easily be modified to give an average value for the ampere turns per inch.

* Professor of Electrical Design, Purdue University, U.S.A.

†This is not a correct assumption when the root density is very high, because in that case flux will leak out from the sides of the tooth to the bottom of the slot, and at some distance from the bottom of the slot (the taper being as indicated in Fig. 5) the total flux in the tooth will be greater than at the root cross section.

Numerical Example.

In order to illustrate this method of calculation, numerical data will be assumed and the manner in which a curve may be plotted giving the relation between the average density (B_y) in the air gap and the field ampere turns necessary to overcome the combined reluctance of air gap and tooth will be explained. The assumed quantities are :

Outside diameter of armature core = 19·5 in.
Gross length of armature core = 11 in.
Net length of armature core (iron only) = 9 in.
Length of air gap δ = 0·25 in.
Depth of slot d = 1 in.
Width of slot s = 0·5 in.
Width of tooth at top t = 0·576 in.
The calculated slot pitch is λ = 1·076 in.

The equivalent air gap as calculated by formula (2) is :

$$\delta_e=\frac{1\cdot076}{\frac{0\cdot576}{0\cdot25}+\left(\frac{5\times0\cdot5}{5\times0\cdot25+0\cdot5}\right)}=0\cdot288 \text{ in.}$$

The next step is to plot a curve giving the connection between air-gap density and tooth density at the centre of the tooth. The calculated values of tooth width at the four sections indicated in Fig. 5 are : t=0·576, t_e=0·572, t_m=0·519, t_r=0·466.

The value to use for t in the formula (4) is preferably the thickness at the centre, or 0·519 in.

Now select arbitrary values of B_t and make the calculations as indicated in the table. Note that μ is supposed to be obtained from data referring to the particular sample of iron used for the armature punchings. The air-gap density B_y is calculated from formula (4), but for tooth densities below 14 000

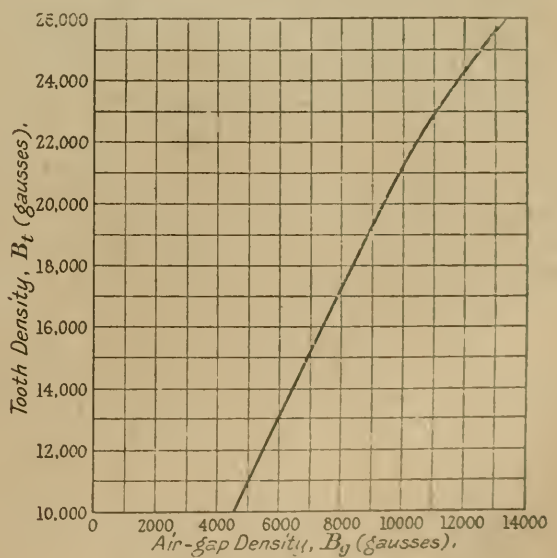


Fig. 6.

gausses the simpler formula (5) may be used, as the difference in the values given by the two formulas is then negligible.

B_t (assumed)	μ	B_y (by formula 4)
12 000	210	5 500 (by formula 5)
18 000	128	8 340
21 000	46·7	9 870
25 000	12·5	12 530

The curve, Fig. 6, which has been plotted from the figures in the Table, gives the relation between the flux density in the air gap and the corresponding density in the iron at the centre of the tooth for any value of the air-gap density.

Ampere Turns for Air Gap and Teeth.

The final step is to calculate the ampere turns required for the air gap and teeth, and plot a curve which shall give this relation for all values of air-gap density. The results of these calculations are given in tabular form. Taking the columns in order, we have :

First column. Any assumed values of air-gap density including the highest value likely to be attained under full load conditions.

Second column. The corresponding values of flux density in the iron at the centre of the tooth (read off curve of Fig. 6).

Third column. The corresponding magnetizing force, read off *B-H* curve (not reproduced here).

Fourth column. The flux density at root of tooth, being values in column 2 multiplied by the ratio $\frac{t_m}{t_r}=\frac{0{\cdot}519}{0{\cdot}466}$

Fifth column. The corresponding value of *H*.

Sixth column. The flux density at top of tooth, being values in column 2 multiplied by the ratio $\frac{t_m}{t_e}=\frac{0{\cdot}519}{0{\cdot}572}$

Seventh column. The corresponding value of *H*.

Eighth column. The average magnetizing force of gilberts per centimetre for the iron in the teeth calculated by applying

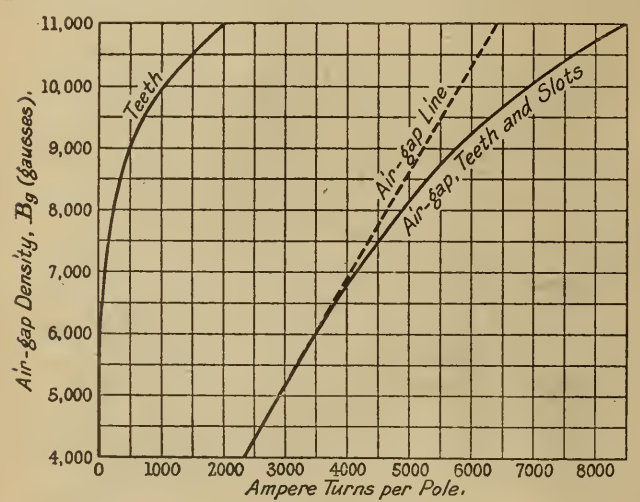


Fig. 7.—Saturation Curves for Air-Gap, Teeth and Slots.

Simpson's Rule (formula 7), except in the case of the last line of figures where this calculation is not necessary because all values of *B* are below the " knee " of the *B-H* curve.

Ninth column. The ampere turns required to overcome the reluctance of the teeth, being :

$$(TI)_t=\frac{Hd_e\times 2{\cdot}54}{0{\cdot}4\pi}$$

where d_e, in this example, has the value $(1+0{\cdot}25)-0{\cdot}288=0{\cdot}962$ in.

B_g	At middle		At root		At top.		H	$(TI)_t$
	B_m	H_m	B_r	H_r	B_e	H_e		
11 000	22 800	900	25 400	2 300	20 700	400	1 050	2 040
10 000	21 200	490	23 600	1 190	19 200	225	562	1 090
8 000	17 300	95	19 250	230	15 600	43	109	212
5 000	10 900	5	12 150	——	9 900	——	5	9·7

The final step in this method of procedure is to plot the curves of Fig. 7. Here the curve marked " Teeth " is plotted from the values in the Table. It gives the ampere turns to overcome the reluctance of the teeth for any value of air-gap density B_g. The ampere turns to overcome the reluctance of the air gap of " equivalent " length $\delta_e=0{\cdot}288$ in. are :

$$(TI)_g=\frac{B_g\times 0{\cdot}288\times 2{\cdot}54}{0{\cdot}4\pi}$$
$$=0{\cdot}582B_g$$

a relation which is represented by the dotted straight line in Fig. 7. All that is now necessary is to add the ampere turns for the tooth to those for the air gap, in order to obtain the final curve giving ampere turns required to overcome the joint reluctance of air gap, teeth and slots for any value of the average flux density, B_g, in the air gap over the space of one tooth pitch.

Hydro-Electric Installations of the Barcelona Traction Light and Power Company.*

By H. F. PARSHALL.

The more important installations are situated on the Pallaresa river at Talarn and Tremp, at Camarasa, and at Seros on the river Segre, a branch of the river Ebro.

The Tremp Power House, which derives its power from the Talarn dam, is equipped with four 7 000 kW horizontal-type turbo-generators, one turbine at each end of the generator. The average annual flow of the river Pallaresa over a period of years is about 49 100 million cub. ft., and the output of this power-house in normal years is about 110 000 000 kWh. At high-water level the working head is 249 ft., and at lowest level it is 118 ft. The results for the year 1917 show an efficiency of 72 per cent., or a water-consumption of 259 cub. ft. per kWh with a head of 196 to 229 ft. The water utilised in an average year at this power-house is 26 593 million cub. ft. The cost of the Talarn and Tremp installation was £1 826 700. The installation at Aytona, or Seros, on the river Segre, of which the rivers Pallaresa and Ribagorzana are tributaries, was the first constructed. The water is taken to the power-house by a canal 12 miles in length, while the diversion dam is at Lerida. The power-house is designed to accommodate five vertical-type generating-units of 8 000 kW (four of which have been installed), and is designed to work with 160 ft. head, the output being in an average year 130 000 000 kWh. The cost of this installation is approximately £1 852 260.

The Camarasa Installation.

The most important and more recent installation described in the Paper is that at Camarasa, sometimes called the " Confluence." The dam at Camarasa is about 105 ft. long at the base, 492 ft. long at the crest, and 318 ft. high from the bottom of the cut-off wall to the footway. It is 246 ft. thick at the base and contains 280 000 cub. yds. of concrete.

The power-house at Camarasa, which is built of reinforced concrete, is designed to accommodate five generating-units of 12 500 kW each, two of which have been installed. The capacity of this power-house completed will be 182 000 000 kWh, and it is designed to utilize the 12-hour discharge at Tremp in 6 hours, should the demand for power so require. The cost of the Camarasa installation, with two units installed, is approximately £1 370 776. With five units installed the cost will be increased by £375 000 and the capital cost per kW will be £27·9. The combined output of the Tremp, Camarasa, and Seros installations is approximately 430 000 000 kWh, and the nominal H.P. is 180 000. The storage capacity of the reservoirs is such that 90 000 000 kWh can be contributed to the combined output of Tremp, Camarasa and Seros.

Phase-Compensation Devices.

Results obtained from phase-compensation by means of synchronous condensers are shown in tabular form. This gives the losses before and after phase-compensation, and shows a gross saving of 24 450 000 kWh per annum, and a net saving, after deducting the losses in the condensers and distribution, of 18 950 000 kWh. The increased revenue derived from the saving in energy effected augments the possible net income by £80 000 per annum. Preliminary calculations showed that, by the use of synchronous condensers, the power-factor could be increased in the ratio of 1 to 1·3, and the terminal voltages increased in the ratio of 1 to 1·2. All the advantages predicted have been fully realised in practice.

Transmission Line Details.

The first transmission lines were equipped with pin type insulators with four petticoats, but these gave a great deal of trouble and were unable to withstand the stress of storms. The line from Seros to Barcelona, which was constructed under the author's direction, is equipped with suspension insulators, seven in series, and has stranded conductors of 250 000 cir. mils section. The line from Camarasa to Igualada has been reconstructed in order to use the suspension type of insulator, and it is equipped with six in series, of the Hewlett type. The standards are designed for straight runs with average spans of 650 ft. They are equipped with two guard wires of $\frac{3}{8}$ in. diameter, and are designed to withstand a wind-pressure due to a velocity of 100 miles per hour with $\frac{1}{2}$ in. of sleet on the wires, the towers to remain stable with two wires broken.

* Abstract of a Paper read before the Institution of Civil Engineers.

The Coming of Age of Witton.

Interesting Developments and Progress at an Important Engineering Works.

On February 7, 1922, the Witton Works of the General Electric Company celebrated their twenty-first anniversary. For on February 7, 1901, the work of building was commenced on what was then nothing more than meadow land. To-day the works occupy many acres of ground and comprise numerous shops of more than ordinary substantial proportions. They employ the labour of some thousands of skilled workers who are engaged in the production of electrical plant and switchgear of every description for all quarters of the globe.

A Broadening Basis.

This development has been accompanied by a broadening basis. For in the very early days the General Electric Company were mainly what would now be called factors. Then they began to manufacture in a limited way and soon became justly celebrated for smaller articles. But in recent years they have turned their attention to the construction of heavy electrical engineering plant and have achieved that success in this wider field which has never been wanting from their endeavours. This expansion, as is well known, has gone hand in hand with useful amalgamations and working arrangements until now the company is a self-contained organisation made up of some twenty large works, each one of which is devoted to the specialised production of a class or classes of electrical or mechanical apparatus. In this co-ordination it will be admitted lies great strength. It is a co-ordination which enables the largest contracts for engineering equipment to be undertaken without it being necessary to use anything but the resources of the Company's own shops.

Prophecy and Realisation.

Mr. Hugo Hirst, speaking at the annual meeting of the Company on July 9, 1918, said, "I have always cherished the hope that I might some day be the instrument of building up an electrical concern of such magnitude that it would be respected not only in this country but all the world over. We have sat still too long and looked admiringly at the progress of our foreign rivals. I see no reason why there should not be two, three, or four great electrical concerns in this country, grouping themselves into big units out of the mass of electrical material at their disposal in order to play a better and more important part in the world's work." With the revival of trade and the obtaining of the important contract for the electrification of the London, Brighton and South Coast Railway there seems no reason to doubt that this ideal is on its way to fulfilment. So wide indeed have become the activities of the General Electric Company, as illustrated at Witton alone, that on the occasion of our visit it was not possible to see more than a little of what was going on, and it is impossible in the space at our disposal more than to touch on the interesting evidences of progress that were displayed.

Recent Extensions.

We may begin by saying that the Witton Works now cover an area of about 100 acres and that recent developments have necessitated the construction of seven new buildings for switchgear work (Fig. 1), standard motor works, administrative offices, a development department, moulded insulation works, and enamelling and plating works. In addition a most luxurious club house has been built and new bays have been added to the foundry, the main engineering works and the small motor works. These extensions have not only rather more than doubled the works in size, but by providing greater facilities for modern organisation have increased the efficiency in a considerably greater ratio. Among these improvements may be mentioned the large number of special machine tools that have been installed, the adoption of the most up-to-date transport methods, the liberal provision of gangways in the shops and roadways between them and the excellent accommodation provided for the staff in the new office buildings.

Fig. 1.—General View of the New Switchgear Works, Witton

The Heavy Engineering Shops.

Taking the main engineering works as our starting point, these are divided into four extensive bays where all classes of electrical machines with outputs exceeding 100 h.p. are constructed, as well as smaller machines if these are of special design or construction. One bay is devoted entirely to the construction of turbo-alternators. This is equipped with a range of specially designed machine tools for turning or milling the solid rotors which have always been a feature in the design of the G.E.C. alternator and for boring and slotting operations on the stators. Subsequently, both stators and rotors pass to the winding section and thence to the assembly, test, and despatch departments. It may be noted that all the G.E.C. turbo-alternators of 6 000 kVA and upwards are provided with embedded temperature indicators. A view in the turbo bay is given in Fig. 2.

We noticed in this bay a 10 000 kVA turbo-alternator for the borough of Marylebone, which will run at 3 000 revs. per min., another for the Bury Corporation with an output of 12 500 kVA at the same speed, and yet another with a capacity of 22 500 kVA, a periodicity of 25 and a speed of 1 500 revs. per min., which is being built for the Birmingham Corporation. G.E.C. activities, however, are not confined to the home market, and as evidence of this we may mention three 3 500 kVA sets which are being built for the city of Pretoria and three others of rather

greater capacity for the city of Auckland. The rotor of one of these machines is shown in Fig. 3.

Rotary Converter Design.

Rotary converter design and manufacture is now a burning question in electrical engineering circles. There is plenty of evidence at Witton of the attention that is being paid to this class of electrical equipment. Four 2 000 kW machines have recently been supplied to the City of London Electric Lighting Company, while two 1 500 and two 2 000 kW sets are now in process of construction for the Charing Cross, West End & City Electric Company. The value of the rotary converter made by the Company is much enhanced by the self-synchronising panel which, it is claimed, offers many important advantages over other types, the operations being extremely simple and mistake proof. A rather unusual machine which we noticed is the rotary converter which is being supplied to the British Mannesmann Tube Company. For this machine a current of 5 000 A is required on the direct current side, thereby necessitating the use of a double commutator. Passing from rotary converters to motors, a large range of motors for rolling mill drive and other steel works equipment were to be seen going through the shops. The features of the design and construction of the motors manufactured by the G.E.C. for this class of work were fully dealt with in our recent Iron and Steel issue.

Fig. 2.—View in the Main Turbo Bay.

The Switchgear Works.

Next in importance and interest to the main engineering shops are the switchgear works, which are conducted under the superintendence of Dr. C. C. Garrard. These works are most spacious. The lay out covers an area of 100 000 sq. ft. and is so situated as to have a main road on two fronts. The stores extend down the centre of the building, and are so arranged that the accommodation and handling of material gives a high degree of efficiency. The grouping of the benches and machines also tends to allow a very rapid progress of work through the shops. This is facilitated by the excellent arrangements for both the natural and artificial lighting. Generally speaking, in one main bay switchboards are erected, while starters and controller gear occupy a second bay on the other side of the stores. Ironclad and heavy switchgear is turned out in a third bay, where a section is also set apart for the many machine tools required. Auxiliary processes, such as plating, enamelling, slate drilling, and cementing, are carried on in a series of small shops, while a fully equipped test room runs across one end of the works with a packing and despatching department adjoining. The universality of the products of the General Electric Company, to which we have referred above, is well exemplified by comparing the orders which were being dealt with in the main engineering shop and in the switchgear shops respectively. This comparison shows that purchasers of motors and other equipment are also obtaining their switchgear from Witton.

An Important Contract.

An important switchgear contract which is now being undertaken at Witton is for the complete equipment of a new switch house for the Metropolitan Railway generating station at Neasden. The main section of the contract calls for 11 000 V gear to control one 12 000 kVA alternator, five 5 000 kVA alternators, and fifteen outgoing 300 A feeders. This switchgear house will be constructed in three storeys with the 'bus bar chambers on the top floor, the oil switches in the middle, and the instrument transformers below. All the switches are to be electrically remote controlled from specially operated panels on the third floor, and the high tension gear will be in brick cubicles. The oil switches will have a breaking capacity of 350 000 kVA. These switches are, however, not the largest which are built by the Company, for only a short time ago a switch with a breaking capacity of 800 000 kVA was sent to a South American mining company for use on 33 000 V circuits. Also on exhibition were the truck type cubicles which are now being made by the Company, and many interesting types of oil immersed switchgear of various kinds. A special type of panel noted on the test bed was that for testing the apparatus of the G.E.C. bias differential system of protection.

The Development Department.

It is hardly necessary to say that those responsible for the policy of the G.E.C. have always realised the need for digging deep in order to build high. Few industrial concerns have paid so much attention to the importance of keeping abreast of the advance of scientific knowledge, and its proper application to practical manufacturing purposes.

Some years ago, therefore, the foundation was laid of what is

Fig. 3.—Rotor of 7 500 kVA Turbo Alternator. Coils being Dropped into Position.

to-day a highly developed organisation for scientific research, with a Central Research Laboratory, which is now being established at Wembley, near London. This organisation undertakes the investigation of the more abstruse manufacturing problems encountered by the various G.E.C. associated factories, whilst to fill the gap between research and production the Company has established Development Departments at its various works, which act as a liaison between the two sets of activities.

Following out these principles, everything that is done at Witton is based on careful experiments carried out in the Development Department, which is situated near the northern border of the Company's estate. Each section of this Department possesses the latest scientific apparatus needed for the development work. Thus the electrical and magnetic section has standards of the highest degree of accuracy for calibration work, and the mechanical branch has a 30-ton Buckton testing machine for tensile and compression tests, a Brinell hardness testing machine, and schleroscope and fabric testing apparatus. There are also two electrically

Fig. 4.—Part of the Electrical Testing Station in the Development Department.

heated ovens, the temperature of which is controlled by adjustable thermostats, which are used for ascertaining the effect of prolonged heating on insulating materials and varnishes.

High Tension Testing.

The workshop has also a suitable equipment of machine tools, and ample bench accommodation, so that models may be expeditiously produced. In this workshop the first model for any new line of manufacture is made.

The Development Department also contains a sub-station with a large distribution board and various motor generator sets from which all voltages, periodicities, &c., likely to be required are available. For high voltages a special transformer cubicle is provided; this gives testing voltages up to 50 000. (In the switchgear works test bed 100 000 V is available.) One most useful accessory is a special photographic dark room, with a photomicrographic camera for investigating the structure of materials. Among the apparatus being tested on the occasion of our visit was the 1 h.p. Pelaphone semi-automatic lighting set. A view of the electrical part of this Department is shown in Fig. 4.

Social and Welfare Work.

Last, but not least, the social work carried out by the Welfare Department at Witton among the workers is on a scale seen in few works, even in these modern days. These activities have for their home the magnificent new Club House, and the playing fields which cover many acres on the eastern side of the G.E.C. estate. The Club was built by the Company, in memory of the many who went from Witton to the Front and did not return.

Some idea of the enormous capacity of the works may be gathered when it is stated that the total combined capital of the company up to date is in the neighbourhood of £8 000 000, inclusive of the cost of post-war developments, while the assets as disclosed in the last balance-sheet are over £11 000 000. With this financial backing and the enterprise which is being shown in the development of all branches of electrical manufacture, the future of the G.E.C. should be rosy.

Comparative Tests on Domestic Heating and Cooking Apparatus.*

By J. RUTISHAUSER.*

Experiments on various types of cooking apparatus were carried out at Davos (Switzerland), and comparisons were made between the costs with different forms of energy. In the first place the efficiency had to be determined—for which purpose tests on heating and on boiling water were made. Representatives of the gas and electricity works at Davos took part in the tests; while practical cookery tests were also made. Good agreement between the results was obtained.

In order to obtain comparative results, the Swiss and German gas and water engineers in 1913 adopted definite standards—as a result of careful experiments—in order to determine the efficiency of gas boilers. These standards have proved to be very suitable and are still in use. They require that in determining the efficiency of a gas boiler, water shall be heated from 20 to 95°C., and that there shall be a definite relation between the size and contents of the pot and the energy supplied (hourly gas consumption of the burner). In Davos the water was heated from 15 to 90°C., because 95°C. at that altitude corresponded to boiling temperature.

Tests on Electrically-Heated Hot Plates.

For the tests, two stoves, each with two hot plates, 22 and 18 cm. in diameter, were used. The rating was 1 460 W and there were three steps. Since no standards were available for boiling tests with hot plates, series of tests were first carried out with different hot plates and pots of various sizes and amounts of water in the pot, in order to determine how the efficiency was affected by the amount of water in the pot. The results are set forth in tables and curves, and it is seen that the efficiency depends largely on the pot-content being very low for small quantities of water. In this respect the conditions with electrically-heated plates are worse than with gas burners. The efficiency also falls off when the current is not cut off until boiling begins. If pots under these conditions are placed on one side when boiling commences the stored-up heat in the plate should be utilised by heating another vessel. Thus it was found that 3·5 litres of water could be heated from 15 to 33°C., thereby increasing the efficiency some 10 to 15 per cent. The cost for heating one litre of water from 15 to 90°C. with 2 kg. of water in the pot was 1·44 to 1·77 centimes (Swiss), corresponding to a consumption of 0·246 to 0·291 kWh. Boiling was cheapest with a medium-sized covered pot when the water was heated with full current on up to nearly boiling temperature. With the hot plate the temperature of the water only begins to rise after a few minutes since time is taken to heat up the plate and the vessel—on the other hand, heat is given off after the energy is switched off. This effect is much less with the gas flame, which is superior as regards regulation.

Tests with Gas Boilers.

For the gas tests a Junker stove with rings of 48 mm. diameter, having a gas consumption per hour of 500 and 300 litres respectively was used. The bottom of the pot was 21 mm. above the burners. With gas at 60 centimes per m³ and electricity at 12 centimes per unit, the average costs of heating a litre of water from 15 to 90°C. and boiling for one hour, are 2·02 centimes for electricity and 2·78 centimes for gas.

Average Efficiencies.

Hot plate (electric), including continued heating after cutting off current, 75·5 per cent.; during period when current was switched on, 66·5 per cent.

Gas boiler, including continued heating after gas is turned off, 56·1 per cent.; during period when gas is burning, 55·5 per cent.

Electric rapid cooker (boiler), 84·3 per cent. In this case the efficiency fell off much less when the pot was only half full than with the hot plate.

Electric ring (a 5 cm. wide ring, enclosing the heating resistance, for clamping outside the pot): efficiency about the same as for hot plate.

Results are also given for radiator-ovens and tip-boilers—the latter being more costly to work with gas than electricity.

Comparative Cooking Tests.

Cooking tests were made in two households. A definite menu was observed for 14 days with cooking by gas and by electricity. All the hot water needed in the first house was heated on the experimental stoves, and the average daily consumptions were 3·54 kWh and 956 litres of gas respectively. This worked out at 14·3 centimes for gas and 10·7 centimes for electricity per person per day. This meant that for equal costs, with electric energy at 12 centimes per unit, gas would have to cost 44·4 centimes per m³; whereas the actual cost was 60 centimes per m³. The costs

*Abstracted from "Schweizerische, Elektrische, Verein Bulletin." Vol. xii., p. 376.

did not differ much so long as stoves (cooking and hot plates) were used, but the gas cost rose rapidly when the oven was used. On the other hand, the electric hot plate was inferior to gas for heating independently small quantities of milk, coffee, &c. For the second household, where the water for domestic requirements was heated independently, the results were very much the same. A pre-war comparison showed that when gas was replaced by electric cooking, the average daily consumption changed from 1·9 m^3 to 8·92 kWh.

With the apparatus tested, it was found that, for boiling water and for domestic cooking, one cubic metre of gas with a calorific value of 5 228 kg.-cal. per m^3 at 0°C. & H. = 760 mm. was equivalent to 3·48 to 3·7 kWh of electricity.

Telephone Line Work in the United States.

Mr. E. S. Byng's Paper on "Telephone Line Work in the United States," which was given in abstract in The Electrician of Nov. 25, was recently discussed at Manchester, Alderman W. Walker being in the chair.

Mr. W. J. Medlyn said that the financial studies of development schemes were undertaken in this country as in America. He enquired whether the Americans used 1 per cent. of antimony in their underground cables as with aerial lines. In this country the lead-antimony alloy was used for the latter, but pure lead for the former. The spacing of poles, 35 to 50 yds., was less than the 60 yd. standard used in this country. It was difficult to appreciate why untreated poles, lasting eight and a half years, should be used in preference to creosoted poles, which lasted thirty-two to thirty-five years. Motor transport and machinery were used less in this country, but, when all factors were taken into account, our telephone rates compared favourably with those in the United States.

American Methods Criticised.

Mr. T. E. Herbert emphasised the difference in climatic conditions between the two countries, and said this influenced open line construction. The methods of construction used in the States would, in this country, lead to utter disaster. The short span adopted was probably the cause of immunity from destruction. A line on Glossop moors with a 20 yd. span failed in two years, because the rate of vibration of the wire was four times as rapid as in a 40 yd. span. They hoped in this country to avoid open routes as much as possible. Glass insulators had never found favour in this country. His experience with aerial cables had been disastrous. He enquired whether the speeds of jointing and pulling in cables were really practical or whether they were spectacular.

Mr. J. Shea thought that the author had brought home the fact that this country could be too conservative in methods of construction. He believed greatly in aerial cable work, and he thought there was a field for that class of work in this country. He agreed with the author as to the high percentage of faults found in the last span in drop wiring.

Telephone and Power Lines.

Mr. G. H. A. Wildgoose thought that the principles underlying construction were the same in the two countries, and that differences were due to differing conditions, not only geographical, but to the volume of work and attitude to the telephone system of the public and the authorities. Underground development schemes were simple in a country where cities and towns were laid out systematically. With reference to the joint use of telephone and power lines, he asked whether any limit to the voltage of power wires was fixed and whether workmen received shocks.

Mr. G. Wallace said that the Manhattan scheme for concentrating testing and localising apparatus would be found unsuitable and uneconomical in cities served by the largest English exchanges. The British method of compiling fault statistics was comparable with that of any other administration in the world. Before comparing English and American fault durations the number and duration of each class of fault should be available.

Speed of American Workmen.

Mr. A. E. White commented on the high speed of jointing and asked for details, the English figures being only one half the American. The cost in England was no greater, and the workmanship would be better. The statement of time given for drawing in cable also needed amplification.

Mr. C. E. Morgan thought that the author described the best conditions, and asked whether any trouble was experienced in working open wire circuits with repeaters through difficulty in maintaining accurate balances.

The Author, in reply, said he held no brief for the Americans. He saw the speeds of working mentioned actually carried out in some cases. Uncreosoted poles were those cut in neighbouring forests. Paint-brush treatment was often adopted and gave a life of five to ten years, the tank treatment giving 15 years. The important point was to protect the wind and water line. The maximum voltage allowed for supply wires was 5 000 V between wires, or 2 900 V between wire and earth.

Electric Vehicle Considerations.

At the last meeting of the Informal Section of The Institution of Electrical Engineers, Mr. R. J. Mitchell, in opening a discussion on "Electric Vehicles," defined the electric vehicle as one driven by accumulators or battery, not by engine-cum-dynamo nor trackless-trolley.

In spite of the simplicity of control the electric vehicle had not made the progress expected of it; in the past this was due largely to the low cost of fuel for the petrol vehicle, while the high first cost of the electric vehicle was to-day made to seem extravagant by the very low prices obtainable for second-hand lorries. Yet the electric vehicle was particularly suitable for town transport. To the objection that it was extremely slow, he replied that this did not matter at all. Nor was it any longer true that the battery did not permit a reasonable day's work from one charge.

Street Widening.

With conditions in most large towns where widening of the streets was a counsel of perfection all too impracticable, the electric vehicle which did not commit the nuisances of smoke, smell, and noise must ultimately become supreme. Another important consideration was its greater conservation of road surfaces. The electric vehicle was easily adapted to special equipment such as tipping gear, cranes, elevating apparatus, &c., which with other vehicles could only be obtained in a roundabout way.

He read testimony to the merits of electric vehicles from the experience of many corporations and large commercial users, showing in some instances most remarkable saving in time and handling, and he appealed for fuller co-operation and help in the matter of charging facilities from supply engineers.

Battery Design.

In regard to improvement in electric vehicles the last word in battery design had not yet been said, and he thought the B.E.A.M.A. should offer £100 000 prize for a battery giving, say, 40 Wh per lb. If a share in the royalties on this battery were stipulated, there would be no need to set aside a reserve for the prize money. The chassis was not perfect either, it could be enormously improved and lightened by better materials. Further, he had found wheels that could with safety, even improvement, be pared down 2½ cwt. per set.

Municipal Virtues.

Mr. A. W. Blake, of Willesden, opened the discussion with a glowing testimony to the virtues of electric vehicles on municipal duties. He spoke from experience of many years and at present was associated with eighteen electric, as well as several petrol, vehicles. Every electric vehicle was working every day, and his figures of working hours showed an astonishingly good service, and freedom from even minor breakdowns. Questions of running cost and of speed could not be answered summarily as conditions and duties varied, but he was able to let out 5 ton electric vehicles on hire to the surveyors' department at 45s. per day (including driver and all charges), and make a profit on it. Mr. Blake thought that one of the first duties of the electric vehicle was to abolish the tramcar; and it was notable how few friends the trams had among subsequent speakers.

Mr. N. Murphy continued the appeal for less apathy from supply engineers. He reminded them that the consumer came to the door for supply and he declared that if this vehicle was not taken seriously, the vehicle makers would perforce provide their own charging facilities.

Mr. A. G. Whyte recalled the statement that the Cleansing Superintendents had done more for the electric vehicle than all the station engineers.

Mr. F. Jackson said the early failures of the electric vehicle that still prejudiced opinion were with cabs and motor buses, requiring relatively higher speeds, but the commercial vehicle was not a touring car and could return to its base. Further, the electric vehicle user would probably employ a fleet and could consequently arrange his own charging. He spoke of the railway companies in London each employing 10 000 to 12 000 horses on local transport.

Mr. W. E. Warrilow did not agree that the station engineer was always apathetic. He recalled a long journey years ago where charging points had been arranged. At one station their arrival was so keenly anticipated that the charging leads were passed out to them already alive.

Mr. R. J. Mitchell, in his conclusion, dealt with the question of regenerative control on electric vehicles. His opinion was that if you can ensure that the driver will take the fullest advantage of the opportunities it may afford, this system may be desirable.

The Royal Commission on Awards to Inventors will, as from March 1st next, sit in two divisions, the second division sitting on Wednesdays during term time at Martlett House, Bow-street, W.C. 2.

Correspondence.

MECHANICAL AND ELECTRICAL EFFECTS OF LARGE CURRENTS ON H.T. SWITCHGEAR.

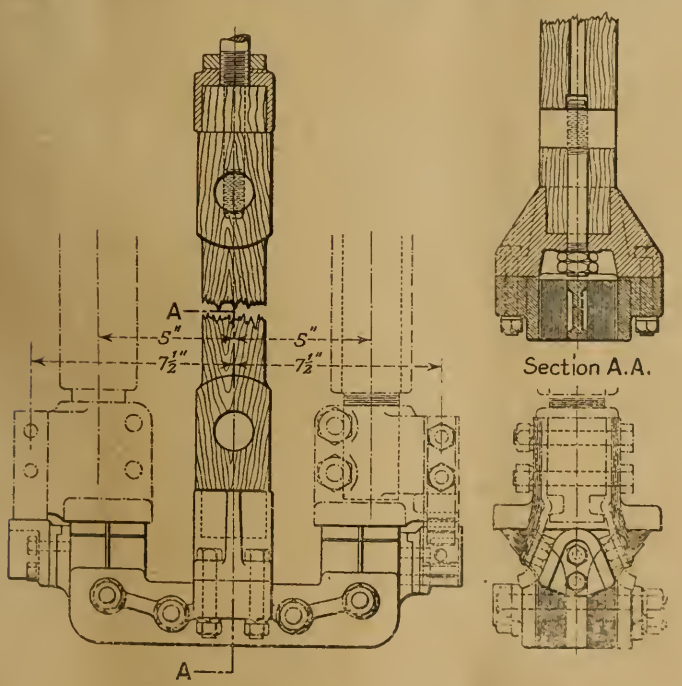
To the Editor of THE ELECTRICIAN.

Sir,—In your issue of January 20th appeared a reproduction of the notes by Dr. C. C. Garrard, dealing with the cinematograph films of Mr. Torchio's tests which Dr. Garrard recently exhibited at the Institution of Electrical Engineers.

Dr. Garrard's comments are very pertinent, so far as they go, but they do not by any means cover the whole subject of burnt contacts on oil switches. Our engineers have had the opportunity of studying the original reports of the New York Edison Company, on which Mr. Torchio's paper was based. In every one of the tests the parallel studs were found to move outwards, frequently to such an extent as to take up a permanent set. In such cases even the mutually attracting wedge contacts do not avail to prevent burning at the contacts, although they are more satisfactory than the brushes in Fig. 1 of Dr. Garrard's paper. It has been found necessary to stiffen considerably the studs of the switches tested, or in the case of the G.E. Company's "pot" switch, to brace the pots.

Since the New York tests, which were taken just three years ago, a great deal of other work on contacts has been carried out. In Mr. Torchio's paper before the American Institute of Electrical Engineers he showed forms of brush contact which were unaffected by heavy currents, other than that in Fig. 2 of Dr. Garrard's notes. These have been tried out and the most successful is undoubtedly that illustrated herewith.

In this contact the main element is a brush, the leaves of which are continuous from one contact block to the other. Internal



A Successful Form of Brush Contact.

I^2R losses are therefore a minimum, and, moreover, the brush type of contact can be bedded in at a higher pressure and gives a lower contact surface drop than the wedge form. The two halves of the brush element take a Y formation in the end view, so that they attract one another, and increase the bedding pressure when heavy currents are carried.

The arcing contacts are of the wedge type, shown in Dr. Garrard's Fig. 3A. We do not agree that the contacts shown in Fig. 3B are an improvement on this, because at the moment the wedge is withdrawn the two controller fingers will spring together and stand a good chance of being welded together by the arc which surrounds them. The fingers on the arcing contact shown herewith are so mounted that it is physically impossible for them to touch and freeze together.

Another factor definitely excluded from Mr. Torchio's programme of tests is the effect on the switch mechanism produced by the repulsion on the moving contact as a whole. In most of the larger switches now on the market, the mechanism would spring during the initial cycles of a short circuit corresponding to the rated breaking capacity of the switch. The current during the first half cycle may be four times the arc amperes.

Finally, it should be clearly understood that given rigid mechanism, rigid studs, and a form of contact which does not deflect under current, burning at the main contacts of a switch is still inevitable unless the resistance of the arcing contact path be kept low. Specific data on this point is not available, but certainly the resistance of the arcing path should not be more than five to ten times that of the main contact path. We are, &c.,

The Metropolitan-Vickers Electrical Company, Ltd.

Manchester,
Feb. 6th.

RATES AND RATE AID.

To the Editor of THE ELECTRICIAN

Sir,—I have read with much interest your article on page 151 of this week's issue of The Electrician in connection with this undertaking.

With reference to your remarks as to reduced charges, I beg to inform you that my Committee have already agreed, subject to the confirmation of the City Council, to reduce the charges for the supply of electrical energy in this city as from the December, 1921, quarter as follows:

1. For ordinary consumers, 25 per cent. off the increased charge over basic rates of 100 per cent., making the net increase 75 per cent.

2. Rateable value consumers, 50 per cent. off the increased charge on the rateable value of 100 per cent, and 25 per cent. off the increased charge on the basic rates per unit of 100 per cent.

3. Consumers taking large supplies and having special agreements containing coal clauses, etc., 15 per cent. off the increased charge of 40 per cent. on the basic rates, making the net increase 25 per cent.

With regard to this latter class of consumer, there will automatically be a large reduction in the charge due to the reduced cost of coal, in addition to the percentage recommended above.—I am, &c.,

H. Dickinson,
City Electrical Engineer.

Liverpool.
Feb. 14th.

[We are glad to learn that the Liverpool Electricity Committee are taking such enterprising action. It is the only right and sound policy.—Ed. E.]

THE REVO ELECTRIC IRON.

To the Editor of THE ELECTRICIAN.

Sir,—With reference to the matter of an 100 V electric iron which was used on a 200 V circuit, and Mr. Davis' reply to my letter appearing in your issue of the 3rd February, it appears that your correspondent chooses to be rather more personal than precise in his remarks.

However, after condensing the statement made by Mr. Davis, we are able to discover the "nigger" in this apparently "wonderful" performance, which is, that the current was only applied to the iron for a few minutes at any time, being switched off before becoming red hot, all of which goes to prove that the performance was not in the least wonderful. In fact, any iron of well-known British make would have given the same or quite probably better results than that attributed to the iron in question.

Your correspondent states that an electric iron "is never in use continuously during ironing operations." The fact that an electric iron *can* be used continuously is one of the prime arguments in favour of using electric irons in preference to any other, since they are usually designed and loaded in order to promote a saving in time and prevention of heat loss in the iron during the process of ironing. It is evident that if an electric iron is to be switched off every few minutes to prevent over-heating and burning of the material, ironing under these conditions would become not only laborious but extremely dangerous.

With regard to the supposed incorrect statements of loading and face area on which my calculations were based, I beg to remind Mr. Davis that the original article on this subject was devoid of any technical details, and some presumption was necessary in order to arrive at a concrete argument. The loading applied, however, to well-constructed irons of 4/5 lb. size is approximately 400 W. As to face area, I agree with him that this was probably incorrect, but the incorrectness was distinctly in his favour—the average face area of this size of iron being 18/20 sq. in, which would bring the loading to considerably more than 64 W per sq. in. Your correspondent does not favourably influence his argument by bickering. It would be very interesting to know what electrical heating appliances (other than water-heating appliances) are loaded to "64 W per sq. in. and more."

It is quite clear that Mr. Davis is availing himself of the opportunity of cheap advertisement to the fullest extent as will be seen by the further "testimonial" included in his letter, which has nothing whatever to do with the subject under discussion. I repeat that many irons of well-known British manufacture could withstand even more strenuous tests than either of those he quotes.

In conclusion, I would like to submit that if every manufacturer

were to inset in your columns the many testimonials they receive from their various customers, there would be very little room left for any real items of interest in your valuable journal. I am, &c.

London, W. 9, February 13. WM. B. SCOURFIELD.

[It is difficult to discuss a subject of this kind without doing a little of the advertising to which Mr. Scourfield objects. He will, however, agree that even with this drawback, the matter is of sufficient interest to be ventilated in the columns of a technical journal.—ED. E.]

ELECTRICAL versus MECHANICAL ENGINEERS.

To the Editor of THE ELECTRICIAN.

SIR,—Neither a mechanical nor an electrical engineer, but an engineer nevertheless, and having I hope the best interests of the profession as a whole at heart, Mr. W. B. Pinching's letter in your last issue gave me much satisfaction, as raising the tone of the discussion to its proper plane.

I have no special knowledge of railway administration, but it seems to me inconceivable that there should not be someone to co-ordinate the mechanical and electrical branches of the engineering organisation, and the great thing is that he should be an "engineer." I fail to see why a man trained as a mechanical engineer should be suspected of inability to hold the balance evenly.

To suggest that the heads of both branches should have direct access to the directors and possibly present conflicting views seems to be asking for trouble. That is the sort of thing which gives the lay "administrator," who is never tired of extolling his impartiality of judgment (which arises from knowing nothing in particular), the opportunity of saying "evidently the 'experts' cannot agree, so you had better let me decide for them," and of getting himself pushed in over both professional men.

It is high time that engineers recognised that the growth of specialisation is a source of weakness to the profession, and made efforts to build bridges rather than open chasms. In your issue of the 27th ult., you call on the Institution of Electrical Engineers to take the matter up. I hope they will and remind their members that they are engineers first and electrical engineers afterwards, and that by strengthening the engineering profession as a whole, they will be strengthening every branch of it including their own.—I am, &c.

NABIA.

The Geddes Penknife.

By ERNEST J. P. BENN.

The Geddes Report and the fuss that has been made about it is only another illustration of the shortness of the public memory.

Mr. Gladstone, in introducing his last Budget, entered upon an elaborate apology for a national expenditure amounting to £95 000 000, and expressed the fervent hope that that sum might never be exceeded. It would be useful if we could compare the value which we as a nation secured for Mr. Gladstone's £95 000 000 with the value which we are now obtaining for rates and taxes which are very little short of £1 500 000 000. The Geddes Axe offers a reduction of £75 000 000, a figure which will be very much reduced when all the vested interests have had full opportunity to work up their agitations. Traders and taxpayers generally will take the view that the much-advertised axe is nothing but a small penknife scratching at the surface of the greatest of modern abuses.

A Seven and a Half per Cent. Reduction.

In a word, what Sir Eric Geddes has done is to knock down public extravagance by 7½ per cent. The tradesman who could show no better reduction than that on the highest war-time figures would have to close his shop. The process of deflation in so far as it has been left to individuals to accomplish has gone ahead with remarkable rapidity. This is obvious from the cost of living index figure, where the war-time advance has been reduced by half. How is it possible for the Government to suggest that wages and prices must continue to fall when everything which they themselves control, from postage stamps to Labour Exchanges, is still on the highest war-price scale? The utter futility of Labour Exchanges was pointed out in THE ELECTRICIAN years ago, and what is true of Labour Exchanges is true of many other Government departments. The best that can be hoped of the Geddes Report is that it will set a fashion and that the public enthusiasm for economy will at last begin to be real and effective.

Economy or Value for Money.

Economy is not altogether a happy word in this connection. Public expenditure is not, after all, so much a matter of economy as of value for money, and sooner or later it will be generally recognised that the most ineffective, the slowest, and the most extravagant way of securing any object is through public action.

It would not be difficult to show that the rate of social progress has been in inverse ratio to the rate of public expenditure. Before the war, thanks to private enterprise and personal initiative, we were achieving general social advancement at a rate which was not generally realised. Within a few days we flew across the Channel, we cut the Atlantic journey down to four days, and we knocked ten minutes off the trip from London to Liverpool, and every day witnessed some big advance in human knowledge and personal comfort. Housing gives us a perfect example of the sort of value which we get from money when it is spent through the public purse. The Geddes Report makes this clear. For every £16 worth of housing provided, there is a deficit of £59, £4 of which comes out of the pocket of the ratepayer, and £55 from the unfortunate taxpayer.

We are all in favour of education, but is there anybody willing to argue that the quality of education to-day is four times better than a few years ago? And yet, that is the measure of its cost. It would be very instructive to compare the operations of the Department of Overseas Trade with a body like the Federation of British Industries. I do not doubt that such an investigation would show that the latter gives better value for a thousand pounds than does the former for a million.

The Geddes Report is a lengthy document, but every line of it should be read by every serious citizen. Practical men know that public activity not only usually achieves nothing, but that it always dries up at the source private activities that are badly wanted in these days.

"Exide" Battery Service.

On Wednesday there was a Press visit to the CHLORIDE ELECTRICAL STORAGE Company's showrooms, Daimler House, Shaftesbury-avenue, London.

Amongst the special features were the unspillable batteries for aircraft, field service and police lamps. The plates in the smallest-sized cell are 1/16 in. in thickness, the grids are staggered, and the active material is laced between them, and the wood separators in these, as well as in the larger batteries, are corrugated, so that acid will run down. The company also supply a miner's safety lamp battery to fit a circular lamp case. It is stated that these batteries will give the necessary 1 c.p. for ten hours and that their life is at least eighteen months. A standard battery for motor-car starting and lighting is the six-cell 12 V XC battery. In these cells the positive and negative peaks stand upon separate feet, to obviate short circuits, which might be caused by deposit in the bottom of the box. The battery boxes supplied include glass, lead-lined wood, lead, ebonite and celluloid. Ebonite boxes are considered the best thing so far for motor-cars, but the Lorival Company's material is also useful, as it can be patched up in case of injury.

At a luncheon which followed, Mr. D. P. Dunne (director and sales manager) said the company had not utilised the Press so much as other battery makers had done because its business had been mainly with engineers and contractors, and until batteries had come to be so much used by motor-car people publicity had not been so necessary. The company had, however, in the last few years done more than any other battery company outside America in spreading the doctrine of electric starting and lighting on motor vehicles. They appreciated the co-operation of the Press, and invited any of its representatives to visit their works at Clifton Junction. At Daimler House they supplied the requirements not only of motor-car users, but of the trade. It was not their intention to supplant their service agents or other people in the trade, but to support them. The history of the "Exide" battery went back many years, to the time when the Electric Storage Battery Company of Philadelphia first co-operated in providing a battery for self-starting of motor-cars. Self-starters were now generally used in America and on the Continent, and he thought few cars would be turned out without them in this country in the coming season. The company found that the necessary service must be supplied practically on the doorstep of the users, and therefore they had appointed over 200 agents in this country, who were tested as to their ability to execute repairs, and also (in addition to the company's establishment in Sydney) distributors in Australia, India, and South Africa, while in the United States and Canada the sister company, the Electric Storage Battery Company, took care of the "Exide" situation. When he was in America the Ford Company used 4 000 "Exide" batteries a day, and the same company in England, when they were somewhat busier than at present, used 1 200 in a week. The batteries were also used on aircraft, on farms, by the Ministry of Munitions, and the Army and Navy. The Admiralty sent the company a letter on Nov. 30, 1918, acknowledging that the use of the company's batteries in submarines was one of the factors which led to their success. The submarines which the company had helped to equip had sunk fifty-four enemy warships and 274 other enemy vessels, and there was no record of any of the batteries failing. The chief cause of the company's success was that they and the Electric Storage Battery Company had made batteries, and nothing but batteries, for thirty years, and no expense for research had been spared.

The Fuel Research Board of the Department of Scientific and Industrial Research have appointed a committee to advise upon the SAMPLING AND ANALYSIS OF COAL. The personnel of the committee is as follows:—Prof. Thomas Gray (chairman), Prof. J. W. Cobb, Messrs. J. T. Dunn, J. S. Flett, G. Nevill Huntly, S. Roy Illingworth, J. G. King, C. H. Lander, R. Lessing, C. A. Seyler, F. S. Sinnatt, and Prof. R. V. Wheeler. It is intended that the methods recommended by the committee shall be adopted in connection with the physical and chemical survey of the national coal resources. Communications should be addressed to the Secretary (Miss N. Renouf), 16 and 18, Old Queen-street, Westminster, London, S.W. 1.

Electrical Imports and Exports.

IMPORTS.—The following are official values of electrical machinery, apparatus and material imported into this country during January, 1922, with increase or decrease compared with January, 1921 :—

Electrical machinery, £46 871 (decrease £64 130); telegraph and telephone cables, submarine, nil; other than submarine, £3 497 (decrease £12 354); telegraph and telephone apparatus, £17 195 (decrease £11 621); other electrical wires and cables, rubber insulated, £4 607 (increase £2 129); with other insulations, £3 533 (decrease £5 827); carbons, £2 647 (decrease £15 460); glow lamps, £19 036 (decrease £683); arc lamps and electric search-lights, nil (decrease £3 902); parts of arc lamps and searchlights (other than carbons), £567 (increase £409); batteries, £3 650 (decrease £14 114); electrical instruments, commercial and scientific, and electricity meters, £5 833 (decrease £10 496); switchboards, £945 (increase £727); other electrical goods and apparatus, £50 200 (decrease £59 741). Total of electrical machinery, apparatus and material (other than uninsulated wire), £158 581 (decrease £195 063).

EXPORTS.—The exports of electrical machinery, apparatus and material during January, 1922, with increase or decrease compared with January, 1921, were as follows :—

Electrical machinery, £567 264 (increase £122 132); including railway and tramway motors, £15 878 (decrease £17 409); other generators and motors, £344 499 (increase £101 102); other electrical machinery, £206 887 (increase £38 439); telegraph and telephone cables, submarine, £3 393 (decrease £90 105); other than submarine, £81 663 (decrease £105 819); telegraph and telephone apparatus, £221 071 (increase £79 218); other electrical wires and cables, rubber insulated, £56 120 (decrease £129 187); with other insulations, £123 966 (decrease £82 977); carbons, £6 743 (decrease £12 032); glow lamps, £29 010 (decrease £13 855); arc lamps and searchlights, £951 (decrease £344); parts of arc lamps and searchlights (other than carbons), £537 (decrease £127); batteries, £33 394 (decrease £52 614); electrical instruments, commercial and scientific, and electricity meters, £36 466 (decrease £12 675); switchboards, £85 975 (increase £63 567); other electrical goods and apparatus, £122 920 (decrease £125 739). Total of electrical machinery, material and apparatus, other than uninsulated wire, £1 369 473 (decrease £370 557).

The Illuminating Engineering Society.

The annual dinner of the ILLUMINATING ENGINEERING SOCIETY, on February 10th, was notable for the variety of aspects of illumination touched on by the guests of the evening. Sir Herbert Jackson, representing the Royal Society, in proposing the toast of the Illuminating Engineering Society, recalled that its President, Sir John Parsons, initiated a discussion on "glare" at one of the first meetings in 1910, and remarked that there was still need for educational effort in this direction. Mr. Lawford, President of the Council of British Ophthalmologists, endorsed the necessity of closer study of the effect of light on the eye, and the number of distinguished ophthalmic surgeons present showed the interest now taken by the medical profession in illumination. Mr. F. W. Goodenough, Mr. Thomas Hardie (President of the Institution of Gas Engineers), and Mr. A. A. Campbell Swinton (Vice-President of the Institution of Electrical Engineers), all referred to the growing recognition of future possibilities of co-operation between gas and electrical undertakings. Mr. L. Gaster, in proposing "The Guests," acknowledged the sympathetic attitude taken by various Government Departments when approached regarding lighting problems. Mr. C. R. Groves, H.M. District Inspector of Factories, and the Right Hon. William Brace (Mines Department), in responding to the toast, spoke appreciatively of the influence exerted by the society in the fields of industrial lighting and illumination in mines. Mr. H. E. Blain, well-known for his work in connection with the "Safety First" Movement, referred to the importance of good illumination as an element in safety, both in connection with traffic, and industrially. Among others present may be mentioned Major-Gen. Sir Frederick Sykes (Controller of Civil Aviation), Sir William Lister, Mr. H. Fisher (President of the Ophthalmological Society), Mr. Joseph Orringe (President of the Electrical Contractors' Association), and Alderman George Clark (Chairman of the Society of British Gas Industries).

Extensions at Stepney.

STEPNEY Borough Council on Monday adopted the recommendation of the Finance Committee that application be made to the Electricity Commissioners to sanction a loan of £300 000 for extensions of the electricity undertaking, made up as follows :—Sub-station plant and switchgear, £27 640; e.h.t. transmission cables and switchgear, £94 543; l.t. feeders and switchgear, £59 150; l.t. distributing mains and street boxes, £45 000; service lines, £20 000; meters, £7 000; buildings, switch gallery, &c, £6 000; machinery, £13 505; contingencies (at 10 per cent.), £27 162. Application is also to be made for £31 650 for additional expenditure incurred over the estimates approved by the Council in 1919 and 1920 for plant at the Milo End, Limehouse and Whitechapel sub-stations. In regard to the items for e.h.t. cables and the l.t. feeders and switchgear, the Commissioners have been allowed to suspend the repayment of capital for five years.

The Council are supplying the London Hydraulic Power Company with electricity for working the motor-driven pumps at their premises in Wapping. Payment is to be made at bulk supply rates, and the company guarantee an annual minimum payment of £1 000.

Novel Applications of Electricity.

Nearly each week sees some new APPLICATION OF ELECTRICITY, and among the most recent uses to which it is put are the making of new mown grass into hay, and an artificial salmon barrage. According to reports, a method has been worked out in Switzerland for preserving newly mown grass without drying it in the sun. The grass is placed on metal sheets in silos of about 400 cubic ft. capacity. The top of the silo is closed by another metal sheet, and the sheets at the top of and bottom are connected with an electric circuit. Alternating current at a pressure of from 200 to 500 V is passed through the grass for several days. It is said that the current kills all the microbes whose presence would cause the damp grass to decay, and it is claimed that the process enables the grass to be preserved in its natural state until required, and that it contains twice the nutriment of an equal quantity of hay. It is claimed that from 130 to 200 kWh are sufficient to treat five tons of grass. If the claims made prove to be correct, then farmers will be rendered independent of the weather for haymaking purposes.

The question of an ELECTRICAL SALMON BARRAGE was dealt with in a recent issue of the "Pacific Marine Review." It is said experiments have been made in order to discover means of keeping fish out of the irrigation ditches on the Pacific Coast. The irrigation ditch, as at present operated, is a considerable menace to the salmon fisheries. It is estimated that each year between 3 000 000 and 4 000 000 young salmon pass into these ditches and are left to die when the water is drawn off. Numerous devices have been tried. Screens, with a fine mesh, placed at the head of the ditches, proved ineffectual. The drift and waste clogged the meshes, and the waters carrying the young fish would flow over the top of the screen and out on to the adjacent ground. Several other means were tried, but only with partial success. After making experiments, Mr. C. D. Hessey, Game Commissioner of Yakima County, in Eastern Washington, worked out an electrical barrier or fish stop, which was placed across the head of the irrigation ditch. A small water-wheel and an electric generator furnish electric current. Small iron bars, set 4 ft. apart on the front of the device, extend down into the water. By a system of wiring and a vibrator to regulate the current, the water is charged with electricity for a distance of about 4 ft. from the bars. Fish coming down stream with the current strike this charged water and immediately whirl around and continue on their way instead of going on into the irrigation ditch. It is claimed that the electric barrage is a successful solution of the problem.

Electricity Supply in Malaya.

Among the developments which have resulted from the transfer from Siam to Great Britain in 1909, of Kedah, one of the native States in the Malay Peninsula, is the introduction of electric lighting in the town of ALOR STAR, the capital of the State. The town is now well lighted, and electricity is also being introduced into public and private establishments. Many of the natives had never seen electric lighting before, and others travelled long distances by boat along the rivers and canals to join till nearly dawn in the parades in the streets which followed the inauguration of the new illuminant.

The installation was supplied by a British firm, and the material and machinery came from England. The generating station is a steel building, designed on the truss principle, and giving a floor space of 4 320 sq. ft. The prime movers consist of four sets of twin-cylinder Tangye semi-Diesel engines, each set being capable of driving the generators to their full rated capacity. Cooling of the engine cylinders is effected by pumping water from the adjacent river through settling and storage tanks. Duplicate sets of Tangye's electrically-driven pumps supply the necessary water. The three E.C.C. dynamos, of 60 kW each 600 revs. per min., generate direct current at 230 V. The dynamos are of the three-bearing type, with commutating interpoles. The Electric Construction Company also supplied the switchboard of oiled slate, mounted on an iron frame, three generating panels and two distributing panels. Power is distributed on the overhead system, the main feeders consisting of heavy stranded bare copper wire fixed on insulators carried on wooden cross arms. The poles (26 ft.) are of tubular steel set in cast-iron bases, and they are also utilised as street light standards.

The street lamp fittings are of a type specially designed by the contractors and were made by the Wardle Engineering Company. The main streets are lit by lamps of 200 c.p. each, the smaller streets by 100 c.p., and in the residential quarters by 50 c.p. Suitable lightning arresters are provided to guard against the heavy lightning discharges experienced in a tropical country. Current is supplied to private houses and Government buildings at 30 cents (about 8½d.) per unit, and to shop-houses at a flat rate per month. A large demand has already arisen for power, and it is anticipated that it will soon be necessary to install additional plant, for which provision is already made in the power-house.

The supply of all the machinery and electrical gear, as well as the work of installation, were undertaken by Huttenbach, Lazarus and Sons, Limited, who operate the plant and generate electricity for distribution to consumers under licence from the Kedah Government.

Owing to the meeting of the Institution of Electrical Engineers taking place on Wednesday afternoon, February 22nd, the BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION have altered the time of their ANNUAL LUNCHEON at the Hotel Cecil, to 1.0 for 1.15 p.m. instead of 1.30 p.m.

Legal Intelligence.

Municipal Omnibus Competition with Tramways.

Pleadings have been closed in the action brought by the Dundee, Broughty Ferry and District Tramways Company to restrain Dundee Corporation from running a motor omnibus service between High-street, Dundee, and Broughty Ferry. Prior to the Dundee Boundaries Act (1913) no part of the company's undertaking was within the city, but in 1913 the city was extended so as to include Broughty Ferry. At present the Corporation, who own and work a tramway system, have limited powers to provide and run omnibuses. Last year they made application for a Provisional Order for (*inter alia*) powers to run omnibuses on any route within the city without restriction and also beyond the city. The clauses relating to omnibuses were struck out of the Order, but in October last the Sub-Committee of the Tramways Committee, with a view of testing the amount of traffic on the route, agreed to run an omnibus service. The company contend that the service is *ultra vires*. The route of the omnibus services extends to over four miles, and part of it would be in competition with the company's tramways, which form a junction with, and act as an extension of, the Corporation system. The Corporation is empowered to purchase the tramway lines at certain specified periods, upon paying the fair market value of the undertaking as a going concern. It is contended that the Corporation motor omnibus service would seriously depreciate the value of the company's undertaking and reduce the price payable by the Corporation when they exercised their power of purchase. The company maintain that the proposed service cannot be a test service to decide if the Corporation should apply for powers to construct a tramway along the route.

The Corporation's contention is that the company, as statutory tramway undertakers, have no right to complain of the 'bus service, and that the service is within the statutory powers of the Corporation. The service is experimental, and is being run solely for testing the amount of traffic on the route. It is also alleged that the company do not possess any monopoly under their statutory powers, and are not entitled, as tramway undertakers, to object.

The Gasfilled Lamp Patent.

Mr. Justice Eve, on Friday, granted an injunction to the British Thomson-Houston Company, restraining the B.T.T. Electric Lamp and Accessories Company from supplying ½-W lamps (which it was alleged were an infringement of the former's letters patent) until further order.

Sir Arthur Colefax made the application, and this motion was opposed by Sir Duncan Kerley on behalf of the B.T.T. Company.

Sir Arthur Colefax explained that the patent was the subject of litigation between the present plaintiffs and the Corona Lamp Works, which subsequently went to the House of Lords. Their lordships' decision had been given in favour of the plaintiffs, supporting the patent and holding it to be valid, and to have been infringed. With regard to the present action, it seemed to him that the infringement was, in fact, admitted. What defendants said was that if certain facts were proved, it would be held that the patent was invalid. It was not said that the facts could be proved, although the question raised was merely that of validity, which had been in question for eight years before being held to be valid after very protracted litigation. It was also said by present defendants that the patent had been declared valid on the assumption that the discovery, on which it was based, was new, whereas they say it was not. With regard to that, Sir Arthur pointed out that he had himself protested against the subject matter of the patent being regarded upon any such limited basis, and on that their lordships had been in his favour. They had looked at the patent irrespective of whether it was new or not. The present defendants were in an extensive way of business; they had branches in all parts of the country, and offered Dutch ½-W lamps for sale. Having referred to their advertisement in the "Electrical Review," counsel said defendant had made an arrangement with the Stella Lamp Works for the latter in future to supply ½-W lamps. He submitted that such action was an infringement of the patent.

Sir Duncan Kerley, for defendants, observed that the patent had been granted as long ago as 1913. These so-called ½-W lamps had been sold ever since by people other than those who claimed to be the patentees. It was perfectly obvious that in the circumstances a great trade had been built up, which plaintiffs now asked his lordship to say must be summarily stopped without any further trial. Furthermore, plaintiffs had waited for six weeks after the decision of the House of Lords before taking any action against defendants. The advertisements were inserted before the date of the House of Lords decision, and counsel thought it only right to say that in those circumstances it was not a case where the matter should be brought to a point which might be disastrous to the people he represented. It was a practice of the court in circumstances such as these not to make any order where the validity of the patent was really going to be contested. In the previous action the whole argument on subject matter was the alleged discovery made by Dr. Langmuir, but the defendants had now ascertained that the alleged discovery had been published before the date of the specification in question. He had not been able to make use of that fact in the arguments of the old ½-W case, but he was now in a position to submit to the court that it would have made an appreciable difference in the way the whole matter had been looked at. On those grounds he contended that no order should be made.

His Lordship said he had no evidence before him that the granting of an injunction would cause irreparable damage to defendants. In the absence of such evidence he could not interfere with the ordinary practice of the court in such cases. There would, therefore, be an injunction granted until further order.

B. T. H. Company v. Corona Lampworks, Limited.

The hearing of this action for an injunction to restrain an alleged infringement of plaintiffs' patent for "improvements in and relating to vitreous containers, having sealed in conductors," has been continued before Mr. Justice Astbury.

Prof. C. Vernon Boys said he had read and considered plaintiffs' specification and the various documents that were relied on in defendants' particulars of objection, and he did not find the two elements in plaintiffs' invention, viz., the feature of proportioning a composite wire so as to get the same coefficient of expansion as glass, and taking a metal for the outside or coating whose oxide was soluble in glass at a relatively low temperature, in any of the prior documents. At the date of plaintiffs' patent there was no common knowledge which would have led one to proportion a composite wire in the way in which the specification did.

Dr. Otho Oberlander, consulting chemist, gave the result of tests he had made with 10 of the alleged infringing lamps, and of the result of analyses of defendants' wire.

Mr. A. E. Gimingham, technical director of the Edison Swan Electric Company, said that for a long time it was most essential, in order that they might make a successful seal, that they should have platinum for a leading-in wire, and platinum or platinum-coated wire was universally used down to the date of the plaintiffs' patent.

On the 9th inst. Sir A. Colefax, K.C., summed up the case for plaintiffs, and said it seemed to him that their specification was a clear and well-drawn document from the standpoint of clearly stating what the invention was, and he did not think any difficulty arose on the construction of the documents. It was not important, however, to notice defendants' particulars of insufficiency in the case. He supposed at one time the issues would narrow down to want of subject matter.

Mr. R. Frost (for defendants) said they were not going to rely on the first three of the particulars of insufficiency.

Sir A. Colefax said in that case defendants were apparently still to place some reliance on the last particular, which was a very curious one. "No directions are given as to whether the expansion of the wire is to be measured in a radial or longitudinal direction." The short answer was that one did not measure the expansion in any direction at all. One would construct a wire in accordance with the specification and its directions.

His Lordship said he supposed what was meant by defendants' plea was that no directions were given in the specification as to whether one was to get the equivalent co-efficient by the ordinary longitudinal test or whether one was to take it on the cross section.

Sir A. Colefax said he believed his lordship's statement was the correct one, but the plea of defendants was a bad one. If, as plaintiffs said, the lateral expansion was what mattered and not the longitudinal expansion or extension, according to the evidence of Mr. Swinburne and Prof. Boys, then the first thing to see was whether or not plaintiffs' patent worked on that basis.

His Lordship said if they were to get into a maze of science over a simple document like plaintiffs' specification, he did not know where they were to get to in the end. The specification was addressed to people who *prima facie* would be able to put it into practice, and it told them to take a core and cover of tungsten and copper, so much of one and so much of the other, so that the average coefficient of expansion would be about the same as glass. If they assumed that, what had the longitudinal or lateral expansion to do with it?

Sir Arthur Colefax next addressed the court on the issue of infringement, and contended that the lamps (12 in number) sold by defendants fell within the claim in plaintiffs' specification.

His Lordship said he was not at present troubled with any of the anticipations, but the thing that did trouble him was the construction of the specification with regard to claim three. Claim one incorporated the proper coefficient of expansion; claim two expressly claimed a coating of copper provided they had got the combination of claim one, but claim three simply claimed a core of tungsten and a sleeve of copper, and it did not say that it had to be proportioned as in the patent.

Mr. Frost, who opened the case for defendants, said the issues were subject matter and infringement. Before that patent wires of nickel iron core covered with platinum were known and worked, and he submitted that at the date of the patent defendants had a perfect right to take that wire and substitute for the platinum something else which was known to have the property of getting the wire to stick.

His Lordship said prior to the patent the common practice was to make the leading in wire of platinum or something covered with platinum, and that was for the reason that platinum was a non-oxidising clear-face metal to which the glass would readily weld, and they thought it would not weld if they had a surface which would oxidise. There were certain alternatives to platinum suggested, but there was not a single document in the case which suggested that one could take off a platinum covering from a composite wire and substitute for it the very thing that platinum was used to avoid.

Mr. Frost said the question was whether the inventor in that case was the first man to place at the disposal of the public the free and unfettered use of metal whose oxide was soluble as a means of sticking glass on a composite wire. If he was not, then he could not have his patent.

The hearing was continued on Tuesday and Wednesday, when evidence was given for the defence.

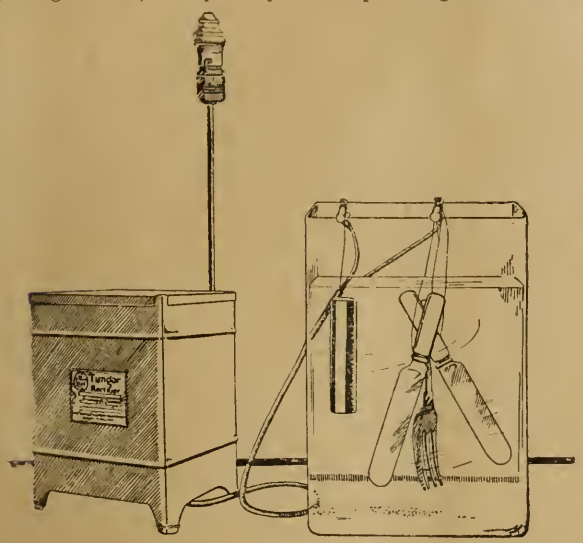
The case had not concluded when we went to press.

A New Electro-Plating Outfit.

The TUNGAR BATTERY CHARGER, which was originally designed for the charging of accumulators on alternating current, is now being employed with success for the operation of electro-plating vats. In the case of the retail jeweller and others who may desire to execute electro-plating on a small scale, the Tungar is a convenient and economical device.

Briefly, the Tungar is a self-contained apparatus, which, when connected to the ordinary a.c. lighting circuit, converts the a.c. into d.c. and transforms it down to a voltage suitable either for battery charging or electro-plating. The conversion to d.c. is effected by means of a special Tungar bulb, which operates on the same principle as the valve used in wireless telegraphy. There are no moving parts in the Tungar, and it does not require oiling.

Several sizes of Tungar are made, ranging from 2 A 7·5 V d.c. to 12 A 7·5 V d.c. For most jewellers, however, the 2 A Tungar is stated to be quite strong enough. The 2 A Tungar set illustrated is of the half-wave type. With the set operating at 2 A, and reckoning 4 oz. of silver to a gross of teaspoons, the operation of plating this quantity takes approximately four hours. A feature of this method of plating is that, due possibly to the pulsating character of the



TUNGAR BATTERY CHARGER CONNECTED ON THE PRIMARY SIDE TO AN ORDINARY LAMP HOLDER AND ON THE SECONDARY TO A SMALL ELECTRO-PLATING VAT.

current, the surface of the finished article is, it is claimed, much more shiny than when plated by the steady current from a battery.

The 2 A Tungar set has also been used with success in gold plating and gold colouring, or washing, such as is required for the insides of cups, &c. In washing cups, a small amount of the solution is poured into the article to be plated. A gold anode is held in the solution and slightly agitated, and the gold is deposited on the inside of the article. A small cup was gold-washed by this method in about a minute. The voltage across the vat ordinarily required for both gold and silver plating is not more than $\frac{1}{4}$ V, so that it is necessary to have a small rheostat connected in series with the set.

Full particulars will be gladly supplied on application to the makers, the BRITISH THOMSON-HOUSTON COMPANY.

Quick-Make Switches.

The rapid growth during the last few years of the use of electricity for industrial purposes, entailing the use of high capacity switches by non-technical persons, has intensified the demand for fool-proof switch gear.

One of the most frequent causes of damage, and sometimes breakdown, has been caused by bad contact. The unskilled person, in switching on, will often slowly "inch" the blades into contact, or will leave the switch in circuit when the blades are in slight or half contact. In either case arcing is liable to be set up, with immediate damage, and eventual breakdown of the switch.

To avoid this trouble, the MIDLAND ELECTRIC MANUFACTURING COMPANY have introduced a range of switches which they call the "Glasgow-Premier" and the "Paragon-Premier," and they claim that in using these switches the above troubles can never arise.

Immediately the operator begins to switch on, the blades "chop in" to instantaneous full contact, quite independently of any action on his part, and in switching off the circuit is just as fully and rapidly broken, so that there is never at any time danger of arcing or damage to contacts or blades. The blades cannot remain in any intermediate position. The quick action in both the make and break is effected by a powerful and unbreakable coil spring, thus removing all operating strain from the switch movement and all possibility of error from the operator. To make assurance doubly sure, the "follow on" of the handle by the operator effects a positive make independent of the spring.

Flood Lighting at Selfridges.

The accompanying illustration, taken at night, shows the first section of the new Selfridge building in Orchard-street, London, W., where a complete system of flood lighting has been recently installed. The floodlights are of a standard design, manufactured by the GENERAL ELECTRIC COMPANY, and consist of a solid copper

PART OF SELFRIDGE'S NEW BUILDING PHOTOGRAPHED AT NIGHT.

body lined with sectional parabolic reflectors of mirror glass. They are equipped with 400 W Osram gasfilled projection-type lamps, with specially concentrated filaments. The installation was designed by the illuminating engineering department of the company, and is the first example of flood lighting as applied to large London stores.

New D.C. Motor Starter.

WILLIAM GEIPEL & COMPANY have recently put on the market a new type of d.c. motor starter which we illustrate herewith. The case and cover are of steel, and no cast iron whatever is used in its construction. The no volt and overload coil magnet frames are of specially annealed steel, with a consequent minimum of residual magnetism to cause faulty working of the starter. The contacts are of very heavy section, renewable from the front, and the contact

WILLIAM GEIPEL & COMPANY'S NEW MOTOR STARTER.

shoe is of large area and has a positive spring pressure directly above the centre of the contact. The resistances are of the firm's well-known patented plate pattern. All back connections are made of copper strip machine-formed to standard size and dimensions throughout.

The complete apparatus is very light and extremely robust, being practically unbreakable, and is claimed to be specially suitable for export.

Parliamentary Intelligence.

Imports from Germany, 1921.

Mr. Baldwin stated in reply to Mr. Doyle (House of Commons, February 13th, 1922) that the imports from Germany in 1921 of electrical machinery amounted to 241 tons, valued at £44 996.

Merchandise Marks Bill.

In reply to Mr. G. Terrell (House of Commons, February 13th, 1922), Mr. Baldwin stated that the Government intended to introduce this Session a Bill based on the recommendations of the Merchandise Marks Committee, but it was not possible yet to have a date for its introduction.

Effect of Increased Telephone Rates.

In reply to Mr. Percy (House of Commons, Feb. 14, 1922), Mr. Kellaway said that since the increased telephone rates were imposed, 61 500 telephone subscribers had discontinued, and 55 000 extensions had been surrendered. More than half of these were due to normal causes, such as removals, death, or bankruptcy. During the same period there had been 67 500 new subscribers and 60 000 new extensions.

Wireless Telegraphy.

In reply to Sir H. Norman (House of Commons, February 13th, 1922), Mr. Kellaway stated that the number of wireless licences issued to amateurs for experiments in reception was 6,986 and in transmission 286. The annual revenue derived from the fees was at present £3 265 and £355 respectively. The annual expenditure incurred in connection with the issue of the licences and the inspection of the stations was about £5 200.

Telephone Cabinets: Euston Station.

Replying to Mr. Gillis (House of Commons, February 13th, 1922), who called attention to the fact that the Post Office telephone service from Euston Station call-box is 4d., Mr. Kellaway stated that the telephone cabinets at the station were the property of the railway company, and the calls were dealt with by the operators at the company's private exchange. The Post Office was not in a position to prevent a railway company or other subscriber from charging more than the Post Office call office fee for the privilege of using the subscriber's telephone installations.

Safeguarding of Industries Act.

In the House of Commons on Tuesday, Capt. Wedgwood Benn presented a Bill to repeal the Safeguarding of Industries Act of 1921. He contended that the Act had done nothing to build up British trade. It had raised prices, diminished employment, created great irritation with France, and impeded the work of European reconstruction.

Sir Richard Cooper contended it was unfair to repeal the Act until it had had a fair chance of getting into operation.

On a division, the motion to introduce the Bill was rejected by 170 votes to 92.

Omnibus and Tramcar Traffic.

Major Glyn asked the Parliamentary Secretary to the Ministry of Transport (House of Commons, February 13th, 1922) whether, in the opinion of the expert advisers to that Ministry, motor-omnibus traffic was preferable to tramcar traffic in all congested cities and areas; and whether the overhead trolley system had any considerable merit in comparison with the slot system?

In reply Mr. Neal said the first part of the question could not be answered without reference to local circumstances; as regards the latter part, if by "slot system" was meant the conduit system of electric traction, the overhead system was, he understood, the cheaper in respect of cost of installation and maintenance.

North Metropolitan Electric Supply Company.

Mr. G. Locker-Lampson asked the Parliamentary Secretary to the Ministry of Transport (House of Commons, February 13th, 1922), whether they had made a permanent Order, which could not be revised for five years, increasing the maximum price of electricity to be charged by the North Metropolitan Electric Power Supply Company in Southgate to 8d. per unit without holding any public inquiry, although the temporary Order had another eighteen months to run, and in spite of the fact that since the temporary Order was made wages and prices had fallen and were still falling, the benefit of which the public might reasonably be expected to share.

Mr. Neal: The Minister of Transport, on the application of the company mentioned, and after considering the representations made against the application by Southgate Urban Council and the County Council of Middlesex has made an Order fixing the maximum price at 8d. per unit. This price is the same as that authorised by the temporary Order which would have expired in August, 1923. In the circumstances, it was not considered necessary to put either the company, the local authorities, or the Department to the expense of a public inquiry. The opportunity for revision of the maximum price will occur in five years' time, or in three years if a Bill similar to that introduced last session is passed into law.

Private Bills.

The following Bills passed their first reading in the House of Commons on Feb. 10:—Birmingham Corporation Bill, Bristol Corporation Bill, Bristol Tramways Bill, Metropolitan Railway Bill, Neath Corporation Bill, Nottinghamshire and Derbyshire Tramways Bill, St. Marylebone Borough Council (Superannuation) Bill, Shoreditch and other Metropolitan Borough Councils (Superannuation) Bill, Swansea Corporation Bill, Worthing Corporation Bill, London County Council (Tramways, Trolley Vehicles, and Improvements) Bill.

The Chairman of Ways and Means of the House of Commons and the Chairman of Committees of the House of Lords have decided that the following Bills, which have been certified as having complied with the Standing Orders, shall originate in the House of Lords:—Black Country Tramways and Light Railways, Bolton Corporation, Doncaster Corporation, Kingston-upon-Hull Corporation, London, Brighton and South Coast Railway, North Metropolitan Electric Power Supply, South Wales Electrical Power Distribution Company, Yorkshire Electric Power.

In the case of the Blackburn Corporation Bill, the Standing Orders have not been complied with.

It is to be regretted that the directors of the London, Brighton & South Coast Railway Company have found it necessary to drop their Bill for further financial powers, as it will mean a postponement of their big scheme for the further electrification of their main line to the south coast. It is understood, however, that arrangements are being made in other directions with a view to settling the financial question, and there is very little doubt that the further electrification scheme will be proceeded with in the not distant future. The postponement will not affect in any way the contract which the General Electric Company has secured for the electrification of part of the Brighton line. The contract is for the provision of the whole of the electrical equipment for twelve additional motor coaches, each of 1 000 h.p., to enable the section of the line from Balham through Thornton Heath to Selhurst and West Croydon to be operated electrically.

I.E.E. Commemoration.

It is announced that the following speakers will contribute to the discussion at the three sessions which are to be devoted to "Reminiscences and Experiences in Electrical Engineering," at the Institution of Electrical Engineers' Commemoration Meeting next week.

On Wednesday, Feb. 22, at 3.30 p.m., Col. R. E. Crompton will open the meeting, and will be followed by Mr. S. Evershed, Mr. E. Garcke, Mr. W. Judd, Dr. G. Kapp, Sir Alexander Kennedy, Sir Oliver Lodge, and Lord Parmoor.

On Thursday, Feb. 23, at 3.30 p.m., the meeting will be opened by Sir Charles Parsons, who will be followed by Mr. Frank Bailey, Sir T. O. Callender, Dr. S. Z. de Ferranti, Mr. J. H. Holmes, Mr. W. H. Patchell, and Mr. J. Swinburne. At the evening meeting on that day Mr. J. E. Kingsbury will open, and will be followed by Mr. Llewelyn Atkinson, Mr. B. M. Drake, Sir William Noble, Mr. G. W. Partridge, Mr. A. A. Campbell Swinton, Mr. A .H. Wharton, Mr. C. H. Wordingham, and A.Wright.

The remarks of the above speakers and written contributions from Mr. Baldwin, Mr. G. Balfour, Sir Charles Bright, Mr. R. A. Chattock, Mr. H. Edmunds, Sir K. Elphinstone, Mr. W. B. Esson, Sir R. T. Glazebrook, Mr. F. E. Gripper, Mr. H. Hirst, Sir J. Kennal, Mr. Faraday Proctor, Mr, A. Siemens, Mr. C. B. Sparks and Mr. J. C. Vaudrey will be published in a special Commemoration Number of the "Journal."

A Devon Electricity Scheme.

An agreement has been reached between Torquay and Newton Abbot Councils in regard to electricity supply, and the Torquay Town Council have decided to proceed with the scheme and to acquire the power station at Newton. The Dart scheme has been definitely rejected. Mr. H. F. G. Woods, the Torquay electrical engineer, explains that the undertaking of the company at present supplying Newton Abbot (the Urban Electric Supply Company) will be purchased, and it is proposed to supply Newton, Torquay, and the intervening rural areas with electricity. The plant at the Beacon Quay generating station will be removed to Newton Abbot and further plant purchased. High tension transmission lines will be carried, partly underground and partly overhead, from Newton to Torquay, terminating in a new sub-station in Lymington-road. The estimated capital expenditure is £143 177 (from which £5 000 may be deducted as the scrap value of the Torquay plant), including £96 277, cost of re-equipment and extension of the power station, £2 500 for transmission lines, and £6 000 for a new main sub-station. The total annual working costs are estimated at £54 150, or an average of 3·9d. per unit for a sale of 3 350 000 units. Taking 4·2d. as the price per unit sold in Torquay and Newton Abbot, although at present it is considerably more, the undertaking would show a credit balance of £4 475 for the year's working. Steps are to be taken to obtain powers to carry out the scheme.

Trolley Omnibuses in Canada.

Six trolley omnibuses are being used by the Toronto Transportation Commission on suburban routes for experimental purposes. The view is held that they are more economical than petrol 'buses where there is an increasing, but not sufficiently dense, traffic for tramways. One of the vehicles has been built by the St. Louis Car Company, and the electrical equipment is by the Westinghouse Company. The body is built directly on to the chassis frame; the wheel-base is 16 ft. 2 in., and the overall length of the 'bus is 26 ft. The driver is located at the front on the left-hand side, and the entrance and exit door is directly at his right. Foot-operated hand brakes are provided on all four wheels, and a separate pair of hand-operated emergency hand-brakes are supplied on the rear wheels. There are two 25 h.p. motors, and the series parallel control apparatus is underneath the hood. The control is operated by means of a foot pedal, pivoted at a point under the centre of the foot, so that a slight rocking motion backwards and forwards controls the various steps.

Electricity Supply.

A Methodist chapel in Grafton-road, Kentish Town, is being converted by the St. Pancras Borough Council into a sub-station.

Lincoln City Council have decided on many salary reductions as from March 1, including a 5 per cent. reduction of the remuneration of Mr. S. Clegg, the city electrical engineer.

The Minister of Transport has extended for one year from July 31, 1921, the periods allowed by the Rickmansworth and Chorley Wood Electric Lighting Order, 1914, for laying mains.

Acting on the advice of the Electricity Committee and the Ministry of Transport, Cardiff Parliamentary Committee has decided to withdraw its opposition to the St. Mellon's Electricity Order.

In submitting the report of the Electricity Committee to the Stafford Town Council on Monday, Councillor Meade stated that the department was now within 5½ per cent. of the maximum output.

Watford Urban Council and Herts County Council will both oppose the Order of the Electricity Commissioners placing a considerable part of the county in the London and Home Counties district.

Southport Town Council has instructed the Borough Electrical Engineer (Mr. E. Moxon) to prepare a report on the electricity undertaking, particularly in regard to the generating plant, and to state what alterations, if any, are required to obviate the constantly recurring breakdowns in the supply.

The Long Eaton electricity undertaking appears to be in need of reorganisation, if the statements made by the chairman of the Electricity Committee (Mr. J. Pegg) are accurately reported. Mr. Pegg alleged that the new Babcock boiler is not required, that many meters have not been registering the consumption of electricity, that no tools are available, and that the works are in a shabby condition. It has been decided to appoint a capable male clerk to assist in costing, &c., and a fitter to maintain the works in a more efficient condition, and to provide necessary tools.

The London County Council have authorised the substitution of gasfilled lamps for inverted arc lamps at the L.C.C. Central School of Arts and Crafts and the London Day Training College. No material saving in the consumption of energy is anticipated as a result of the change, but there will be a great saving in labour, as, apart from the necessity for the occasional attendance of electricians, the trimming of the existing arc lamps occupies from one hour a day in the spring to four hours a day during the winter months. The estimated cost of carrying out the work is £410.

It was reported at a meeting of Cardiff City Council, on Monday, that the number of applications received from proposed consumers of electricity were so numerous that many had been refused, because the generating plant was insufficient. The Electric Lighting Committee recommended that £59 300 be spent on extensions to boiler-house plant at Roath station, including the installation of three new water-tube boilers with mechanical stokers, economisers, coal handling plant, &c. Mr. Morley New, the City Electrical Engineer, said that the proposed expenditure was based on the normal increase of output of electrical energy, and explained that the present plant was inadequate to meet the increase of output, and was partly obsolete. The applications received in the quarter ending December was 20 per cent. more than for the corresponding quarter for the previous year, and he considered that it was desirable to get on with the work during the summer months. The recommendation was then adopted.

New Schemes and Mains Extensions.

Aldershot Urban Council has received sanction to borrow £6 857 for electricity purposes.

Maidenhead Town Council propose to install a 200 kW semi-Diesel engine at the electricity works.

Ashford (Kent) Chamber of Commerce has petitioned the Urban Council to establish electricity works in the town at the earliest possible moment.

Littlehampton Urban Council have decided to sign the agreement with the Sussex Electricity Company for the supply of electricity to the town.

The North Metropolitan Electric Power Supply Company have informed Ware Urban Council that they propose to erect overhead cables for the supply of electricity to the town.

Dunleary (better known as Kingstown) Urban Council has appointed J. P. Tierney and Company, their consulting engineers in connection with the new electrical scheme for that town.

The electricity scheme for Coleraine should soon take definite shape as the Irish Society is giving the use of the water power at the famous "Salmon Leap" on the Lower Bann for generating electrical energy.

With a view to extending the electric light to the smaller houses, Eastbourne Corporation have approved a scheme for wiring and fitting such premises on a rental basis. An experiment will first be made with fifty cottages.

The Electricity Commissioners have informed Boston Rural Council that March next has been fixed as the date for the commencement of the Provisional Order of 1915, which has been held up on account of the war

Crompton & Company have entered into an agreement for supplying electricity to Bideford, Northam, and Westward Ho! and into a provisional agreement to supply Torrington. The estimated charges will be 10d. per unit for lighting, and 3d. for power. It is proposed to use overhead mains.

Truro Town Council have submitted to the Electricity Commissioners an electricity supply scheme, prepared by Dr. Purves, and an amended offer from the Cornwall Electric Power Company to supply electricity in bulk. A canvass of the district is to be made to ascertain the probable demand.

Reporting to St. Annes Council on the extension of mains in the Lytham area, Mr. J. H. Clothier, electrical engineer, stated that 7 000 yards of cable had been laid up to January 30th, and another 2 000 would shortly be completed. One hundred and twenty-five new applications for supply had been received.

Monmouth Corporation have applied to Hereford Electricity Committee for a supply of electricity in bulk on terms to be agreed. The chief electrical engineer of Hereford (Mr. W. T. Kerr) has been authorised to act in an advisory capacity in connection with the erection of the necessary transmission line and switchgear.

The North Metropolitan Electric Power Supply Company have asked Luton Town Council for a supply of electricity in bulk for a period of twenty-one years from Oct. 1 next. The company offer to pay a fixed capital and standing charge of 15s. per quarter per kW of the maximum demand, a charge per unit equal to the actual cost of fuel used per unit generated throughout the quarter, plus 25 per cent. The capital outlay for additional plant needed to provide the supply will be £12 000.

At the monthly meeting of Dover Electricity Committee last week it was suggested in a report by the engineer that something might be done in the way of co-operation between Dover, Deal and Folkestone in connection with the supply of electricity that might solve the financial problem with which Dover was faced. The electricity supply powers of the Deal Gas Company will lapse in three months' time, and the engineer at Dover (Mr. R. C. Harper) has been instructed to see the engineer of the Deal Gas Company, and report.

Wigan Corporation has decided to carry out a scheme of electricity plant extensions in two stages. A 5 000 kW generating set is required at once, which will cost about £50 000. The set will be available in December next, when the load on the station will be about 9 000 kW. There are, however, a number of large firms awaiting supply, but the full scheme which the committee have in view will have to be examined by the expert engineers of the South-East Lancashire District Electricity Committee. It is anticipated that the Bradford-place station will be developed to its fullest capacity, and a new super-power station erected.

Alteration of Charges.

Pending a complete revision of electricity charges at Malvern, the Urban Council has decided to charge consumers of 5 000 units or over per annum for lighting purposes at 1d. less than the price charged to ordinary consumers, but no discount will be allowed.

Newcastle (Staffs) Electricity Committee recommend that as from the March meter readings the price of electricity for lighting be reduced from 66⅔ per cent. to 50 per cent. above pre-war prices. If in May the Committee find themselves in a better position they will make a further reduction.

The following reductions have been made in the prices of electricity in Dudley :—Lighting (including street lighting) from 80 per cent. to 60 per cent. over pre-war prices as from Jan. 1, and power over 600 units per quarter from 80 per cent. to 60 per cent. from March 31 next. No further reductions are to be pressed for at least six months. A reduced minimum charge of 10s. 6d. per quarter for each of the two summer quarters and the present minimum charge of 13s. 4d. for the two winter quarters has also been agreed upon.

Doncaster Town Council have reduced the charges per unit for electricity from Jan. 1 as follows :—Private lighting, from 7⅞d. to 7d. ; theatres and cinemas, from 5¼d. to 4⅜d. ; churches, chapels, &c., from 6⅛d. to 5¼d. ; special rates, from 5¼d. to 4⅜d. ; for a consumption per quarter not exceeding 200 units per kW demanded, from 3d. to 2⅜d. Above 200 units per quarter, 2⅜d. to 2¼d. ; 250 units, 2⅜d. to 2¼d. ; 300 units, 2¼d. to 2d. ; 400 units, 2d. to 1⅝d. ; 500 units, 1⅝d. to 1½d. ; 600 units, 1⅝d. to 1⅜d. ; and above 700 units, 1½d. to 1¼d. ; tramways, 2·1d. to 1⅞d.

G.E.C. Labour-Saving Devices.

The General Electric Company gave special demonstrations of labour-saving devices at their showrooms at Kingsway, London, last week. The efficiency of the wide range of electric drills and other tools made by the company was well demonstrated, and other specialities shown were the "Time-Saver" electric washer, tailoring irons which switch off the current when replaced upon the hot plate, "Magnet" sealing wax heaters, copper electric urns, hot-water radiators with immersion heaters, explosion-proof mining telephone sets, the "Kingsway No. 2" miners' safety lamp, and the "Witton" fractional horse-power motors, from 0·02 to 0·5 h.p.

Apart from the moving-part labour-saving appliances, there were shown "daylight" gasfilled lamps with blue bulbs, which are excellent for colour matching, and have been supplied in considerable numbers to Selfridge's and other stores for the purpose, and also the company's well-known flood-lighting lamps.

In addition to the above-mentioned exhibits, there were splendid displays of alabaster and other lighting fittings, silk shades, heaters, &c.

Electric Traction.

For the nine months ended Jan. 5, READING Corporation tramways receipts showed a decrease of nearly £3 500 compared with the same period last year.

Penny fares for short distances are to be reintroduced on the BURTON-ON-TRENT tramcars for an experimental period of three months, commencing on April 1.

ACCRINGTON tramway receipts for the year ending January showed a decrease of £5 700, but a saving of £7 600 on the permanent way repairs and wages, left a credit balance of £1 900.

At the meeting of the LONDON COUNTY COUNCIL, on Tuesday, Mr. W. J. Squires, Chairman of the Highways Committee, said that from Dec. 31, when penny fares were reintroduced on the tramways, the average loss of revenue worked out at £10 000 a week.

On the recommendation of the Electricity and Tramways Committee, CARDIFF City Council have decided not to proceed with any tramways extensions at present. The Tramways Committee has appointed a sub-committee to consider tramway extensions in every part of the city.

At a dinner attended by members of the House of Commons on Monday evening, the question of the ELECTRIFICATION OF RAILWAYS in the LONDON area was considered, and it was decided to hold a meeting of the Industrial Group of the House on Monday next to give further consideration to the matter.

With the announcement of a large reduction in the price of electricity for all purposes at SALFORD it was hoped that a reduction in tram fares would follow, but at the last meeting of the Council, the Tramways Committee stated that this would still be impossible as the receipts were down by £1 200 a week as compared with the same period last year.

The Joint Industrial Council for the TRAMWAYS INDUSTRY, which should have met in London last Thursday to discuss the report of a special committee appointed to consider the revision of the national agreement of March, 1919, has been postponed until this week. The normal working week of forty-eight hours is to be retained, but the companies seek other modifications, and particularly an examination of the guaranteed week clause, which, they declare, has been found in practice to be unworkable.

A series of accidents, brought about by an electric car getting out of control on an incline, occurred in High-street, GLASGOW last week. The car, which was being driven southward, failed to answer to the brakes when at Rottenrow and rushed down the incline to Duke-street. At that crossing it collided with a railway lorry, and though the front of the car was wrecked and the driver was thrown off, it continued down High-street. When near Glasgow Cross it collided with a heavy motor van.

It is reported that the trial trips on the 55-km. stretch, Bellinzona-Chiasso, of the GOTTHARD LINE, have been satisfactory, and the line is to be opened for public traffic. The section Bellinzona-Chiasso, which formerly took 72 minutes to run, will in future only take 59 to 60 minutes. The section Giubasco-al-Sasso will be opened as a double line probably in September next, the "Railway Gazette" states, as soon as the necessary bridges have been widened. The line Lugano-Taverne is to be doubled.

Seventeen persons were injured in a tramway accident at ROCHDALE last Thursday. A Corporation tramcar, running from Facit to Rochdale, had reached John-street, where there is a steep gradient of 1 in 14, and when half-way down the descent the brakes failed. The driver applied the magnetic brake, but this also failed. At the foot of the hill the car left the rails, mounted the pavement, crashed into a store, and then overturned.

Mr. F. H. Rudd, the borough electrical engineer, who was among the passengers, received injuries to his head, and was unconscious when taken to the infirmary, but happily he soon recovered.

Exhibition Notes.

The DESIGN AND INDUSTRIES ASSOCIATION is holding an exhibition of LABOUR-SAVING APPLIANCES at 6, Queen-square, Bloomsbury. The exhibition, which is entitled "Deliverance from Drudgery," will remain open for a month.

The promoters of the BRITISH EMPIRE EXHIBITION have decided to postpone the exhibition at Wembley Park from the year 1923 to 1924. The decision was come to on account of representations made by India on the short time available to prepare their exhibits. The Dominion Governments were consulted and all have approved of the postponement.

Following upon representations made by the Society of Motor Manufacturers & Traders, the proprietors of OLYMPIA have made arrangements for the CONSTRUCTION OF A NEW HALL on similar lines to the existing one, with which it is to be connected, the entrance being in the Hammersmith main road. When the enlargement is completed, the available floor area will be over 300 000 sq. ft. The intention is to complete the enlargement, if possible, in time for the shows to be held this autumn.

An International Technical Exhibition of Engineering will be held at LIÉGE during June and July under the organisation of the Association des Ingenieurs de l'Ecole de Liége. It is understood that French engineering interests will be well represented, and a certain amount of American participation is anticipated. The exhibits will include machines and machinery equipment, instruments, models, books, plans, diagrams, and all documents relating to engineering. Applications for space should be addressed to the Secretary, 16, Quai des Etats-Unis, Liége, before the end of March.

Personal and Appointments.

Mr. T. A. EDISON celebrated his seventy-fifth birthday last Saturday.

CAPTAIN R. J. WALLIS-JONES, O.B.E., T.D., was present at a Levée held by the King at St. James' Palace last week.

SWINDON Town Council has appointed MR. NICKLIN as electrical and mechanical engineer at a commencing salary of £500 per annum.

Mr. H. CARDWELL DAY has been appointed borough electrical engineer and tramways manager to the Heywood Corporation at a salary of £400 a year.

Mr. LINCOLN CHANDLER has resigned his position as managing director of the Metropolitan Carriage, Wagon and Finance Company, and his seat on the directorate.

Capt. H. HOOPER has been appointed honorary secretary of the South Midland Centre of the Institution of Electrical Engineers, in succession to Mr. J. D. MORGAN, who is relinquishing the post after ten years' service.

The Leyton tramways now form part of the L.C.C. system, and Mr. J. DUNCAN, Leyton traffic superintendent, and Mr. E. J. HAMMETT, Leyton car-shed superintendent, now become L.C.C. district traffic superintendent and car inspector respectively.

The public subscription initiated by the "Echo de Paris" in order to make a presentation to Prof. BRANLY has now been closed. The total sum, which amounted to 218 253 francs (£4 385), is to be applied by the distinguished scientist for research work.

Mr. W. T. UPTON, electrical engineer, of George-street, Oxford, has been elected to the committee of the Oxford branch of the National Citizens' Union. At the annual meeting of the Oxfordshire Provincial Grand Lodge of Freemasons Mr. Upton was decorated by Lord Valentia.

Mr. J. M. CALDER, general manager of Reading Corporation Tramways, has been appointed to represent the tramway undertakings in the east, south-east, and part of the south coast areas on the special consultative committee established by the Municipal Tramways Association to consider the question of revising the agreement of March, 1919, for regulating and controlling the working conditions of tramways.

The position of Mr. J. M. MCELROY, general manager of the Manchester tramways, in relation to his continued ill-health was considered by a sub-committee of the Tramways Committee on Tuesday. Nothing was decided, but it is probable that the sub-committee will again have the matter before it. In the event of Mr. McElroy's resignation from the position of general manager, it has been suggested that it would be to the interest of the tramway undertaking that his services should be retained in an advisory capacity.

Business Items, &c.

SMITH, ROBERTS & COMPANY have started business as electrical engineers at Horsmonden (Kent).

HIGGS BROTHERS announce that they will shortly open a branch at 84, Albion-street, Leeds, to deal with all their sales in Yorkshire.

The LONDON FACTORS & AGENTS, LTD., 39, Parliament-street, London, S.W. 1, announce that their registered cable address is "Lonfacgent, London," and for inland telegrams, "Lonfacgent, Parl."

The WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY announces the removal of its office in Cuba from Edificio Banco del Canada to Edificio Banco Nacional de Cuba at Havana. Mr. J. W. White is the manager of this office.

The Midland Counties District Office of FERGUSON, PAILIN, LTD., has been removed from Guildhall Buildings, Navigation-street, Birmingham, to Daimler House, Paradise-street, Birmingham. The new telephone number is "Midland 2594."

EDWARD HOLME & COMPANY have removed their electrical department and offices from Moss-lane, Altrincham, to Hartington-road, Broadheath, Altrincham, and have erected an extension to their die casting foundry at Broadheath which will enable them to concentrate the whole of their manufactures under one roof. The new telephone number is "Altrincham 776."

An interesting inexhaustible pocket torch has recently been placed on the market by the LEVERLITE LAMPS COMPANY. Current is generated by a small six-pole alternator, the permanent magnet of which is rotated by hand-power through a train of wheels. The generator supplies energy at 3·5 volts, and a good light is obtained by even a slight pressure on the lever. The chassis carrying the movement is separate from the pressed aluminium case of the lamp.

As the result of research work carried out by Mr. H. H. Ashdown and others at their Openshaw works, Armstrong, Whitworth & Company have produced a steel, known as "VIBRAC," which is claimed to have the property of never tempering brittle and of being absolutely reliable and consistent in its behaviour under any normal treatment. In addition to responding satisfactorily to even higher mechanical requirements, particularly in respect to elastic limit, than those obtained from nickel chrome steels, "Vibrac" may, subject to any normal treatment, after tempering, be either furnace cooled or cooled in air, thus cutting out all risks of distortion, and yet give higher impact values than nickel chrome steel treated under the most favourable conditions

Institution Notes.

Arrangements are being made by the INSTITUTION OF ELECTRICAL ENGINEERS for the erection of a permanent aerial on the roof of the Institution building.

The first WORLD POWER CONFERENCE, which is being promoted by the British Electrical & Allied Manufacturers' Association in co-operation with other associations, will meet in London at the British Empire Exhibition in 1924. Mr. D. N. Dunlop, director of the B.E.A.M.A., 36, Kingsway, London, W.C., is the organising director.

Mr. T. Britten, of Crompton & Company, presided at a meeting of the CHELMSFORD ENGINEERING SOCIETY on Feb. 2, when Mr. H. G. Allen, managing director of Queen's Engineering Works, Bedford, read a Paper on "The Design and Operation of Condensing Plants." An interesting series of lantern slides was shown, and a long discussion followed the lecture.

The first National Committee for India of the INTERNATIONAL ELECTRO-TECHNICAL COMMISSION consists of Mr. A. O. Coubrough, Mr. A. Cochran, and Mr. C. D. M. Hindley, all of Calcutta. It is anticipated that there will be developments in the near future justifying the formation of a committee that can correspond with the Commission on electrical matters of interest to India. In future the newly-constituted Institution of Engineers (India) will make the appointments to the newly-formed committee.

Sir Charles Bright represented the INSTITUTION OF ELECTRICAL ENGINEERS at the recent Air Conference, moving a resolution to the following effect :—That (1) for the purpose of economy, the Navy, Army and Air Force be absorbed under a Ministry of Defence, and (2) that civil aviation—aerial transport in particular—be dealt with by the Ministry of Transport or some other Civil Department. The necessary notice not having been given, this resolution could not be put to the meeting in the usual way. It, however, preceded the publication of the Geddes Economy Report.

A large number of members of the INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS were present at the meeting of the Institution held at the Institution of Electrical Engineers, Savoy-place, last week, when a series of films were shown illustrating telephone inventions of to-day and other electrical apparatus in operation. Pictures were shown of the first Bell telephone in 1875, the first telephone switchboard for five subscribers in 1877, a present-day switchboard for 10 000 subscribers, and the assembling of the parts (no fewer than 205) which go to make an ordinary house telephone.

At a general meeting of the INSTITUTION OF AUTOMOBILE ENGINEERS on the 8th inst., a large audience listened to a paper on "Engine Lubrication" by Mr. E. L. Bass, a graduate of the Institution. The Paper, which was awarded the Daimler Premium for the 1920/21 session, was followed by an excellent discussion. Lieut.-Col. D. J. Smith, has unanimously been elected president of the Institution for the ensuing session, and Messrs. H. G. Burford and L. H. Hounsfield have been elected to fill the vacancies in the list of vice-presidents. According to present arrangements, the following (among other) Papers will be read during the next session :—"Railless Trolley Traction," "The Electric Vehicle compared with the I.C.E. Vehicle from the Builders' Point of View," the same from the Users' Point of View, "Ignition," "The Present Position of the Diesel Engine in Relation to the Automobile," "Dynamometers," &c.

A Paper was read at the BIRMINGHAM AND DISTRICT ELECTRIC CLUB last Saturday by Mr. G. C. A. McDonald (member), on "Illumination from the Users' Point of View." The lecturer stated that observation of private houses, offices, works, and shop windows showed what a vast and practically untilled field there was for electrical engineers who would specialise in scientific illumination. Many well-known firms had spent large sums in investigation, in the production of scientifically designed fittings, and in the education of the public, but so far as he could see the effect had been small, largely owing to the indifference of electrical engineers, contractors and fittings manufacturers. Mr. McDonald gave a detailed account of recent investigation of the known laws dealing with the use of light reflectors. He emphasised the correct diagnosis of the quantity and quality of light required for each specific purpose, and gave the methods upon which sound lighting schemes could be devised. He dealt at some length with the rival claims of direct, indirect, and semi-indirect forms of lighting, giving relative efficiencies and values for special purposes of each system, his personal view being that for most purposes the indirect system was the best. The lecture was illustrated with lantern slides, diagrams, and mathematical formulæ.

Obituary.

The death is announced of MR. JAMES LIVERSEY DYSON, Chief Engineer of the Rangoon Tramway service since 1905, who carried out the conversion from steam to electric power.

We regret to record the death of Mr. T. W. CLARK, late Chief Electrician of the Telegraph Construction and Maintenance Company, which took place at Worthing, Sussex, on Jan. 19, after a short illness.

The death took place on Sunday, in his 77th year, of MR. GAVIN ALEXANDER CUTHBERTSON, who for more than 30 years was Yorkshire District Manager for the Pulsometer Engineering Company, of Reading.

Telegraph and Telephone Notes.

TRIM Urban Council have applied to the Postmaster-General for a telephone service in the town.

As the result of the economic agreement between ITALY and RUSSIA, telegraphic and wireless communications are to be resumed this week.

In preparation for the GENOA CONFERENCE the Italian Government last week tested a direct telephone between Brussels and Genoa. The conversations were stated to be quite clear.

The Director-General's report of the workings of the INDIAN POSTS AND TELEGRAPHS for the year ended March 31 last states that telephone exchanges and connections numbered 255 and 10 703 respectively.

A Reuter's message from Reval states that the Great Northern Telegraph Company is engaged in RESTORING ITS COPENHAGEN-PETROGRAD-PEKING LINE. Owing to cable defects between Petrograd and Copenhagen communication has been provisionally established by way of Finland and Sweden. The Petrograd-Peking line has been restored as far as Irkutsk.

It is announced that as soon as possible after the conclusion of the debate on the Address, steps are to be taken to set up again the SELECT COMMITTEE on the management and future of the POST OFFICE TELEPHONES, over which the Right Hon. Sir Evelyn Cecil presided. It will be remembered that Sir Evelyn and his expert assessor (Mr. W. W. Cook) conducted personal investigations into the telephone systems of the Scandinavian countries, while Mr. Cook visited Canada and the United States. Sir Evelyn has been engaged for some time in preparing a draft report.

In Italian commercial circles there is a movement in favour of direct submarine telegraph communication with South America, and a project has been put forward by an Italian company for a CABLE FROM ITALY TO SOUTH AMERICA, touching the Spanish coast *en route*. The Barcelona Chamber of Commerce recently asked the Spanish Minister of State whether it could be arranged that the cable should be laid so as to afford direct communication between Barcelona and South America, but the Minister replied that the company's plans did not permit of the adoption of this suggestion. The Italian company will obtain financial support from its government, and the projected cable will start from Fiuminca, at the mouth of the Tiber, and connect Malaga, Cape Verde, Fernando da Noronha, Rio de Janeiro, Montevideo, and Buenos Aires.

Wireless Notes.

A wireless service between Stockholm and Petrograd was inaugurated on Saturday.

It is reported that the Marconi Company in London is in negotiation with the Danish authorities concerning the establishment of a wireless telephone service between LONDON and COPENHAGEN. Experiments are shortly to be carried out.

Mr. Hoover, Secretary of Commerce, is to preside over a conference at Washington this week to discuss plans for the further GOVERNMENTAL CONTROL OF THE WIRELESS TELEGRAPH AND TELEPHONE. It is complained, the "Daily Telegraph" correspondent states, that the amateur and commercial use of wireless has developed to such an extent that the "air is full of chatter," and ether traffic regulations and possible ether policemen, will be required to regulate the situation.

The first of a series of regular WIRELESS TELEPHONE TRANSMISSIONS FOR the benefit of English WIRELESS AMATEURS took place on Tuesday evening. The Marconi Scientific Instrument Company prepared a fifteen-minute musical programme for the occasion. The first telephonic item was radiated from the Marconi station at Writtle at 7.35 p.m. (Greenwich), on a wave length of 700 mètres. This was preceded by a series of telegraphic signals for calibration purposes on 1 000 mètres. The power employed for telephony is limited to 250 W. in accordance with the terms of the Post Office licence.

Imperial Notes.

The formal opening of the new electricity supply station at KROONSTAD (ORANGE FREE STATE) recently took place. The cost of the plant and equipment was about £60 000. The annual output has grown from 75 000 units in 1905 to over 1 000 000 units last year.

It is stated that the AUSTRALIAN GOVERNMENT has decided to RAISE the EMBARGO on the importation of goods from ex-enemy countries on Aug. 1 next, when a Tariff Board will be established to determine the duties to be imposed on goods coming from countries having a depreciated currency, and on goods likely to be dumped to the disadvantage of local traders.

There is distinct evidence of an INCREASE in the EXPORT DEMAND for ELECTRICAL SUPPLIES, especially hydro-electric and traction purposes. It is satisfactory to see that the New Zealand Government have decided to admit electrical machinery for new industries, gold recovery, &c., free of duty, provided it is of British manufacture, and as there is a 10 per cent. duty on imports from foreign countries, British goods will enjoy an advantage. British manufacturers are anxious to see their products dutiable in all overseas markets on a weight instead of an *ad valorem* basis. British and German goods have to pay duties on an *ad valorem* basis, the latter in effect enjoy a great advantage over the more highly valued manufactures. Electric lamps entering Australia are now dutiable on a weight basis, with the result that British lamp producers are competing more successfully.

Foreign Notes.

Four electric cranes are being installed at Abo (Finland) Harbour to expedite loading operations.

The Tyssefaldene Company have purchased the Alby United Company's factories at Odda, Norway, for 50 000 kroner. The Tyssefaldene Company, together with the English syndicate, will restart the factories within six months for the production of ammonium sulphate.

For the past year the gross profit of the Siemens & Halske Aktien-Gesellschaft was 54 480 939m., against 25 778 925m in 1919-20, the net profit being 37 008 494m., against 16 435 763m. A dividend of 20 per cent. has been declared, against 14 per cent., but over 7 500 000m. has been placed to reserve, 1 000 000m. to disposal fund, and 1 000 000m. carried forward.

The net profit of the Siemens Schuckert Werke A.G. was 22 502 195m., against 12 769 752m. The dividend is 16 per cent., against 10 per cent. last year, but 5 000 000m. is put to reserve, 1 000 000m. is credited to disposal fund, and over 2 000 000m. carried forward. The reserve funds of both companies now amount to 94 000 000m.

The Government of French West Africa intends to adopt electric traction on the railway from Kayes to the Niger. It is thought that waterfalls on the Niger and Senegal will be utilised to provide the necessary electrical energy and to supply power for industrial purposes, and the Société Générale des Enterprises has been entrusted with the task of preparing a detailed scheme.

It is stated that five 40 000 kW turbo generators, three of which will be water-cooled, are to be installed in the large power station which is now being built at Gennevilliers to supply Paris. These turbines will work on a steam pressure of 320 lbs. per sq. in. and a super-heat of 350 deg. F. The generators will be connected to 6 000/60 000 V transformers, without intervening low-tension 'bus bars.

The new Spanish customs tariff came into operation yesterday (Thursday). The duty on most articles has been greatly increased, but a feature of the new tariff is the creation of *ad valorem* duties which are applied as follows: Motor-cars and cycles, 25-30 per cent.; agricultural machinery, 10-30 per cent.; internal combustion engines, 15-50 per cent.; and drilling and stamping machines, 15-60 per cent. The duty on coal is unaltered, but there is an increase of 10 per cent. on cables.

The results of investigations, recently made by Drs. Zimmern, Langlois and Balthazard into the electric voltage likely to prove fatal, have been communicated to the French Academy of Medicine. It is reported that there were a dozen fatal cases caused by contact with domestic circuits conveying energy at 110 V a.c, but there were exceptional circumstances to account for the accidents. In one case a girl in a bath, the water of which contained mineral salts, was killed by touching an electric radiator; after washing a floor with potash, a domestic shared a similar fate on touching an electric lamp, and in the Paris Tube a workman, who seized a lamp while standing in water impregnated with mineral matter, was also killed.

A start has at last been made on the big scheme for harnessing the Skagit river, which is to provide electric power for the city of Seattle and neighbouring towns and settlements. The work will cost several million dollars and will take three years. A commencement has been made with the construction of a tunnel through which the waters of the Upper Skagit river will be diverted during the building of a big concrete dam. This tunnel will then be used as a penstock in which turbo-alternators will be installed, but it will not be completed until next winter at the earliest, and will be 2½ miles in length. The scheme includes the construction of about 100 miles of electric railway in and around Seattle, and the work of installing the transmission lines has also been begun.

An important piece of railway electrification work is to be carried out by the Western Railway Company of Buenos Aires, which has recently raised £2 000 000 by means of debentures for adopting electric traction on its suburban services. The short tunnel line between the company's terminus and the port elevators is already operated electrically, but when the suburban railways are converted to electric working the facilities for handling grain and goods will be much greater and increased revenue should be earned. It is also proposed to introduce electric traction on the Great Southern loop line to La Plata, and as there are various other big railway schemes which are likely to be carried out in the near future there should be a good prospect of securing some of the orders for plant and rolling stock by British engineering firms.

The German Patent Office have dismissed the objection of the Fried. Krupp A.G. to the grant of a German patent applied for by H. H. Thompson & A. E. Davies (of the Rapid Magnetting Machine Company) for an invention relating to an electro-magnetic separator for separating feebly magnetic ores from other ores, and from each other, by means of a high-intensity magnetic separator. Patents have already been granted in England, America, France, and other countries. The opposition of Krupps was successful in the Examination Department, but the inventors appealed, and the higher court decided that there was a patentable invention, but they required a practical demonstration of the machine to prove that it was commercially possible to do what was claimed. After a series of experiments the decision of the tribunal was reserved, but it has now been issued, and is in favour of allowing the patent.

Arrangements for the Week.

FRIDAY, Feb. 17th (to-day).

Institution of Mechanical Engineers.

6 p.m. At Storey's-gate, St. James's Park, London, S.W. Annual General Meeting and Paper on "Electric Welding Applied to Steel Construction, with Special Reference to Ships," by Mr. A. T. Wall.

British Electrical Development Association.

7.30 p.m. At the Chartered Institute of Patent Agents, Staple Inn-buildings, W.C. Salesmanship Conference. (No. 4.) "Salesmanship in Relation to Electric Lighting." Speaker, Mr. H. Harrison.

Junior Institution of Engineers.

8 p.m. At Caxton Hall, London, S.W. Lecture on "Water Purification for Boiler Feed Purposes," by Mr. W. J. Leaton.

MONDAY, Feb. 20th.

East India Association.

3.30 p.m. At Caxton Hall, London, S.W. Paper on "Hydro-Electric Power in India," by Mr. A. T. Arnall.

Institution of Electrical Engineers.

Informal Meeting.

7 p.m. At Savoy-place, London, W.C. Discussion on "The Emergency Use of Oil Fuel during the Recent Coal Strike," opened by Mr. E. F. Hetherington.

Liverpool Sub-Centre of North-Western Centre.

7 p.m. At the University, Liverpool. Lecture on "An Oscillograph Investigation of the Gulstad Relay," by Dr. S. S. Richardson.

Royal Society of Arts.

8 p.m. At John-street, Adelphi, London, W.C. Cantor Lecture on "The Mechanical Design of Scientific Instruments," by Prof. A. F. C. Pollard.

INSTITUTION OF ELECTRICAL ENGINEERS.

Commemoration Meeting.

At Savoy-place, Victoria Embankment, London, W.C.

Tuesday, Feb. 21st.

3 p.m. Experimental Lecture on "Michael Faraday and the Foundations of Electrical Engineering," by Prof. J. A. Fleming, F.R.S.

7 p.m. At Hotel Cecil, London, W.C. Annual Dinner.

Wednesday, Feb. 22nd.

3.30-6 p.m. Short discourses on "Reminiscences and Experiences of Electrical Engineering in both its Technical and Legislative Aspects."

8.30 p.m. Prof. Fleming will repeat his lecture of the previous day.

Thursday, Feb. 23rd.

3.30-6 p.m. Continuation of Discourses on Electrical Engineering.

8-10 p.m. Conclusion of Discourses on Electrical Engineering.

TUESDAY, Feb. 21st.

Institution of Electrical Engineers.

(North-Western Centre.)

7 p.m. At the Engineers' Club, Manchester. Discussion on "The Utilisation of Waste Heat from Electrical Generating Stations," with Introductory Papers by Messrs. C. I. Haden and F. H. Whysall.

WEDNESDAY, Feb. 22nd

British Electrical Development Association.

12 noon. At the Hotel Cecil, London, W.C. General Meeting, followed by luncheon.

Institution of Electrical Engineers.

(South Midland Centre.)

7 p.m. At the University, Birmingham. Lecture on "Rotary Converters with Special Reference to Railway Electrification," by Mr. F. P. Whitaker.

Industrial League and Council.

7.30 p.m. At Caxton Hall, London, S.W. Lecture on "A Proposed Solution to the Transport Problem," by Mr. R. Horniman.

THURSDAY, Feb. 23rd.

National Liberal Club: Political and Economic Circle.

8 p.m. At Whitehall-place, London, S.W. Lecture on "Brains in Industry," by Mr. C. J. Melrose.

FRIDAY, Feb. 24th.

Electrical Power Engineers' Association.

7 p.m. At the Engineers' Club, Coventry-street, London, W. Informal discussion on "Boiler Troubles."

North-East Coast Institution of Engineers and Shipbuilders.

7.30 p.m. At the Literary and Philosophical Society, Newcastle-on-Tyne. Paper on "Running Costs of Diesel-Engined Ships," by Mr. T. Madsen.

Junior Institution of Engineers.

8 p.m. At Caxton Hall, London, S.W. Lecture on "Curved Beams, Rings and Chain Links," by Prof. E. G. Coker.

Edinburgh Electrical Society.

8 p.m. At the Philosophical Institute, 4, Queen-street, Edinburgh. Paper on "Some Experiments in Electrical Sound Detecting," by Mr. B. A. Pilkington.

Tenders Invited and Accepted.

UNITED KINGDOM.

Hull Corporation. Feb. 20.—500 or 1 000 tons girder tramway rails. Forms of tender, &c., from the City Engineer.

Dublin Electricity Committee. Feb. 20.—Transformers for one or two years. Specifications, &c., from the City Electrical Engineer, Fleet-street, Dublin.

Great Western Railway. Feb. 20.—Stores for three months from March 1st, including telegraph instruments, electrical apparatus (insulators), &c., electrical wires and cables, telegraph ironwork, and tools, telegraph drysalteries, and electric lamps.

Hammersmith Borough Council. Feb. 22.—Stores for 3, 6, or 12 months, commencing on April 1, including electric light sundries, insulated wire, metals, packing and jointing materials, tools, joint boxes and connections, and meters. Particulars from Mr. G. G. Bell, Borough Electrical Engineer, 85, Fulham Palace Road, W. 6.

Doncaster Corporation. Feb. 22.—Wiring and fitting sixty houses on the Carr House-road site. Forms of tender, &c., from Mr. R. E. Ford, 3, Priory-place, Doncaster.

Burton-on-Trent Corporation. Feb. 22. 6 000 kW three-phase turbo-alternator, with condenser and switchboard; and two 40 000 lb. water-tube boilers, with economisers, coal-handling plant, &c. Specifications from the Borough Electrical Engineer.

Metropolitan Water Board. Feb. 23.—Electric lamps, &c., for three, six, or twelve months. Forms of tender from the Chief Engineer, 173, Rosebery-avenue, London, E.C. 1.

East Grinstead Urban Council. Feb. 24.—Oil engine driven generators, motor balancer, motor booster, steam engine and dynamo, storage batteries, main switchboard, super-heater, feed-water heater, cable system, street lamps and travelling crane. Specification from the Clerk of the Council, 102, London-road, East Grinstead.

Skipton Urban Council. Feb. 25.—Supply, laying, &c., of four core, paper insulated, lead covered, steel tape armoured cable. Specification, &c., from Mr. W. Emmott, 35, Commercial-street, Halifax.

Liverpool Select Vestry. Feb. 27.—Overhead electrical installation at their Olive-mount Institutions, Wavertree. Particulars from the Clerk, Mr. G. W. Coster.

Leeds Corporation. Feb. 27.—One year's supply of stores and materials to the Tramways and Highways Departments, including copper bands, electrodes, electrical sundries, engineers' furnishings, ironmongery, &c. Specifications from the General Manager, Tramways Department, 1, Swinegate, Leeds.

Eston. Feb. 28.—The erecting and providing of plant in connection with the overhead lines, underground cables, transformers, sub-station equipment, and public lighting fittings required under Eston Electricity Special Order, 1921. Particulars from the Clerk, Mr. T. Belk, Cleveland House, Grangetown, S.O., Yorks.

Belfast Tramways Committee. Feb. 28.—Six or twelve months' supply of stores, including electrical accessories, cable, lamps, insulating tapes, carbon brushes, controller fingers, spares for Westinghouse controllers, armature and field coils, trolley heads, trolley wire, galvanised wires, suspension cars, &c. Forms of tender from the General Manager, Napier-street, Sandy-row, Belfast.

Edinburgh Corporation. March 14.—Steel tramway poles. Specifications, &c., from the Tramways Manager, 2, St. James-square, Edinburgh.

Hampstead (London) Borough Council. March 15.—Supply of various stores for six or twelve months, including electrical engineers' stores and oils for the electricity station. Form of tender, &c., from the Town Clerk.

Aylesbury Corporation.—300 kW converter, with e.h.t. and l.t. switchgear. Specifications, &c., from the Borough Electrical Engineer.

Aylesbury Corporation.—1 500 kW or 1 000 kW turbo-alternator, condenser and switchboard. Specification from the Borough Electrical Engineer.

Accrington Corporation.—Supply, delivery, and complete erection of 25 000 lb. water-tube boilers, economisers and brickwork. Particulars from Mr. A. W. Clegg, Engineer and Works Manager.

Cheshire County Mental Hospital.—Six months' supply of electrical goods, ironmongery, &c. Forms of tender from the Clerk.

AUSTRALIA.

Commonwealth of Australia. Feb. 23.—144 tons of copper wire, 30 000 copper tapes and binders. Particulars from the Supply Officer, Australia House, Strand, London, W.C. 2.

Postmaster-General's Department, Brisbane. April 19.—* Supply and delivery of testing and telegraph instruments, including d.c. ammeters, a.c. bridge condenser coil, condensers, cross-talk meters, detectors, milliammeters, polarised relays, and artificial telephone cable boxes. (Stores Schedule No. 549.)

Municipal Council of Sydney (Electricity Department). April 24.—*Supply, delivery, and erection of two 2 000 kW rotary converters; one 10 000 to 12 000 kW turbo-alternator.

SOUTH AFRICA.

Durban Corporation Electrical Department. April 12.—* Two 500 kW rotary converter automatic sub-station equipments. Alternative tenders for mercury arc rectifiers may be submitted instead of rotary converters, the switchgear to be completely automatic and suitable for their proper operation and control.

BULGARIA

Bulgarian Department of Posts. March 8.—*Porcelain insulating tubes for telephones (10 000), insulating tubing (impregnated paper) for telephones (2 200 metres), ebonite caps (1 700), and insulated copper wire (1 000 metres).

Bulgarian Post and Telegraph Authorities, March 15.—* The supply of 1 A fuses, cartridge fuses for protection from lightning, 3 A fuses, line annunciators, carbon lightning arresters.

Bulgarian Postal Authorities, March 21.—*Telephone, pole-line hardware (4-pin carriers for insulators, bolts, etc.).

Bulgarian Postal Authorities, March 27.—*3 000 junction pieces for batteries. Delivery required within four months.

SPAIN.

Spain.—H.M. Consul at Vigo states that the heavy gale recently experienced on the coast there destroyed the commercial wharves of the port, together with the plant, such as hand, steam and electric cranes. He states that tenders will possibly be invited at an early date, and suggests that United Kingdom firms interested should communicate through their agents in Spain with the Ministry of Development (Ministerio de Fomento), Madrid, or to the Port Works Office (Obras del Puerto) at Vigo, the authorities in charge of the reconstruction, giving full particulars of their latest designs. Firms not represented in Spain can obtain the name of a suitable agent on application to the Department of Overseas Trade. (Reference D.O.T. 5 394/F.L./S.C.)

Glasgow Corporation has accepted the tender of D. & J. Gilmour for wiring and fitting houses at Craighton, at £3 769 17s.

Swansea Housing Committee has accepted the tender of W. Alban Richards, of London, for wiring 119 houses, at £65 557.

Stepney Borough Council have accepted the tender of A. Reyrolle & Company for a feeder panel on the switchboard of Wapping sub-station at £384.

Stepney (London) Borough Council have also placed the following orders :—Sutton & Company, one mile 3 in. earthenware pipes, £306, and troughs and covers, £234; G. W. Neale, solder, £106.

Worthing Corporation has accepted the tender of the Enfield Ediswan Cable Works (lowest tender received) for cable, £1 591. Ten tenders were received, the highest being £2 043.

Lewisham (London) Guardians have accepted the tender of the Star Electric Maintenance Company for repairing electric wiring, &c., at the Children's Home, Goat House Bridge, Norwood Junction, at £148.

Alderley Edge Urban Council has accepted the offer of the Alderley & Wilmslow Electric Supply, Ltd., for street lighting in connection with the housing scheme, at £1 18s. per 30 c.p. lamp per annum, and for standards and time switches at £18 2s. 6d. per lamp.

Cannock Urban Council have accepted the following tenders: F. Pickering (lowest tender), for the erection of a new transformer station, £1,650. (Sixteen tenders were received, the highest being £2,332); General Electric Company, for the coupling up of electric cables, £354.

In face of severe competition, Ruston & Hornsby have secured a contract from the South African Government for thirty-eight heavy oil engines. The engines are to be supplied to the South African Railway and Harbour Department for driving grain elevators and for electric lighting purposes in different parts of the Union. The order is understood to amount to 2 500 B.H.P.

Bermondsey (London) Council have accepted the following tenders :—Enfield Ediswan Cable Works, cable, £430; W. T. Henley's Telegraph Works Company, three feeder pillars, £6 6s. 6d. each; Sykes & Sugden, house service boxes, £1 8s.; and end division boxes, £1 16s. each; Pontifex & Company, lamp columns, £3 16s. 6d. each.

Trade Inquiries.

An Englishman in Canada, who is a civil engineer, desires to represent, on a commission basis, United Kingdom manufacturers of equipment, tools, or machinery, particularly applicable to railways, mines, power plants, &c. Agencies would be undertaken for Eastern Canada or the whole of the Dominion, according to the nature of the goods. Particulars from the Department of Overseas Trade. (Ref. No. 160.)

An Englishman residing in Toronto, already representing a Canadian firm for battery separators, desires to represent United Kingdom manufacturers of automobile parts and accessories, hard rubber or glass battery jars, galvanised products, electric meters, fireless cookers, &c., on a commission basis, for the province of Ontario. Particulars may be obtained from the Department of Overseas Trade. (Ref. No. 161.)

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* *Particulars from the Department of Overseas Trade.*

Companies' Meetings, Reports, &c.

Frederick Braby & Company announce an interim dividend of 5 per cent., less tax, on the ordinary shares.

An interim dividend of 2½ per cent. has been declared by Greenwood and Batley on the ordinary shares.

The North Metropolitan Electric Power Distribution Company has declared a dividend of 4 per cent. on the ordinary shares for the year 1921.

The directors of the Liverpool Overhead Railway Company recommend payment of a dividend of 5 per cent. for the year 1921 on the preference shares.

The Metropolitan District Railway announces a dividend of 1 per cent. on the ordinary stock for the year 1921. This is the first dividend to be paid on this stock since 1882, when the rate was 3-16 per cent. £65 000 has been placed to reserve, leaving £60 550 to be carried forward.

Swansea Corporation are this week offering for subscription £850,000 5½ per cent. redeemable stock at 98. Part of the proceeds will be utilised for extensions of the electricity supply and other municipal undertakings.

Subject to final audit, the revenue of the London and Suburban Traction Company will enable it to pay 3½ per cent. in respect of arrears on its 5 per cent. cumulative preference shares, with a carry forward of £11 523, compared with £1 205 brought in.

Subject to audit, the directors of W. T. Henley's Telegraph Works Company recommend a final dividend on the ordinary shares of 2s. per share, less income tax, making, with the interim dividend of 1s. per share paid on Sept. 1, 1921, 3s. per share for the year.

Mather & Platt, Ltd., recommend a dividend for the year 1921 of 10 per cent., tax free, including the interim distribution of 3 per cent. This is the same as the dividends for the last two years, and the balance carried forward is increased from £105 457 to £287 661.

The income for 1921 of the Montreal Light, Heat, & Power Company, after deducting expenses and taxes, depreciation and renewal reserve, &c., was $4 222 742. The sum of $20 000 has been set aside for pensions, and, subject to income tax, $975 053 is carried forward.

The revenue of the Pennsylvania Water and Power Company for 1921 was $1 962 252, and the divisible balance was $843 028. Dividends amounting to 7 per cent. were declared, $170 125 was added to depreciation, and $75 000 to sinking fund, leaving $3 254 to carry forward.

After providing for interest, sinking fund, income-tax, etc., the profit of the Paisley District Tramways Company for the year ended December 31st, 1921, amounted to £34 736. A dividend of 4 per cent. on the ordinary shares is recommended, leaving £8,032 to be carried forward against £6 545 brought in.

The South Metropolitan Electric Tramways & Lighting Company recommend a dividend on the ordinary shares for the year 1920 of 7½ per cent. The sum of £15 000 has been placed to reserve (an addition of £4 500 compared with the previous year), leaving £2 864 to be carried forward, against £1 556 brought in.

The City and South London Railway recommends a final dividend on the consolidated ordinary stock of 1¼ per cent., making 3¼ per cent. for the year. After placing £36 000 to reserve (an increase of £11 000), £25 000 remains to be carried forward, compared with £18 820 brought in. The dividend for 1920 was 1½ per cent.

The transfer books and register of members of the South Metropolitan Electric Light and Power Company will be closed from the 18th to the 28th inst. (inclusive), for the preparation of warrants for dividends payable in receipt of the 7 per cent. cumulative first preference 6 per cent. cumulative second preference, and ordinary shares.

The final dividend recommended by the London Electric Railway Company on the ordinary shares is 1¾ per cent., making for the year 1921 3¼ per cent. The sum of £65 000 has been placed to reserve (an addition of £20 000 compared with 1920), leaving £39 700 to be carried forward, compared with £22 350 brought in. The dividend compares with 1⅛ per cent. last year.

The County of London Electric Supply Company has declared a final dividend at rate of 11 per cent. on the ordinary shares, making 8 per cent. for the past year, after providing £180 000 for reserves and carrying forward about £21 000. In 1920 the dividend was at the same rate, £50 000 was placed to reserve for renewals, depreciation, &c., £62 500 to general reserve, and £18 595 carried forward.

The Central London Railway Company recommends final dividends on the undivided ordinary and preferred stocks of 2 per cent., making 4 per cent. for the year, and a dividend for the year on the deferred ordinary stock of 4 per cent. It is proposed to place £29 000 to reserve (an increase of £9 000), leaving £59 600 to be carried forward, compared with £15 161 brought in. For 1920 the dividend on the ordinary stock was at 2¼ per cent.

The Metropolitan Electric Tramways, Ltd., recommend a dividend of 7 per cent. on the 5 per cent. cumulative preference shares, being the balance of 4½ per cent. for the year ended Dec. 31, 1919, and 2½ per cent. on account of the year ended Dec. 31, 1920. The sum of £67 500 has been placed to reserve for reconstruction and renewals (an addition of £57 500 compared with previous year), leaving £2 420 to be carried forward, compared with £1 538 brought in.

The accounts of Cambridge Electric Supply Company, Ltd., for the year ending Dec. 31 last show a total profit for the year of £13 064, which, added to £2 112 brought forward from 1920, makes £15 176. After deducting debenture and other interest (£2 379) and placing £5 000 to depreciation, there remains a balance of £7 797. The directors recommend the payment of a dividend of 5 per cent. for the year, which will absorb £4 955 10s., leaving a balance to carry forward of £2 841 10s.

Subject to final audit of accounts, the revenue of the Underground Electric Railways Company of London will enable it to pay the full interest to Dec. 31, 1921, on its 6 per cent. first cumulative income debenture stock and to pay interest at 2 per cent., free of tax, on its 6 per cent. income bonds of 1948 for the half-year ended Dec. 31, 1921, with a carry forward of £26 600, compared with £20 137 brought in. For 1920 interest at 2 per cent., free of tax, was paid on the 6 per cent. income bonds.

After placing £10 000 to general reserve, the North London Railway Company recommend a final dividend to Dec. 31, 1921, of £3 15s. per cent. on the consolidated (ordinary) stock, making £6 per cent. for the year, carrying forward about £14 700. Consequent on the ordinary dividend being at rate of 6 per cent., the holders of the preferential consolidated stock, 1866, become entitled to an additional 10s. per cent. For 1920 the dividend was £5 10s. per cent., with £10 000 placed to general reserve and £14 565 carried forward.

At the annual meeting of the Dublin United Tramways Company in Dublin last week, Mr. L. A. Waldron, who presided, stated that the passenger receipts had increased by £74 063 over the previous year, and in the parcels department by £1 700 odd, and by a similar sum for the carriage of minerals. With regard to the overcrowding of the cars, they were doing all they possibly could to meet the complaints, and to assist the long-distance passengers on the Dalkey line they were running in the rush hours a couple of cars upon which the minimum fare was 3d., with a view to preventing passengers using the long-distance cars for short journeys.

The net revenue of the North Metropolitan Electric Power Supply Company for 1921 was £125 333, compared with £96 174 for 1920. Adding interest and dividends received and the balance of £4·433 brought forward, the total is £136 128, less mortgage and other interest £31 979, reserve fund for 5 per cent. mortgages £2 000, redemption fund for 7½ per cent. debenture stock £1 142, contribution to reserve £25 000, leaving £76 007. The directors propose a dividend on the ordinary shares at the rate of 10 per cent. per annum, carrying forward £5 006.

In the annual report of the South-Eastern & Chatham Railway Companies for 1921, it is stated that the Managing Committee has for some time past been considering the means of providing adequate accommodation for the traffic on its lines, and has arrived at the conclusion that the only method of doing so is by the introduction of electric traction. Up to the present time there has been no opportunity of raising the necessary capital for the work, but the Committee has now approached the Advisory Committee appointed under the Trade Facilities Act, 1921, with the object of obtaining capital under the guarantee of the Government.

The net profits of the St. James' and Pall Mall Electric Light Company for the year ending Dec. 31, 1921, applicable to dividends on shares, amounted to £31 232, to which £5 887 brought in from 1920 was added, making a total of £37 119. From this sum £10 500 was paid out in interim dividends for the half-year ending June 30th, leaving £26 619, which the directors propose to deal with as follows : a dividend at the rate of 7 per cent. on the preference shares for the second half-year, £3 500; a dividend on the ordinary shares for the second half-year of 8s. 6d. per share, making a total distribution of 12 per cent. for the year, £17 000; leaving £6 119 to be carried forward. The connections, which at the end of 1920 were 19 904 kW, have been increased during the year to 21 167 kW, and 13 464 418 units were supplied to consumers.

The report of the London Electric Supply Corporation for the year ended Dec. 31 last shows a profit for the year of £102 286, against £99 487 last year. To this has to be added £14 256 brought in less interest on temporary loan (£2 116), making a total of £114 427. From this sum the following have been deducted :—Interest on debenture stock to Dec. 31, 1921 (£23 494), sinking fund for redemption of debenture stock in 1931 (£16 580), leaving a balance of £74 352 15s. 10d., which the board propose to deal with as follows :—Payment of a dividend of 6 per cent. on the preference shares (of which an interim dividend of 3 per cent. was paid on Sept. 1, 1921), £26 952; payment of a dividend of 4 per cent. on the ordinary shares, £13 320; to reserve, £15 000; to contingencies, £5 000; leaving £14 080 15s. 10d. to be carried forward. The supply has been efficiently maintained during the year. Units sold numbered 47 490 802, as against 47 366 351; the total costs per unit sold being 1·47d. (1·38d.) The average receipt per unit sold (lighting and power) was 1·91d. (1·81d.).

The report of the Metropolitan Railway Company for 1921 shows gross receipts of £2 236 166 and expenditure of £1 727 090. Including miscellaneous receipts (net) from rents, interest, &c., £241 870, and £15 416 brought in, the total net income is £766 362. A dividend is recommended at the rate of £3 5s. per cent. per annum for the half year ended Dec. 31, 1921, making £2 5s. per cent. for the year, leaving £17 797 to be carried forward. The amount transferred to the general renewals fund is £50 000. The surplus land dividend is £3 per cent. for the year, compared with £2 17s. 6d. per cent. for 1920. The number of passengers carried, excluding season ticket holders, totalled 75 172 423, against 95 273 887 in 1920. The additions to the rolling stock include forty-seven new electric

cars. Three of the electric locomotives have been re-equipped with higher-power motors, and all the other electric locomotives are gradually being dealt with in a similar manner. A switch-house to accommodate the new switchgear required for the augmented generating plant at Neasden is being erected, and the work of installing the plant is progressing satisfactorily.

The report of the London & South-Western Railway Company for 1921 states that the expenditure on capital account for the year was £172 004. Gross receipts amounted to £13 354 530, as compared with £13 315 258, and expenditure to £11 497 653 (£11 242 248). Including miscellaneous receipts £216 387, an appropriation from the £1 046 161 received from the Government under the allocation scheme, £250 000, and balance from last account £65 555, the total net income is £2 388 819 (£2 362 358). After deducting the interim dividend of 2 per cent. paid on the ordinary stock and placing £60 000 to the credit of revenue suspense accounts for loss on sale of investments in Government securities, Feltham marshalling sidings and electrification of suburban lines, there remains £652 941, which admits of the payment of a dividend of 4 per cent. for the second half of the year, making 6 per cent. for the year (same as in 1920), and leaving a balance of £71 920 to be carried forward. The dividend on the preferred converted ordinary stock is at the rate of 2 per cent. for the past half-year, and on the deferred converted ordinary stock at the rate of 2 per cent. for the whole year 1921.

For 1921 the net profit of the Yorkshire Electric Power Company amounts to £74 316, against £64 739 in 1920. The 1920 ordinary dividend of 8 per cent. is repeated, £15 000 is again placed to general reserve (raising it to £104 000), and £23 259 carried forward, compared with £20 938 brought in. The report states that the extensions of the Thornhill and Barugh power stations were delayed by the coal stoppage, but are now proceeding satisfactorily, and will be available for supply within the next few months. Extensions of mains and sub-stations have been made for supply in bulk to the Corporations of Dewsbury and Todmorden and the Urban District Councils of Elland and Honley. In this part of the company's area there are two important municipal undertakings, those of the Sheffield and Rotherham Corporations. With both these the company has entered into arrangements for joint working in the interests of cheap production. An inter-connection has already been made with the Sheffield Corporation undertaking for a substantial amount of current. Underwriting arrangements have been made for an issue of £558 360 6 per cent. preference shares of £5 each at £4 per share. The issue will probably be made next week.

The annual meeting of the British Columbia Electric Railway Company was held in London on Tuesday, Mr. J. Davidson (deputy chairman) presiding in the absence, owing to ill-health, of Mr. R. M. Horne-Payne. In moving the adoption of the report and accounts, the chairman said that the gross earnings, which exceeded $9 500 000, constituted a record in the history of the company. In 1920-1921 they carried 71 065 275 passengers, compared with 66 411 030 in 1919-1920. In 1920-1921 they delivered 140 285 620 kW of electricity for light and power, against 120 173 919 kW the previous year. The only department which had fallen backward slightly was the freight department, where 412 534 tons were carried, compared with 430 931 tons. Owing to their purchase in 1920 of the undertaking of the Western Power Company of Canada, they had a present and potential supply of power sufficient to meet the requirements of the communities they served for many years to come. A recent expert examination of their power plants indicated that for a relatively moderate capital expenditure they might reasonably expect to add an additional 10 000 kW to the capacity of the plants. They were erecting an additional unit of 7 500 kW in the Western Power Company of Canada, and it should be possible for them to obtain 80 000 h.p. from the development of the second power site owned by the Western Company. The management were actively considering plans to make available those water-power resources, but the time at and extent to which development work could be undertaken would depend upon the growth of the demand for power.

Books Received.

"Electrical Engineers' Pocket Book." (London : International Correspondence Schools, Ltd.) Pp. xiii.+437. 10s. 6d. net.

"Continuous Wave Wireless Telegraphy." By B. Mittell. (London : Sir Isaac Pitman & Sons.) Pp. xv.+114. 2s. 6d. net.

"Electrical Installation Rules and Tables for Rapid Reference." By W. S. Ibbetson. (London : E. & F. N. Spon.) Pp. ix+60. 1s. 6d.

"Research in Industry." By A. P. M. Fleming, C.B.E., and J. G. Pearce, B.Sc. (London : Sir Isaac Pitman & Sons.) Pp. xvi.+244. 10s. 6d. net.

"Work of R.E. in the European War, 1914-1919." (The Signal Service, France.) By Major R. E. Priestley, M.C., B.A. (Chatham : W. and J. Mackey & Co.) Pp. xvi+359.

"Switching Equipment for Power Control." By Stephen Hayes, A.B., E.E. (London : Hill Publishing Company.) Pp. viii. † 463. 20s. net.

"Factory Accounts in Principle and Practice." By E. Garcke and J. M. Fell, C.B.E. Seventh edition. (London : Crosby Lockwood & Son.) Pp. xx. + 290. 15s. net.

"The Failure of Metals Under Internal and Prolonged Stress." A general discussion before the Faraday Society. Edited by F. S. Spiers, O.B.E. (London : Faraday Society.) Pp. 215.

Social Notes.

A social and dance, on a large scale, organised by the staff of the Edison Swan Electric Company, and open to all the Ponders End employees, was held at the works last Saturday evening. Almost 900 were present, and the girls' dining hall, a building capable of seating about 1 500, was transformed into a palais de dance, and a long programme was enjoyed. The other entertainments provided were two concerts, one by Mr. A. P. Ambler's party and the other by the Edi-wan (girls) Musical Society and Orchestra and an up-to-date cinema which showed two splendid programmes. The side attractions included X-ray demonstrations and a show organised by a party of the foremen, in which the employees were invited to "get their own back" by endeavouring to knock off the hats of the foremen with tennis balls.

The staffs of Pritchett & Gold and E.P.S. Company, Ltd., and of their incorporated firm, Peto & Radford, spent an enjoyable evening at the Grosvenor Hotel on Wednesday last week. During the evening the chairman of the company, Sir Archibald G. Gold, and Lady Gold were presented, in celebration of their silver wedding with a silver rose bowl by Mr. Charles Pritchett, on behalf of the directors and staff. Mr. Pritchett, who is also a director of the firm, said that while the company had sustained a great loss by the death of his brother, Mr. G. E. B. Pritchett, the founder and first chairman of the company, they could not have found a more suitable successor as chairman than Sir Archibald. Sir Archibald Gold said in reply that the very handsome presentation had come as a great surprise to him, and, in thanking the staff for their kindness, he assured them that their gift would always be among the most valued of his possessions. An excellent musical programme was provided by members of the staff and their friends, the items being interspersed with dances, one of which, the "Lucky Spot Waltz," was won by Mr. C. H. J. Allworth, advertising manager of The Electrician, and Miss Emile Smith.

The Brighton Railway Contract.

As announced in The Electrician last week, a contract in connection with the extension of the electrification of the London, Brighton and South Coast Railway Company has been placed with the General Electric Company, who will undertake the necessary manufacture at their Witton Engineering Works, Birmingham. Work will begin within the next two months, and will be completed within twelve months.

It is understood that the contract is one of several which will probably arise out of the grouping system consequent upon last year's Railway Act, and is for the provision of the whole of the electrical equipment for twelve additional motor coaches, each of 1 000 h.p., to enable the section of the line from Balham, through Thornton Heath to Selhurst and West Croydon, to be operated electrically. The equipment is for employment with single-phase alternating current, and as the manufacture of this class of apparatus was formerly mainly in the hands of Germany, the importance of the contract, from the British national standpoint, cannot be overestimated.

It is a matter for congratulation that the enterprise and manufacturing facilities of the G.E.C. have enabled them to secure a contract of this nature, which should open up countless possibilities for the future.

Prices of Metals, Chemicals, &c.

Tuesday, Feb. 14.

	Price.	Inc.	Dec.
Copper—			
Best selected per ton	£65 0 0	—	£0 10 0
Electro Wirebars .. ,,	£69 0 0	—	£1 0 0
H.C wire, basis ..... per lb.	0s. $10\frac{15}{16}$d.	—	¼d.
Sheet ..... ,,	0s. 9¼d.	—	¼d.
Phosphor Bronze Wire (Telephone)—			
Phosphor-bronze wire, basis ..... ,,	1s. $2\frac{3}{16}$d.	—	¼d.
Brass 60·40 —			
Rod, basis ..... ,,	0s. 7¼d.	—	—
Sheet, basis ..... ,,	0s. 10d.	—	¼d.
Wire, basis..... ,,	0s. 10¼d.	—	¼d.
Pig Iron—			
Cleveland Warrants . per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 SWG ,,	£22 0 0	—	—
Lead Pig—			
English ..... ,,	£22 5 0	—	—
Foreign or Colonial .. ,,	£21 0 0	£0 2 6	—
Tin—			
Ingot ..... ,,	£153 7 6	—	£1 2 6
Wire, basis ..... per lb.	2s. 1¼d.	—	—
Aluminium Ingots	£120 0 0	—	—

Salammoniac.—Per cwt. 65s.-60s.
Sulphur (Flowers).—Ton £10 10s.
,, (Roll-Brimstone).—Per ton £10 10s.
Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.
Copper Sulphate.—Per ton £28
Boric Acid (Crystals).—Per ton £65.
Sodium Bichromate.—Per lb. 5½d.
Sodium Chlorate.—Per lb. 3½d.

Rubber.—Para fine, 11¼d. : plantation 1st latex, 8¾d. to 9¼d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Partnerships Dissolved.

HEATH, Leonard James, RICHARDSON, Alfred Charles, and KETLEY, Leonard, electrical engineers, &c., at Wood-street and Bawtry-road, Doncaster, York, under the style of HEATH, RICHARDSON, & COMPANY, by mutual consent as from Oct. 31, 1921. Debts and claims received by Bell & Watson, 2, St. Sepulchre-gate, Doncaster.

MARSH, Arthur Harold, and SANDERSON, John William, electrical engineers and contractors, &c., Station-road, Ossett, Co. York, under the style of MARSH & SANDERSON, by mutual consent as from Jan. 7, 1922. Debts received and paid by A. H. Marsh, who will continue the business.

OGDEN, Harold, and DYSON, Leonard, electrical engineers, under the style of DYSON & OGDEN, 16, Savile Park-terrace, Halifax, by mutual consent as from Dec. 31, 1921.

Bankruptcy Information.

HURWORTH, Walter, and WATMOUGH, Arthur Appleby, in co-partnership under the style of HURWORTH, WATMOUGH & COMPANY, 41, Town-street, Horsforth, and 1, Back James-street, Harrogate, electrical engineers. First meeting, Feb. 23, 11 a.m., 24, Bond-street, Leeds. Public examination, March 21, 11 a.m., County Court House, Albion-place, Leeds.

INCE, Arthur Courtenay, 21, Fenkle-street, Newcastle-upon-Tyne, formerly under the style of THE NEWCASTLE ELECTRICAL ENGINEERING COMPANY, now with a partner under the style of THE TYNE ELECTRICAL INDUSTRIES, electrical contractor. Receiving order, Feb. 6. Debtor's petition. First meeting, Feb. 22, 11 a.m., Pearl Buildings, 4, Northumberland-street, Newcastle-upon-Tyne. Public examination, Feb. 23, 11 a.m., County Court, Westgate-road, Newcastle-upon-Tyne.

Notices of Intended Dividends.

WATKINSON, Matthew, WATKINSON, Harold, and WATKINSON, Arthur, trading as WATT & COMPANY, 22 and 24, Palmer-road, Sheffield, electrical engineers, &c. Last day for receiving proofs, Feb. 25. Trustee, T. C. Parkin, jnr., 36, Bank-street, Sheffield.

WORMULL, Frederick Alfred Stanley, carrying on business at 273, High-street, Lewisham, as THE LEWISHAM ELECTRIC WIRING COMPANY. Last day for receiving proofs, March 1. Trustee, T. Gourlay, 29, Russell-square, W.C. 1.

WORTHINGTON, Vincent Broughton, Ellesmere-yard, Walkden, co. Lancaster, electrical engineer, &c. Last day for receiving proofs, Feb. 25. Trustee, J. G. Gibson, Byrom-street, Manchester.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

LLANELLY & DISTRICT ELECTRIC LIGHTING & TRACTION COMPANY, LTD. Registered Feb. 6. Trust deed dated Jan. 24, 1922, securing £125 000 debenture stock; charged on electricity supply and light railways undertakings of the company and hereditaments as set out in trust deed, also general charge. *£78 331. April 22, 1921.

Satisfaction.

REYROLLE (A.) & COMPANY, LTD., Hebburn-on-Tyne, electricians. Satisfaction registered Feb. 8. £7 500, part of amounts registered June 13, 1907, &c.

Deed of Arrangement.

WILKINSON, Guy, 16, Oxford-street, Harrogate, and Shott House, Spofforth, electrical engineer. Composition of 10s. in the £, payable by three equal quarterly instalments, commencing April 1 next; secured by a surety. Filed, Feb. 8. Trustee, C. H. Baker, 1, Albion-street, Leeds. Liabilities unsecured, £543; assets, less secured claims, £270.

Bankruptcy Proceedings.

FAWCETT, Ernest, 20, St. Anne-street, Liverpool, electrical and heating engineer. The public examination of this debtor was held on February 13th at Liverpool. The statement of affairs showed unsecured liabilities of £349, against net assets 14/11. He served an apprenticeship as an electrical, heating and hydraulic engineer, and afterwards for some years he worked for various firms of engineers. In August, 1920, he became connected with an electrical company, in which he invested £500, and of which he was appointed a director. The company carried on business at 20, St. Anne-street, Liverpool. It was not successful, and went into voluntary liquidation on June 1st last year. Debtor believed that the liquidator had realised the whole of the assets. He stated that he found out that the company was not a success about January or February last year. It had improved considerably when the heating department was taken on, and debtor became surety for a bank overdraft of £500, along with two other directors. He estimated that £250 of that would rank against his estate for dividend. In August, 1921, he commenced business in partnership with another gentleman, who found all the capital of £250. The business was similar to that of the company, and it was successful until January this year. According to the terms of the partnership, it was to be dissolved on the bankruptcy of either partner. The condition was that the surviving partner should take over the business with all the debts and assets. Proper books of account had not been kept. The whole of the household furniture was claimed by debtor's wife. The examination was closed.

FIGGINS, James Victor, 3, Pottery-terrace, Alexandra-road, Newport, electrical engineer. The first meeting of creditors was held last week. Ranking liabilities were returned at £753, while net assets were estimated at £39. Debtor attributed his failure to bad debts, loss on a contract, and strike. He started business in partnership at Newport in November, 1919. Since February last the business had been carried on in his own name. The matter was left in the hands of the Official Receiver as trustee.

Private Meetings.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

GOSS, Frederick Charles, 64, Gloucester-road, Bishopston, Bristol, electrical engineer. The creditors of the above were called together in Bristol a few days ago, when a statement of affairs was presented which showed liabilities of £1 221, all of which were due to the trade. The assets were estimated to realise £339, from which had to be deducted £15 for preferential claims, leaving net assets of £324, or a deficiency of £897. The assets consisted of stock expected to produce £150; book debts valued at £40; cash in hand, £14; furniture, £75; and motor-car, £60. There were also fittings, fixtures and utensils amounting to £22 6s. 6d., on which no realiseable value was placed at the moment. Debtor started in business in partnership with another with a capital of £50. The partnership was dissolved in October, 1919, and a little later the debtor started on his own account with a borrowed capital. The present position was attributed chiefly to the general slump in trade. The drawings had been about £6 a week. An offer had been received for the purchase of the stock, motor-car and furniture for £200. The matter was discussed at some length, and eventually it was decided that attempts should be made to obtain a better offer and one which would enable a composition of 4s. in the £ to be paid. Failing such an offer being forthcoming, the opinion was expressed that the matter should be dealt with in bankruptcy. The following are creditors: Wholesale Fittings Company, Ltd., Bristol, £47; Newtons, Taunton, £82; Mackintosh Cable Company, Derby, £28; Edison Swan Company, Ltd., Bristol, £36; Metropolitan-Vickers, Ltd., Bristol, £52; Petters, Ltd., Yeovil, £37; Simpson Baker & Company, Bristol, £463; London Lamp Company, London, £23.

WILSON-WOLF ENGINEERING COMPANY (THE), LTD. (in voluntary liquidation), 172, Thornton-road, Bradford. At the recent statutory meeting of creditors it was resolved to confirm the voluntary liquidation, with Mr. R. S. Dawson as liquidator, and an advisory committee was appointed, consisting of representatives of Clement Talbot, Ltd., the Hoffman Manufacturing Company, Ltd., and the Concordia Electrical Wire Company, Ltd. The statement of affairs showed ranking liabilities of £9 545 (£3 142 to trade creditors) and a deficiency of £8 138. The present position has been brought about by the moulders' strike and the coal strike.

Liverpool Electricity Accounts.

The total income of the electricity supply department of LIVERPOOL Corporation for the year ended Dec. 31 last was £995 988, including £760 981 from sales of electrical energy for lighting and power and £202 603 for traction. In the expenditure, which amounted to £662 157, are included two items for new services (£15 300) and meters (£15 254). The gross profit was £333 831, out of which interest (£110 335) and sinking fund contributions (£86 550) were paid, and after placing £86 946 to renewal fund, the balance (£60 000) has been devoted to the relief of rates. The capital expended during the year was £392 696, making the gross capital expenditure £3 092 135, but loans amounting to £856 019 have been redeemed. The amount at credit of sinking fund is £690 532, the reserve fund is £209 924, renewal fund £59 572, cancelled debt account £650 445, and cancelled stock account £205 574.

New Companies.

Consolidated Trading & Manufacturing Company, Ltd. (179 577). Private company. Registered Feb. 9. Capital, £500 in £1 shares. Electrical and general engineers, &c. Subscribers (each with one share): J. D. H. Bryant and L. D. Stears. Secretary, C. Nickols. Registered office, Cromwell House, High Holborn, W.C.

Deben Construction Company, Ltd. (179 521). Private company. Registered Feb. 7. Capital, £5 000 in £1 shares. To acquire the business carried on by W. F. Weston, V. J. T. Weston, R. Parr and Frances M. Emuss, at Woodbridge, Suffolk, as the Deben Construction Company, and to carry on the business of civil, mechanical and electrical engineers, &c. First directors: H. J. Emuss (managing director), A. E. Farr (chairman). Qualification, £10. Registered office, Woodbridge, Suffolk.

Engineering & Mercantile Company, Ltd. (179 554). Private company. Registered Feb. 8. Capital, £5 000 in £1 shares. To carry on the business of electrical engineers, &c., including the construction, laying down, altering and maintaining building works and machinery, and to acquire the business carried on at 61-62, New Stone-buildings, Chancery-lane, W.C., as "Rothstein, Izchakin & Company." First directors: Chanaan Izchakin, Samuel Rothstein, and Mordchel Mazower (all permanent, subject to holding £200 shares). Registered office, 61-2, New Stone-buildings, Chancery-lane, W.C.

Engineers' Supply Association (Norwich), Ltd. (179 467). Private company. Registered Feb. 3. Capital, £5 000 in £1 shares. Subscribers (each with one share): F. C. Harbott (first and sole governing director) and S. E. Parish. Registered office: 17-18, Basinghall-street, E.C. 2.

Freeland White and Company, Ltd (179 611). Private company. Registered Feb. 10. Capital, £3 000 in £1 shares. Electrical, telephone and general engineers, electricians, etc. Subscribers: P. F. White (1 000 shares), J. Reynolds (50). Solicitors: Chamberlayne, Hackins and Company, 83, Pall Mall, S.W.

Industrial Intelligence, Ltd., has been registered as a company limited by guarantee, without a capital divided into shares. The objects are:—To promote publicity and propaganda of all kinds, especially such as may be calculated to foster production, manufacture and trade in and between all parts of the British Empire and other countries; to promote and assist the production and distribution of literature, printed matter, photographs, illustrations and advertisements, and billposting of all kinds; to organise meetings, lectures and exhibitions; to establish and conduct commercial agencies, &c. The company is to be governed by a council of not more than six members, two being elected annually at the general meeting and one nominated by each of the following bodies:—The Federation of British Industries, the British Electrical and Allied Manufacturers' Association, the Cable Makers' Association, and the British Engineers' Association. First members:—Llewellyn B. Atkinson, Roland T. Nugent, D. A. Bremner, and D. N. Dunlop. Registered office, 24, Chancery-lane, W.C. File number 179 507.

Irish Automatic Telephone Installation Company, Ltd. Private company. Registered in Dublin Feb. 11. Capital, £10 000 in £1 shares (5 000 8 per cent. cumulative preference). First directors: T. Wm. Delany, K. J. Kenny, and J. P. Dillon. Secretary, A. Channing. Registered office: 8, Nassau-street, Dublin.

Kinecessities, Ltd. (179 589). Private company. Registered Feb. 9. Capital, £500 in £1 shares. Electricians, mechanical and electrical engineers, manufacturers of cinematograph films, dealers in and providers of machines and instruments of all kinds, including automatic machines, seating indicators for theatres, cinemas and railways, and accessories of all kinds, &c. First directors: C. F. O. Hamley and A. B. M. Gray. Qualification, £1. Registered office, 33, Charing Cross-mansions, W.C.

Leicester Electrical Engineering Co., Ltd. (179 533). Private company. Registered Feb. 9. Capital, £2 000 in £1 shares. To acquire the businesses of electrical engineers carried on (1) by T. Baker at 93, Upperton-road, Leicester, as "T. Baker and Company," and (2) by W. H. French at 346, Humberstone-road, Leicester, as "W. H. French," and to carry on the business of manufacturers of and dealers in electrical material, goods and appliances, electrical and other automobile accessories, etc. Permanent directors: T. Baker and W. H. French. Qualification, £100. Secretary, W. C. Quinn. Registered office: 11, Bowling Green-street, Leicester.

Metal Electrical Syndicate, Ltd. (179 561). Private company. Registered Feb. 8. Capital, £7 500 in £1 shares. To acquire interests in any invention relating to electrical deposit of metals, and to carry on the business of electro-platers, &c. Subscribers (each with five shares): A. E. Mawn, S. J. Quin, G. P. Millard, and A. E. Brain. Registered office, Westminster House, 7, Millbank, S.W. 1.

Ossorum Foundry Company, Ltd. (179 537). Private company. Registered Feb. 7. Capital, £15 000 in £1 shares. To take over the business of a manufacturer and caster in brass, gunmetal, aluminium, phosphor bronze, and other non-ferrous metals, carried on by M. T. Higgins at 28-32, Totterdown-street, Tooting, S.W., as the "Alumina Foundry Company," and to adopt an agreement with A. D. Hunter for the acquisition of a secret process for the manufacture of an alloy of alluminium and/or other non-ferrous metals known as "Ossorum Metal." Subscribers (each with one share): A. D. Hunter and F. A. Dandor. Subscribers to appoint first directors. Qualification, £250. Remuneration not more than 5 guineas each per meeting attended. Registered office, 28-32, Totterdown-street, Tooting, S.W.

Rock Safety Geysers, Ltd. (179 512). Private company. Registered Feb. 6. Capital, £300 in 1s. shares. Electricians, &c. Subscribers (each with one share), Ivy E. Fisher and W. T. Hick. Subscribers to appoint the first directors. Qualification, £5. Solicitors, R. S. Shackleford, Broad-street House, E.C.

Skirving Rutherford Institute, Ltd. (179 499). Private company. Registered Feb. 4. £500 in £1 shares. To carry on the business of medical electricians, makers of and dealers in reclining electric light baths, and other apparatus. Subscribers: W. Skirving Rutherford, and Amy Bernard. Registered office: 17, Bishops-road, Paddington, W.

Alfred E. Walker (Loughborough), Ltd. (179 543). Private company. Registered Feb. 8. Capital, £2 500 in £1 shares. To take over the business of a painter, decorator and signwriter, carried on by A. E. Walker at 16, Devonshire-square, Loughborough, Leics., and to carry on the same and the business of electricians, electrical engineers, &c. First directors, A. E. Walker (permanent managing director and chairman whilst holding 200 shares) and A. H. Walker. Remuneration until first general meeting, A. E. Walker £6 per week, A. H. Walker £5 per week. Secretary, A. H. Walker. Registered office, 16, Devonshire-square, Loughborough.

COMPANIES INCORPORATED OUTSIDE THE U.K.

Particulars of the North-East Service Inc. have been filed pursuant to Sec. 274 of the Companies (Consolidation) Act. The capital is $25 000 in $100 shares. The company was incorporated in the State of New York on Nov. 17, 1920, to carry on the business of dealers in electric motors, dynamos, electric supplies, &c. The British address is London. W. Frost, of 179, Queen Victoria-street, is authorised to accept service of process and notices. Directors: J. W. Tracy, C. W. Coopman, J. S. Fitch, and V. M. Swan, all of Rochester, N.Y. File number 2 069 F.

Particulars of Unipressure, Ltd., have been filed pursuant to Section 274 of the Companies (Consolidation) Act. The company was incorporated in Jersey on Oct. 8, 1921, with a nominal capital of £50 000 in £1 shares, to adopt an agreement with G. Le Marchand and to carry on business as financiers, concessionaires, miners, mechanical and electrical engineers, suppliers and transmitters of electricity and electric energy for lighting, heating power, telegraphic, telephonic, or other purposes, general agents, &c. Directors: A. S. Elmore, The Grove, St. Lawrence, Jersey engineer; R. H. Bingham; F. W. Brackett; and Dr. Friedrich Esser. The British address is 701, Salisbury House, E.C. 2, where J. A. Stocker, chartered secretary, is authorised to accept service of process and notices on behalf of the company. File number, 2 066F.

Catalogues, Price Lists, &c.

The Cheltenham Works, Ltd., are circulating a new edition of their illustrated catalogue containing details of Relmac and Super Reno lathes and accessories.

The latest trade price list of M.K. wall plugs and sockets, issued by the Heavy Current Electric Accessories Company, shows a reduction in prices of from 14 to 25 per cent.

Special features of the "Ediswan" primary batteries are given in the leaflet published by the manufacturers, the Edison Swan Electric Company. A useful list of addresses of the company's twenty-four depots is given on the last page.

Peyton & Peyton, Ltd., have issued a supplementary catalogue and price list of their latest electric light fittings. The Sloan Electrical Company, which represent the firm in the London district, the West of England, and on the South Coast, will be pleased to send a copy of the catalogue on application.

An illustrated catalogue of the Kestner Patent Water Tube Boiler has just been brought out by Ransomes, Sims & Jefferies, Ltd., who, as we announced in our issue of Jan. 6, have been appointed sole manufacturers and licensees in the United Kingdom, the Colonies and Dependencies, South America, Dutch Indies, and China.

The Clyde Electrical Company have published a list of their "Clydelco" cable sockets, which are made to conform to B.E.S.A. specifications. The advantages claimed for these sockets are that they are considerably heavier than those at present on the market; they are pressed from solid drawn copper tube, and are heavily tinned all over. The prices range from 1s. 3d. to £4 15s. per dozen.

"Notes on Automatic Telephony," issued by the Relay Automatic Telephone Company, is a nicely got-up pamphlet, setting out some of the advantages of automatic telephones in comparison with the old-fashioned systems still in use in many places. Points to interest the business man are dealt with, demonstrating the reason why the "Relay" automatic telephone is "the system of to-day and of the future." A number of interesting illustrations are given.

Simplex Conduits, Ltd., has issued a supplement (List No. 3) to their general catalogue of conduit and conduit fittings. It is solely a provisional means of giving the current prices, as, in the course of the next few weeks, the firm hope to issue a new and complete edition of the catalogue. Particular attention is drawn to the recent introduction of certain distinctive features in the Simplex conduit. For instance, every length of conduit, after being finally approved, is now marked with a distinctive red label: and every length of screw conduit sent out is fitted at one end with a screwed coupler, and at the other end with a cap of suitable material completely covering and protecting the clean threads which are cut after the enamelling of the conduit.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MEWBURN, ELLIS & CO., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

COMPLETE SPECIFICATIONS.

140 451 SIEMENS-SCHUCKERTWERKE GES. Means of changing the poles of four-phase windings of alternating current dynamo-electric machines. (30/6/17.
141 364 INDUSTRIAL RESEARCH CORPORATION. Electrical generating systems. (8/4/19.)
142 105 LINCOLN ELECTRIC CO. Electric arc systems, and particularly electric arc welding systems. (26/2/15.)
145 436 SIEMENS-SCHUCKERTWERKE GES. Protective arrangements for alternating-current systems. (20/12/18.) (Additions to 138 867.)
148 964 GES. FÜR NAUTISCHE INSTRUMENTE. Electrical contact device. (11/5/16.)
149 205 MYLO, E. Inclined carbon lamp provided with magnetic regulations of the arc. (28/6/18.)
149 920 AKT. GES. BROWN, BOVERIE ET CIE. Apparatus for starting single armature converters from the alternating current side. (16/8/19.)
151 962 WESTERN ELECTRIC CO., LTD. Repeaters for high-frequency electric signalling systems. (30/9/20.)
160 431 FORSHEE, J. K. Electrodes. (18/3/20.)
160 730 BOUCHEROT, P. Electric relays especially suitable for wireless telegraphy. (24/3/20.)
161 548 MEGERLE, E. Electro-magnetically operated sounding horns and the like. (10/4/20.)
166 518 METROPOLITAN VICKERS ELECTRICAL CO., LTD. Electrical controllers. (15/7/20.)
168 723 CLIFFE, J. W., & RUTTER, T. B. Automatically operated electric switch mechanism for use in connection with cinematograph apparatus to cut off the current in case of breaking of a film. (30/6/20.)
168 741 WEST & CO., LTD., A., & PAGE, G. Contacts for electric switches and other circuit closing devices. (12/7/20.)
168 804 IGRANIC ELECTRIC CO., LTD. (Cutler Hammer Manufacturing Co.). Controllers for electric motors. (2/11/20.)
168 812 WICKETT, J. H. Electrical treatment of ferreous metals during casting. (3/6/20). (Divided Application on 154 711.)
169 191 HOLSLAG, C. J. Electric arc welding systems. (25/3/20.)
169 199 CLOVER, H. K Electric faucets. (18/5/20.)
169 208 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Systems of Electrical control for dynamo-electric machines. (20/5/20.)
169 239 TWISS, G. V. Fittings for electric pin insulators and the like. (17/6/20.)
169 243 LAZARUS, S. A. Telephone instruments. (18/6/20.) (Cognate Application 6 285/21.)
169 246 IGRANIC ELECTRIC CO., LTD. (Cutler-Hammer Manufacturing Co.). Charging-appartus for electric-storage batteries. (18/6/20.)
169 250 RADIO COMMUNICATION CO., LTD., & LEA, N. Production of electrical oscillations by means of thermionic valves. (19/6/20.)
169 257 STOCKWELL, E. J., & FALK, STADELMANN, & CO. Method of securing metallic contact or electrical continuity between unscrewed tubes and fitting in conduit wiring systems. (21/6/20.)
169 280 COATES, W. A., DAVIES, D. R., & METROPOLITAN-VICKERS ELECTRICAL CO., LTD. Electrical switch-gear. (22/6/20.)

APPLICATIONS FOR PATENTS

November 19, 1921.

30 907 SULLIVAN. Duplex, &c., telegraphic systems.
30 930 SCHIERWATER. Electric smoothing irons, kettles, &c.
30 935 ASPDEN. Incandescent lamp holders.
30 959 ENGLISH ELECTRIC CO. Packing device for use between fixed and rotating parts.
30 968 B. T.-H. Co. (G. E. Co.). Electric heaters.
30 973 MARKS (S. A. A. E. Soc. Anon.). Protecting devices for electric installations.
30 983 LAWSON. Electric bells, gongs, &c
30 984 AYMARD. Electrically operated horns.
30 993 BROWN. Electrical recording and reproduction of sound.
30 994 MARKS (S. A. A. E. Soc. Anon.). Multiplication of phases of a.c. network.

November 21, 1921.

31 006 HYLAND. Portable electric lamps.
31 014 PILKINGTON. Electric transmitters.
31 021 RAILING, OWEN & QUANCE. Insulated connector for electric conductors.
31 027 SYKES. Electro-magnetic apparatus for recording sound.
31 033 FULLER. Storage battery containers
31 043 SHEARER. Electric ignition timers or distributors for internal combustion engines.
31 057 CRUICKSHANK. Electrodes or anodes for prevention of corrosion in boilers, &c.
31 069 MÜLLER. Excess voltage cut-out.
31 080 CHAMBERLAIN & HOOKHAM & JAMES. Instruments for measuring wattless component of alternating currents
31 083 ELLIS & VINES. Electric heat radiators.
31 095 AUTOMATIC TELEPHONE MFG. CO. Telephone instruments. (7/12/20, U.S.)
31 096 CARLES. Apparatus for overcoming effects produced upon telegraph, &c., lines by vicinity of s.p. currents. (4/3/21, France.)

November 22, 1921.

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31 225 B. T.-H. Co. (G. E. Co.). Electric instruments.
31 229 MYERS. Automatic switches.
31 249 WESTERN ELECTRIC CO. Switches. (26/11/20, U.S.)
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31 270 WEEKS PHOTO-ENGRAVING CO. Apparatus for electrical etching. (2/4/21, U.S.)
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Notes of the Week.

"The Electrician" Sixpence Again.

Beginning with next issue, the annual subscription to The Electrician will be reduced from 52s. to 25s., and single copies will be obtainable at 6d. instead of 1s. each. Existing subscribers will receive immediate benefit from these reductions by having the unexpired balance of their subscriptions spread over an additional period, the exact length of which will depend on the amount of prepaid subscription standing to their credit on March 1. The Electrician has long been regarded as an impartial mirror of the doings and views of the electrical industry as a whole. The electrical industry, perhaps more than any other, is dependent for its progress on constant research and investigation, and it is felt that the conclusions of scientists engaged in such work, as well as questions of policy and the latest news, should be available to every student of electrical matters at a price suited to his purse, be it fat or be it slender. The Electrician contains, week by week, information which is absolutely indispensable to its readers. Indeed, for the man who takes his profession seriously it is not a question of whether he shall or shall not read it: he knows perfectly well he must read it if he is to keep abreast of the times. The appeal of The Electrician has been greatly widened during the past few years, and abundant evidence reaches us that in its present form the paper provides just the medium of expression which members of the electrical profession and industry everywhere are seeking.

The Institution Jubilee.

Once again The Electrician has distinguished itself by being in advance of the times—in this case nearly twelve months. For in our issue of May 13, 1921, we called attention to the fact that on May 17, 1871, was held a meeting which resulted in the formation of the Society of Telegraph Engineers, and to the development in subsequent years of this small body into the Institution of Electrical Engineers, with a Royal Charter and a membership of over 10 000. We confess that at the time we were surprised that we were almost alone in celebrating this event, and that the Institution itself took no particular steps to mark its birthday. It now appears that though May 17, 1871, was the true date of birth, the first council meeting was only held on June 30 of that year, while several months were spent in collecting materials for the meeting of the opening session, so that the "working life" of the body did not begin until February 28, 1872. While it may be argued that any body has a perfect right to celebrate its anniversaries when and how it pleases, it may also be pointed out that the policy adopted on this occasion creates a new terror for biographers. In accordance with this law a man's career starts, not with his birth, but with the beginning of "his working life"—rather a nebulous milestone. This foreshortening will often deprive us of much entertainment, and will add both simplicity and complication to the preparation of the chronicles of the men and doings of future times.

Fathers of Electrical Science and Industry.

In arranging the Jubilee Commemoration of the Institution the Council took a wise course. For history and tradition were the foundations of the meetings that have been held this week. The lessons that can be learnt from the remarks of the various speakers are that the enterprise, foresight, and optimism of the pioneers—qualities which have assisted much to make the electrical industry what it is to-day—will be required in ever greater measure in future, as the hill we have to climb seems to become ever steeper, and the field that it is our duty to till opens ever more and more upon our view. Prof. Fleming spoke pointedly and instructively on the theme of Faraday, a name which will ever be honoured among electrical engineers as connoting all that is best in human nature, whether it be considered from the point of view of the scientist or the man. Subsequent speakers, while dealing with their

own experiences, did honour to KELVIN, CLERK MAXWELL, BRIGHT and SIEMENS, to take as typical the many names that are household words in the electrical industry. Especially do we commend the remarks of Mr. WORDINGHAM on HOPKINSON, a man who, as FARADAY was the father of electrical science, was the father of the modern electrical industry. It is by considering the work, no less than the personality, of such men that electrical engineers may gain encouragement to deal with the tasks that lie before them. In this connection we should do well to remember, as the "Westminster Gazette" reminds us, that "The Institution of Electrical Engineers is our own," though we welcome the idea that "its celebration of its fiftieth birthday is a matter which the world at large may well be inclined to share with us." In fifty years the Institution of Electrical Engineers has erected a great tradition. It is for electrical engineers of the present to do all they can to increase the brightness of its glory. It may then be said that the commemoration was a great success, and that the only regret of those present was the forced abstention of the PRESIDENT from the proceedings. The commemoration was Mr. HIGHFIELD'S idea. He must console himself with the fact that he is not the only creator who has failed to see the culmination of his work.

The Revision of Electro-magnetic Laws.

IN a Paper recently read before the Franklin Institute, Dr. CARL HERING points out that some so-called "universal" laws require restatement. At all events, experiments can be devised which apparently violate some of the rules of electromagnetism. One old and well-known law, given in every text-book, is that "like currents attract and unlike currents repel.' Dr. HERING contends that the law so stated is incorrect. Interpreted literally, it would lead to the inference that the current density in a conductor was greater at the centre than at the periphery, and, further, that in an electro-plating bath there would be a denser deposit at the centre of the anode that at the edges. This is not the case. The law should accordingly be reworded to state that attracting and repelling forces act on the conductor, not the current *per se*. Another interesting problem is the "pinch effect," *i.e.*, the tendency of a liquid conductor carrying a sufficiently high current to contract at the centre, breaking the circuit. The contraction is accompanied by marked movement of the liquid conductor in the direction of the axis, and there appears to exist a self-produced stretching force, which is utilised in electric furnaces to expel the molten metal. There is also evidence of a force tending to stretch a conductor axially, thereby tending to increase its length, and its existence can be illustrated by experiments with mercury troughs.

Maxwell's Law Doubted.

SOME physicists maintain that all electromagnetic forces influencing a conductor must of necessity be perpendicular to its axis, not axial. The observed effects, however, require some explanation. Dr. HERING also questioned the usual version of MAXWELL'S familiar law, based on the alteration of the magnetic flux in a circuit. He has devised circuits which, when unlinked, give no induction because the circuit cuts the flux, but the conductor does not. This distinction Dr. STEINMETZ has attempted to observe in a new version of the law. A number of other ingenious experiments are described in Dr. HERING'S paper. All indicate some degree of revision in the usual wording of electromagnetic laws. Dr. HERING, however, appears to have evolved one general law, "that a current-carrying circuit will tend to produce any and only such motions of its conductors as will produce a counter E.M.F. somewhere in that circuit" (though not necessarily in the moving part). We commend the Paper to the notice of educationists, who may find some of the experiments, mostly easy to repeat, a valuable aid in promoting knowledge of the principles underlying electromagnetic phenomena, and possibly as an indication that a revision of the customary wording of rules and laws is desirable.

Electric Traction—A Distribution Question.

IN the course of the discussion on Mr. F. P. WHITTAKER'S Paper on "Rotary Converters with Special Reference to Railway Electrification," Major A. M. TAYLOR delivered an oration on single-phase and direct-current traction from what may be called the mains engineer's point of view. It is true that his remarks were not very closely connected with rotary converter design, nevertheless they were highly interesting, and as pressure on our space, caused by the Textile Issue, prevents our dealing with the Paper this week, they may be referred to here. This is Major TAYLOR'S argument: For the section of railway between, say, London and Birmingham, 1 500 V is nothing like a high enough pressure to employ, as, with the present traffic, the natural and proper spacing for the sub-stations would be thirty-six miles, and at that voltage no sub-station could economically feed a length of more than six miles, and even then there would be a transmission loss of 10 per cent. In other words, to deal with a total train load of 6 000 kW, 36 000 kW of sub-station plant would be required, of which, under the worst conditions, only 6 000 kW would be in active operation.

The Advantages of Single Phase.

ON the other hand, by employing single-phase traction at 11 000 V, only three static sub-stations would be required, with an aggregate capacity of 6 000 kW, at one thirty-sixth of the price that would be necessary for direct-current traction. Thus, though a little efficiency on the locomotives might have to be sacrificed, there is every argument for employing single-phase rather than direct-current for main line working. We agree. But we must also point out that Major TAYLOR'S comparisons are not quite fair. According to him, traffic between London and Birmingham consists only of express passenger trains. But at both ends there is a fair, and growing, suburban traffic, while the freight load, a most important factor, must not be neglected altogether. Taking these additional influences into consideration, it could be shown that an aggregate sub-station load factor would be much better than that given by Major TAYLOR, though his arguments in favour of single-phase on the rural sections would equally stand. We are glad this point has been raised, for it is often forgotten in traction discussions. The sub-station and distribution problems are just as important as the locomotive and track equipment, and are more purely electrical questions.

Yorkshire Electric Power Progress.

A SATISFACTORY account of progress and of development was placed before the shareholders of the Yorkshire Electric Power Company at the annual meeting on Tuesday. Though the company, whose area of supply is a mining and industrial one, was seriously affected by the coal strike, yet its net revenue is about £10 000 more than in the previous year. Notwithstanding the strike, the output was practically the same as in 1920, but under the operation of the coal clause there was a decrease in consumers' charges and also in revenue. However, the economies effected in generation and distribution more than counterbalanced this drop in revenue, with the result that the directors have been able to pay the same dividend (eight per cent.) as in 1920

on a largely increased capital. In addition, there is the same allocation to reserve and a larger amount is carried forward. This is an excellent record for a year full of difficulties, and it reflects the greatest credit upon the policy and management of the company.

Projected Extensions.

The chairman, Mr. A. G. Lupton, referred in cautious though confident terms to the inquiry into the organisation of electricity supply in the Aire and Calder district, and he announced that the directors had in mind the provision of a full and economical supply of electricity for all industries in the West Riding and for electric traction when the railway companies needed a supply. The growth of the company will shortly involve the erection of a new power station at Ferrybridge and the laying of heavy trunk mains. For these purposes and for plant extensions at Thornhill and Barugh and other works, the company want more capital, and therefore an issue of preference shares is being made. The terms of the issue are attractive, and as the prospects of the company are so good we have no doubt the public will subscribe the money as readily as for recent electrical issues. In fact, electricity supply securities are now looked upon with particular favour, and we are confident that the investing public will be justified in their choice.

The Company's History.

Though the company's revenue in 1905, the first year of its operation, was only about £1 000, the figure has now grown to nearly £370 000, every year bringing increased revenue and profits. There are now 440 miles of mains, and during the past year extensions of mains and substations have been made for giving a bulk supply to the Corporations of Dewsbury and Todmorden and to the Urban Councils of Elland and Honley. Arrangements have also been made with Sheffield and Rotherham for joint working in the interests of cheap supply. These facts prove conclusively that the company is facing its public responsibilities in the right way and in the right spirit, for with closer co-operation between the various supply authorities in the District the era of a cheap and abundant supply of electricity, so essential to industrial progress, will be brought within reach, and when this happens there will be a reduction of production costs, bringing in its train increased output and prosperity to the West Riding and to the country as a whole.

The Owner's Risk Scandal.

The principle of heads I win, tails you lose, which is generally applied in dealings between Government Departments and private individuals must now be extended to dealings with the railway companies, for the judgment delivered by the House of Lords last week in the case of Smith *v.* The Great Western Railway Company proves conclusively that redress cannot be obtained for the loss of goods carried on railways at the owner's risk rate. The dispute arose over a parcel of goods handed in at Birmingham for delivery at Wilton, but not only did the goods never reach their destination, but all trace of them was lost. As our readers are aware, an owner's risk contract relieves the railway company from all ordinary risks except on proof of wilful misconduct by its servants, so that, as Lord Buckmaster pointed out in the course of his judgment, even the apparent protection of the trader is illusory, for it is exceedingly difficult to prove wilful misconduct, especially as evidence of such misconduct must rest exclusively with the railway company. In practice, therefore, railway companies may carry goods or lose them as they choose, and traders have no redress.

A Premium on Pilferage.

The matter is of more than usual consequence at the present time, when goods pilferage has increased enormously, a practice which is not likely to be suppressed until transport undertakings are compelled to take greater care of the goods entrusted to them. But the present is also an opportune time for a change in legislation, for equitable provisions could be inserted in the amalgamation schemes under the Railways Bill which will shortly be before Parliament. If this is not done we fear that matters will go from bad to worse, as the larger the undertaking, the greater its inertia. The Federation of British Industries, the B.E.A.M.A., the British Engineers' Association, and other trade organisations would do well to take the matter up so as to compel the companies to take some responsibility for their servants' acts. This could best be done by altering the law to throw upon the companies the burden of proving that reasonable care has been taken by them and their servants in the handling of goods.

"Heaviside" Reprinted.

Matured readers of The Electrician will be interested to learn that Benn Brothers, Ltd., have made arrangements to reprint a small edition of Oliver Heaviside's "Electromagnetic Theory." The edition will be limited to 250 copies, and the three volumes will be sold only in sets, at a price of five guineas net. Aeronauts in the upper air of electrical theory are aware that this work has long been out of print in a complete form. Its value, however, is undiminished, and to those engaged in wireless research its unobtainability is a loss which our publishers are now about to make up. It may indeed be said that, like wine, "Heaviside" improves with age, and we are glad to see that the date of its publication figures in the "Brief Chronology of Electrical Discovery and Invention" which has been issued by the Institution in connection with the Jubilee celebrations.

The Industrial Future in India.

Even those who do not take a close and expert interest in Indian matters know that that country is at present a storm centre. That this should be so is not unnatural. For though India escaped from the main influences of the war, the clash of the conflict and the spread of education have in recent years disturbed the even tenor of its immemorial way and are, in fact, the heralds of profound changes in both political outlook and industrial development. Of the political aspect of these changes it is not for us to speak, but as Dr. J. F. Crowley shows, in an article which we publish on another page of this issue, the industrial fact of this change is one which engineers, and especially electrical engineers, will soon have to contemplate and to which, therefore, they should lose no time in giving their undivided consideration. Especially is the problem one of power. For while India is mainly agricultural, in its large towns industry is growing and in this issue it is particularly interesting to note that the production of textiles is rapidly increasing.

Hydro-Electric Power in India.

Now power in India means wealth, and we have, therefore, often wondered at the comparatively slow progress made in the development of hydro-electric power in that Empire. Though vast resources are available, as the hydro-electric survey of the Government has disclosed, only a small percentage is as yet being utilised. Several grave obstacles to progress provide an explanation of this. Among them

are obsolete laws, bureaucratic methods and conservative native customs. This is clearly brought out in the paper read by Mr. A. T. Arnall, before the East India Association, which appears in abstract on another page of this issue, and in the article by Dr. Crowley to which we have already referred.

Legislative Amendments Necessary.

It is clear for instance that amendments of the Acts relating to the acquisition of land and to the supply of electrical energy are necessary to bring about a desirable stimulation of hydro-electric development. At present before a water power concession is granted the Local Government insists upon the submission of a definite scheme, and before land can be acquired there is a preliminary inquiry to ascertain whether the land is " needed for the construction of some work," and whether the work is " likely to prove useful to the public." If both questions are answered in the affirmative the promoting company must enter into an agreement with the Secretary of State for India in Council, which contains the conditions on which the land is held. There is no definition of a public utility undertaking in the Act, and, as usually happens when there is no standard of comparison to serve as a guide, the interpretation of Government officers differs widely, with the peculiar result that it is at present doubtful whether electro-chemical and other subsidiary industries which would greatly assist in the development of a large hydro-electric scheme would be covered by the provisions of the Act. Great obstacles are placed in the way of transmission schemes where power to supply in the area traversed has not been obtained.

Working in the Dark.

As power developments depend upon private enterprise it is necessary that the conditions on which land can be acquired should be quite definite and known to the investing public before the flotation of a company. At present the public are asked to subscribe to a power company on the concession of the Government, and it is only after this that the Agreement with the Secretary of State for the purchase of land can be drafted and signed. It is therefore not surprising to learn that there has been little eagerness on the part of financiers to invest their capital in these enterprises.

Some Other Obstacles to Progress.

Other obstacles in the path of the hydro-electric pioneers in India are the absence of the right to pay suitable interest out of capital during the construction period, and the terms upon which an undertaking can be purchased. At present a registered company may pay interest not exceeding four per cent. on its paid-up share capital, but this rate is quite inadequate under present conditions, and as private bill legislation is unknown in India, the only way out of the difficulty is to amend the Indian Companies Act of 1913.

Compulsory Purchase Difficulties.

As regards purchase, the local authority or the Local Government has the option of purchasing compulsorily a licensed undertaking after a period not exceeding fifty years at the fair market value of the lands, works and plant, but excluding the " generating station," unless the latter is declared in the licence to form a part of the undertaking for compulsory purchase. Apart from the fact that it is not clear what the " generating station " of a hydro-electric scheme would include, this " concession " is quite inadequate to attract capital except in a limited number of cases where there is a good local demand for power. As is well known, it usually requires about five years to construct such works, and subsequently some years are needed to develop the domand for electricity so that the remunerative life of a concession would, under present conditions, be less than forty years. It is clear, therefore, that the Government must revise its policy without delay and grant concessions for water-power development which will be more attractive than they have hitherto been. That is, of course, if they want such development to take place. The best way to do this would be to appoint a Committee upon which would be placed not only those who are familiar with Indian conditions, but those who have had up-to-date experience of modern power generation and transmission problems.

Bombay Cotton Developments.

How necessary this is is shown by the fact that over 130 water-power sites were disclosed by the Government water-power survey, and it is estimated that there is a total of 1 774 000 continuous electrical horse-power in sight, though even this is only a small fraction of the actual available power. The total capacity of the existing hydro-electric plants is only 91 325 E.H.P. and 148 750 E.H.P. is under construction. Out of this total 79 per cent. is for the supply of power to Bombay city, the centre of the cotton spinning and weaving industry in India. Already the great majority of the mills in this area use electric power, and as the hydro-electric schemes promoted and managed by the Tata Company will ensure an abundant supply of cheap power to the city, considerable development is likely to take place in the next few years. The Tata companies will eventually be capable of supplying 915 000 E.H.P. for 3 600 hours a year at a maximum of $\frac{3}{4}$d. a unit. So great is the demand for power that one of the companies (the Andhra Valley Power Supply Company), though not yet in a position to give a supply, has contracted with the mill owners for the whole of its output at 0·735d. per unit. Its generating plant consists of six 8 000 kW sets and energy will be generated at 5 000 V, 50 cycles and transmitted at 10 000 V to the city where it will be transformed down to 2 000 V, the standard pressure for local mill driving.

Further Reasons for Encouragement.

There is a further reason for the encouragement of trade in India in the bold bid which is being made by other countries, especially Japan and the United States, to capture the import market. As it is the curves which Dr. Crowley give show how the textile industries are growing, while even the iron and steel industries and heavy engineering manufacture are on the upward grade. Apart from power, however, sociological conditions need special study. The weavers in the State of Madras claim to be of the Brahmin caste, and cannot be induced under any circumstances to work in factories. This at present rules out the use of the electric drive, though with more education and modified conditions that may come in time. Handspinning is, however, uneconomic, and here therefore lies a great opening for modern methods. There are, it is obvious, ample problems for solution, and it is to be hoped that the Indian Government will tackle them in a public-spirited way. There is the more reason for this as such developments will increase the earning powers of the country, and by increasing prosperity blunt the weapons of the agitators whose only object is to do harm. Given his way on the other hand, the engineer can do the greatest good. There can be no difference of opinion, therefore, on the choice of course to be taken.

Helping the Textile Industry.

This issue of The Electrician is the fourth which we have specially devoted to a consideration of the application of the electric drive to the operation of textile machinery. On this occasion the question is dealt with on the broadest lines by various contributors. Mr. W. J. H. Wood, of Bolton, discusses the various factors which will enable a mill owner under present conditions—which are very different from those of a few years ago—to decide whether he should use the electric drive in his mill, and whether, should he decide in favour of the electric drive, he should obtain his supply from the public supply mains or from private generating plant. Mr. A. W. Stevenson deals with the electric driving of Scottish woollen mills. These mills are a class of textile factory where special conditions rather favourable to the electric drive are present, principally for the interesting reason that water has long been used as a source of power. The presence of water, however, encourages rather than rules out the use of electricity supply, as will be apparent from the article on the installation at Ballantyne and Company's Walkerburn mills, which appears on another page of this issue, and from the details which Mr. Stevenson gives of the equipment in P. and R. Sanderson's mills at Galashiels.

Textiles and Hydro-Electric Storage.

In the former mill water-wheels were used for over sixty years to supply the necessary power, but owing to extensions, the inefficiency of the transmission within the mills and the hydraulic losses it was decided as soon as the necessary rights could be obtained to adopt electricity supply obtained from modern water turbines for driving the machinery. To do this economically meant the solution of a number of interesting problems, and especially did it necessitate the storage of power on lines which the Severn Barrage Scheme has made familiar. Fortunately, topographical conditions made this possible, and the result is a most interesting scheme on which the millowners and the contractors, Boving & Company, are equally to be congratulated. Though this is not primarily a textile question, the way in which this work is carried out is a gratifying indication that the possibilities of the employment of what water power we possess are not being neglected.

Textiles and Daylight Standards.

The problems of the textile manufacturer do not, however, stop at the spinning or weaving of the material, matters with which we have dealt exhaustively in former textile issues. There remains the great difficulty of dyeing the product, and beyond that again the even greater difficulty of selling it. With dyeing, as dyeing, the electrical industry has not much concern, except that we may express the hope that the work and enterprise which has in recent years been put into attempts to recover a lost industry will not fail of success. But one of the chief problems of dyeing is not so much to colour the material, as to colour it to an exact tint which can be reproduced with accuracy as often as may be required. Modern tastes for variegated and brilliant colours, both in dress materials and in furnishing, therefore impose a dual problem on the textile manufacturer—the production of a hard-and-fast colour and its accurate matching with material of the same colour that has been placed on the market or used as a sample. This problem is not simple. For one thing, it is immensely complicated by the limited nomenclature used to identify colours and tints. It is further complicated by the fact that there is no standard illumination for matching purposes, and that fabrics of certain colours present quite a different appearance in artificial light from what they do in daylight.

A Standard of Illumination Necessary.

Some standard of illumination which shall be stable, and shall correspond as closely as possible to "north-sky" illumination is required. The problem has received a good deal of study, and, as Mr. Dow shows in his article, is now in a fair way to be satisfactorily solved. In quite another way than in the matter of driving can electricity be of use to the textile industry, for such artificial daylight can obviously only be obtained by electrical means.

Electricity as a Factor in Production.

The information which we publish in this issue will, we hope, therefore interest, if not convince, the textile manufacturer of the advantages of using the many ways in which electricity can help him to cheapen his production and thereby the more readily to sell his product. As is only too well known, the textile industry is passing through a period of grave depression. The cost of production is high, raw materials and selling prices follow suit, and demand naturally dwindles. Under such conditions, to advise the textile manufacturer to embark on fresh expenditure for motors and other electrical equipment is rather like offering the man who requires bread a suit of clothes. But there is this about a suit of clothes given to a starving man—it can be turned into money. Equally would the adoption of the electric drive mean money to the textile manufacturer, and the relief from burdens which are inseparable from the use of steam plant. Nor must the gain to the amenities of the Lancashire towns and the improvements in the health of the workers which would be made possible by this means be forgotten.

The Electric Heating of Mills.

All this is clear enough from Mr. Wood's careful analysis of the various methods of driving and power production that the textile manufacturer may employ. From the electrical point of view the matter is complicated by the need for steam in the textile factory. To remove the boilers, therefore, is to deprive the manufacturer of a commodity that he needs, and at once mitigates the use of electricity supply, at any rate when it is drawn from the public mains. But as Mr. Wood hints, even for heating textile mills, it is possible to use electricity, and we shall look forward with interest to the publication of the details of the installation in which this is done.

The Electrical Industry in a Strong Position.

Fortunately for real progress, the electrical industry is in a stronger position with regard to the textile issue than it was twelve months ago. For one thing, the prices of supply are falling, though this movement might well be accelerated. For another, the generating plant in the central stations is no longer overloaded, and deficiencies are rapidly being made up. For a third, electrical manufacturers are in a position to give speedy deliveries of the necessary equipment. All these, in conjunction, should result in steady progress. As Mr. Wood points out, there is no need to exaggerate the claims of the electric drive. It is not perfect, but it is a good deal better than anything else, and it can give advantages to the textile manufacturer which are obtainable in no other way.

The Textile Industry and Public Electricity Supply.

By W. J. H. WOOD,
Manager, Bolton Corporation Electricity Department.

The textile manufacturer, Mr. Wood points out, wishes to be convinced that in adopting the electric drive he will gain advantages which cannot be obtained in any other way. The problem has many sides, and Mr. Wood considers the particular cases of an existing steam-driven mill changing over to the electric drive and of a new mill; and in both cases the relative economies of private generation and public supply. The heating problem, which is in many cases the determining factor, is shown to be capable of solution by electrical means.

Only those who dwell in industrial districts, and especially in Lancashire, within a fifty-mile radius of Manchester, can fully realise the advantage it will be to the general community if the long-promised, and so much talked-of, cheap and abundant supply of electricity materialises, and is generally applied, as a form of energy, for all industrial purposes.

It is only necessary to stand and observe, from some of the heights of the beautiful, rugged moorlands, so often to be found within a few miles of the centres of industry in Lancashire, fully to appreciate the enormous advantage it would be, from a health point of view, quite apart from any commercial consideration, to remove that depressing blanket of smoke which hangs like a pall over the vista at one's feet.

Lancashire's Staple Industry.

It must be generally known to readers of THE ELECTRICIAN that the staple industry of Lancashire is cotton spinning and the resultant textile trades. Consequently it must be equally well known that Lancashire, as the home of the textile industry of the world, must also present great possibilities for improvements in power production. The greatest advantages to all are, of course, those resulting from a centralisation of power and a cheap and abundant supply of energy, for all purposes, so essential to every manufacturer. Consequently the subject of electricity supply, as applied to the textile industry, much as we have heard of it during recent years, must be of interest not only to the electricity supply engineer, but to the manufacturer of electrical machinery, and especially to the user of energy—the textile manufacturer.

Those who have had experience in pushing the sale of electrical equipment for textile purposes, and those who have canvassed the manufacturer to become a user of electrical energy, perhaps alone fully appreciate the difficulties that have been overcome, to attain even the present-day demand for electrical driving in this industry.

A Cheap Supply of Power Essential.

The Lancashire textile manufacturer is generally a shrewd business man who knows what he wants. One of the chief things in which he is interested is a cheap supply of power for operating the machinery he uses to manufacture the textile goods he deals in, whether it is cotton or any other industry connected with cotton. Whether this power is supplied to him from an outside source, or whether he produces it himself, depends upon how much it will cost him to produce, compared with how much it will cost him to buy.

Although in very many instances the stumbling-block has been prejudice against something new, yet it must be admitted that, in most cases, it has been due to the cost. It has been impossible for the seller of electrical equipment and the producer of electrical energy to convince the textile manufacturer that it would pay him to buy power rather than to produce it himself. Hence we are still constantly faced with such remarks as: "Yes, I should like to drive my mills by electricity, but it is much too expensive as compared with steam." And yet, is it too expensive as compared with steam driving?

The Proof of the Pudding.

Surely the maxim that the proof of the pudding is in the eating is applicable here, because in every part of Lancashire—and we are dealing with the textile industry, whose home is Lancashire—if there is an efficient public supply authority available, there is an increased demand for electricity for textile mill driving, and the number of factories already equipped is proof that it must pay the user. On this point there can be no possible argument, for if it did not the Lancashire cotton-spinner would have "nowt" to do with it.

Many who are not conversant with the conditions obtaining in a modern well-designed and laid-out cotton mill are inclined to underrate the high standard of efficiency that is obtained from the power-producing plant, and one very often comes up against a snag when negotiating for a supply of electrical energy to drive a modern mill already equipped with a modern steam engine running at its most efficient load and under the most favourable conditions.

It is equally true that in many instances, and especially in the case of old-established concerns, antiquated steam engines and boilers are found still grinding out the energy required for operating the factory. But the conclusion is soon reached that there are many steam-power plants in use whose owners will take a great deal of convincing that it will pay to convert and buy electrical energy from a public supply authority.

Does it Pay to Take a Public Supply?

The question is often asked whether it pays the textile factory owner to drive his works electrically, and to purchase the energy from a public supply authority. In answering this question there are many factors to consider and conditions to investigate, because in almost every case these vary. Consequently the question as to whether it pays depends entirely upon the capital outlay involved, the state and performance of the power plant already installed, the adaptability of the factory to electrical driving, and, most essential of all, the price at which energy can be purchased from the public supply authority.

The Advantages of a Public Supply.

Let us, therefore, consider the advantages of a public supply of electricity for the purpose of textile mill driving. So many articles have been written at different times, and so many arguments have already been used, that it becomes difficult to treat the subject with any degree of originality; but the fact remains, providing a public supply of electricity is available at a figure to-day round about a 1d. per unit, it does pay to use it. Not only will the textile manufacturer find that the annual capital charges on the electrical equipment are less than those on a steam-driven plant, but there is also a saving in operating costs.

In the case of an electrically driven mill the space occupied by the electrical equipment is negligible, as compared with that required for boilers and auxiliaries, engine, buildings, reservoirs, &c. This allows considerably more productive, or manufacturing, machinery to be installed on the same ground space. Another outstanding advantage of purchased energy is that the power is delivered at the point of use, consequently friction losses are cut down to a minimum; and, further, the supply being switched on and off as required, the user only pays for what is productive, all stand-by losses being eliminated. The energy required is always available, and the question of providing spare plant does not concern the user, the supply authority relieving him of that responsibility. The consumer is not interested in the many difficulties that arise in running a central power-producing plant, such as obtaining fuel supply, labour complications, breakdowns and other troubles.

The Reliability Factor.

Reliability must be a main feature of the public supply, and, therefore, the public generating station carries spare plant, which is always ready for use in the event of break-

down. And no matter what happens at the station, or what difficulties the supply authority may have to contend with, it does not concern the consumer. For, as he is prepared to pay for the energy he uses, this must be available whenever he chooses to operate a switch.

It is often difficult to obtain from the textile manufacturer any reliable figures of the operating costs of his power-producing plant, or, rather, of what factors he includes when comparing them with the cost of purchased energy. In comparing the cost of purchased energy with the cost of self-produced power, all capital and standing charges on plant, reservoirs, buildings, &c., must be included, as well as repairs and maintenance costs, wages, stores, insurance, rates, and, of course, fuel, cartage of ashes, and water. The purchase price of electrical energy is the net cost of power delivered at the factory, practically at the point of usage, to which must be added the capital and standing charges, and only those items quoted above which apply.

A Definite Example.

Let us take the case of the manufacturer owning an old-established works, who finds it necessary to replace an obsolete steam engine and boiler-house plant, because, owing to many years of service, these are no longer competent efficiently to supply the power required. Naturally, it occurs to him that, as he has to renew the whole, or anyway the larger part, of his steam-power plant, the time is opportune to consider purchasing electrical energy, and he makes inquiries to determine whether it will pay him.

In order to make a comparison at prices obtaining to-day, let us assume that the net cost of electrical energy purchased is 0·75d. per unit, with coal at 20s. per ton, and for a demand equivalent to 1 000 H.P. indicated on steam engine, and 2 350 running hours per annum. The cost of coal, to the mill owner, being 25s. per ton, including the cost of handling and removing ashes.

Assuming that the existing engine and boiler-house buildings, with minor alterations, will be suitable for housing the new steam plant, then it is reasonable to estimate that the cost of the new engine, boilers, economisers and auxiliaries, together with the cost of alterations to foundations, rope drive, &c., will amount to £18 700.

The complete electrical equipment required for this mill, including the necessary sub-station and motor tower, with switchgear, cables, alterations to gearing, and coupling up, will amount to £10 500. This shows a saving of £8 200 in capital expenditure, or, say, £820 per annum. The estimated running costs, taking into account fuel, labour, oil, stores, water and maintenance and capital charges, amount to £7 032 per annum in the case of the steam plant, as against £6 797 per annum, the cost of purchased electrical energy, plus wages, stores, maintenance and capital charges, showing a saving of £235 per annum, making a total saving in favour of purchased energy of £1 055 per annum.

The Case of the New Mill.

Then there arises the case of the new mill, which it is proposed to build on a suitable site within reasonable distance of a railway siding, with ample land available for condensing water reservoirs, &c. Again a comparison has to be made as to whether it will pay to install steam-power plant or to purchase energy from the public supply authority. The proposition is rather different, although in effect similar to that dealt with above. For comparative purposes let us assume that the horse-power required will amount to 1 500 I.H.P. and the purchase prices of electricity and coal are the same as before.

In this case, starting on an entirely new scheme, it is possible to design the lay-out of the steam-power plant and the electrical installation in such a manner that the greatest efficiency would be obtained from either. In addition to the engine and boilers, &c., the estimated capital outlay will have to include, for engine and boiler house buildings, a chimney and foundations, a rope race, together with rope drive and gearing, a condensing water reservoir and pipe connections, at a total estimated cost of £36 960. The electrical equipment required will be as before, excepting that it will have to be of greater capacity, and plant must be included for steam heating, so that the estimated cost of the scheme amounts to £16 375. So that we show a saving on capital expenditure of £20 585, or, say, £2 058 per annum.

The operating or running costs of the steam plant, taking all charges into account, will amount to £10 700 per annum, as against a running cost of the electrical scheme of £10 218 per annum, showing a saving in running costs, and, added to the annual saving on capital, making a total of £2 540 per annum.

The Private Generating Station.

Then we have a third case, where the manufacturer who is erecting a new factory may already be aware of the advantages to be derived from electrical driving, and is considering installing his own private electrical generating plant. Where an efficient public supply is available there is no difficulty in proving that it will not pay to install a private electrical generating plant. The capital outlay involved in electrical equipment for the actual motive power for driving the manufacturing machinery is the same in both cases, and it is therefore a matter of comparing the purchase price of electrical energy with the standing and capital charges on the complete private generating plant, buildings, &c., plus the running cost of such plant.

If the manufacturer is determined to produce his own power, then by all means let him use the ordinary steam-engine drive, and leave electricity out of the question, always assuming that the alternative of a reasonable public supply is not available.

The Heating Question.

It is assumed that in each of the foregoing comparisons the cost of steam for mill heating has been included, which brings us to consider this most important subject.

When a textile factory, or mill, has been converted from steam to electrical driving, and especially in the case of a new factory, equipped in the first instance for electrical driving from the public supply mains, there is always the difficult problem of heating the factory to be overcome. As readers of THE ELECTRICIAN know, it is essential in the case of cotton spinning that a certain even temperature should be maintained at all times, and, as a rule, this is effected by means of steam heating throughout the factory. There is considerable diversity of opinion with regard to the amount of steam required for mill-heating purposes, and this is quite understandable, as it so much depends upon the design of the factory, its locality, and the particular quality of yarn manufactured, the temperature in some cotton mills having to be maintained higher than in others. The fact remains: textile mills must be artificially heated, and, consequently, if a steam-driven mill is electrified, or if a new mill is built for electrical driving, some provision must be made for heating.

In the case of the converted factory, part of the existing steam-raising plant, as a general rule, is retained for mill-heating purposes, and in the case of the electrically driven mill a special heating boiler has to be provided, so that really the manufacturer, even after deciding to adopt purchased electrical energy for driving purposes, is not entirely free from the inconveniences appertaining to boiler-house plant, which he still has to retain purely for heating purposes.

The Electric Heating of Mills.

The writer is of the opinion that in order to obtain the fullest advantage of purchased electrical motive power in cotton mills it is necessary to go a step further, and heat the mills electrically. Although the ordinary methods of electrical heating, we know, to-day are costly, and may not be comparable with the cost of heating by means of steam, the fact cannot be overlooked that there is an urgent demand for some efficient method of electrically heating electrically driven textile mills, and it is a question requiring the fullest investigation.

The price at which energy can be purchased is certainly

one of the governing factors, but, seeing that mill-heating is chiefly required at night, or after the ordinary running hours of the industrial load on the generating station—in other words, it is a heating load which tends to improve the load factor of the electricity supply undertaking—it would be possible to offer special low rates for a mill-heating supply. As a matter of fact, if electrical energy is purchased on the maximum demand plus unit charge basis, the actual units used for heating purposes after ordinary working hours would be charged for at the unit rate only, as the maximum demand charge would already be provided for during the ordinary working hours, and the effect would be a reduction in the average price per unit for the whole supply to the mill.

An Electrically Heated Mill.

The writer has been concerned in the installation of equipment for electrically heating a cotton mill, and although, owing to the general disorganisation of the cotton trade, it has not yet been possible to obtain reliable figures of the cost of operating the plant over any length of time, the experiment so far has proved to be most satisfactory.

The cotton mill is the usual type of about 68 000 spindles, and special attention has been given to the question of supplying each floor with purified and humidified air, by means of a very complete ventilating and humidifying system, such as is found in any modern well-equipped mill. The electrical heating system has been specially designed to work in conjunction with the ventilating system, and for this purpose specially designed heating elements, or radiators, have been installed on each floor of the mill, in the main air ducts supplying each room.

The heating elements are made up in suitable groups, or units, each of 40 kW capacity, and in sufficient numbers to heat up to the desired temperature the purified air required, special attention having been given to the control of the radiators. These are automatically switched in and out, within certain desired temperature limits, and they are also arranged to switch off automatically in the event of the ventilating fans being stopped for any purpose, to prevent overheating when no air is passing through them. Arrangements have also been made that at night, or during the time when it is not essential to have a supply of fresh air, there is a continuous circulation of heated air throughout the factory, on a closed system, and due to the effect of thermostatic control, a constant temperature is maintained.

The experiment is being watched with keen interest, and, if commercially successful, will overcome what is now a difficulty to the textile manufacturer who electrifies his mill—the question of heating.

Labour Conditions and Electricity Supply.

The tendency during recent years has been to reduce the number of working hours in the textile and other trades, and, in fact, reductions have been made. Whether the result has been, or will be, beneficial to the industry as a whole remains to be seen. It has certainly not tended to reduce the price of electrical energy, which, to a large extent, must be governed by the load factor of the supply, as, naturally, it is more efficient to run the generating plant on a steady, even load, twenty-four hours a day if possible. In this case the capital or standing charges on the plant are covered by the greater number of units generated, consequently tending to cheapen the supply.

Of course, it is known that existing factory regulations do not permit of overtime being worked in cotton mills in this country, but it is difficult to see why shift working, covering twenty-four hours a day, should not operate in the textile industry, especially as cotton spinning is a continuous process. The capital and standing charges on any mill or works must be paid for twenty-four hours a day, so why not work the plant during the same period, and increase its revenue-earning capacity proportionately?

Labour, surely, has nothing to fear, because it will actually increase employment, as it would certainly double the number of hands required, and the output would be doubled, at a considerably lower cost of production.

Advice to the Supply Authority.

In conclusion, let the public supply authority study the requirements of the user, and especially the cotton spinner, to whom a cheap and reliable supply of electrical energy is essential if he is to continue holding the field for cotton goods, in competition with other countries, which are daily gaining ground in the textile markets.

On the other hand, it is the duty of the manufacturer to take advantage of the public supply of energy offered, especially in view of the fact that it will pay him to do so, and to co-operate with the supply authority, so that the latter can use his plant to the greatest advantage, thereby tending to cheapen the price of the commodity.

Centralisation of power production means coal saving, and it is essential, in the national interest, to economise coal, because it is our natural source of energy, and, in fact, the capital of the country, limited in quantity. From the point of view of the health of the people, one has only to observe the clearness of the atmosphere over an industrial area after a holiday week stoppage to realise the better living conditions that would obtain if our industries were supplied with power from central producers instead of from individual plants.

Common Battery Telephony Simplified.*

By W. H. GRINSTED.

Since 1912, when the first edition of Mr. Atkins' book was published, the modern manual exchange plants with which the telephone services of London and all our large towns are conducted have been pretty well standardised. There has been little change in principle, but much has been done to consolidate and unify practice. Mr. Atkins deals with only one branch, namely, the circuits, and has taken the opportunity of a new edition to include the changes in that branch. The scope of his book is thus limited, but the treatment is thorough. As many as 157 diagrams are included illustrating the essential elements of the numerous circuits associated with a common battery exchange.

We feel that there is something lacking in this method of explaining the operation of an exchange plant. The electrical arrangements are brought out clearly, but we are left with a very vague idea of the construction of the various pieces of apparatus and their positions on the switchboard and in the exchange building. Those who are employed in exchanges and are familiar with the arrangement of the plant will probably not experience this difficulty. They will desire to study particularly how the apparatus is associated electrically, and in this respect they will find Mr. Atkins' book most useful. The fact that four editions have been called for is evidence that they have found it useful in the past.

Practically every circuit met with in manual common battery practice is described, including subscribers' instruments, extensions and private branch exchanges. The explanation of the C.B. instrument circuit is better than those given in other text books, but is based, as usual, on direct-current principles. Why not treat this as an alternating-current circuit, as it really is? The circuits of desk and testing equipment are dealt with fully.

Diagrams and explanations are in general clear, but more careful revision, keeping in mind the case of the reader ignorant of telephone practice, would have improved the book. For example, in Figs. 5, 6 and 9 the same lamp is successively referred to as the "home or line lamp," "calling lamp," "home lamp," and in Chapter III., in describing Fig. 6, it is called the "answering lamp." On p. 67 the following sentence occurs: "As this relay is in the speaking circuit it has an additional non-inductive resistance to allow the speech currents to pass." The convention used for the relay in the diagram does not show the windings. The reader without prior knowledge will not easily deduce that the non-inductive resistance is added in parallel with the inductive winding. The examples on p. 128 are by no means clear, and in one case "amperes" is misprinted for "milliamperes." Fig. 64 is incorrectly drawn. These and similar cases of loose expressions and minor mis-statements are small but definite blemishes which should be carefully removed in a future edition.

The printing is very good and the binding excellent, almost too good for a technical work of this class. Is this the cause of the increase in price to 8s. 6d.? For a book of limited scope such as this it is a very high price, which will tend to restrict its sale among junior students of telephony.

* Common Battery Telephony Simplified. Walter Atkins. (London: Benn Brothers, Ltd.) 4th edition; pp. 139. Price 8s. 6d.

Electric Driving in Scottish Woollen Mills.

By A. W. STEVENSON, B.Sc. (Edin.), Wh.Ex.
(British Research Association for the Woollen and Worsted Industries.)

The author generally considers the conditions which obtain in the Scottish woollen mills. This is a localised industry in a district where water-power is often available in sufficient quantities or can be economically supplemented by the public electricity supply. The claims of steam driving under these conditions are considered and the various processes necessary to produce the finished wool product are described in detail.

THE outstanding feature of the Scottish woollen industry is the number of comparatively small mills engaged in the making of high-class cloths, in most cases from pure new wool. The bulk of the product finds its way to West-End tailors, though a considerable proportion is exported to America and to tropical countries, and before the war there was also a large trade with Germany, Austria, and the Balkans.

The majority of the mills are located on the Tweed and its tributaries, but the name of the staple product does not originate from the river, but from the misreading of the word "tweels" on a consignment note many years ago. The mills of the north and west work, as a rule, the rougher tweeds, but vicunas are made at Elgin and best overcoatings at Aberdeen, to name two exceptions.

Sometimes spinning, weaving and dyeing are carried on by separate firms, but a more general rule is to find the whole process, from fleece to fabric, carried on within the same gates.

Power Sources—Water.

At one time water was the only power, and for this reason, and to obtain a supply of scouring water, all the older mills were located on streams. In most cases power requirements have far outstripped the low-fall water supply, though a few mills are still driven mainly by water. There is usually a steam engine as a stand-by for drought or frost, and, in some cases, this engine is run continuously for governing purposes, carrying perhaps 10 per cent. of the load. Many more mills could be driven by water-power at the cost of a few miles of electrical transmission, and last year's strike has made many manufacturers wish to be less dependent on coal.

A firm at Walkerburn,* on the Tweed, has put an interesting scheme into operation recently. The river water being of large volume and low fall, direct storage was out of the question. While the mill is standing, the river turbines are used to pump water to a reservoir on the top of a neighbouring hill, 1 000 ft. up, this water returning when the mill is running to a Pelton wheel, in parallel with the river turbine.

A Hawick firm obtain more from their water-power in a different way. During the day a considerable portion of the mill is driven from the public supply by a large d.c. motor, and at night, when the town lighting load is on, this motor runs as a dynamo in parallel with the power-station engines.

Public Electricity Supply.

In a few towns public electricity supply is available, mostly direct current, which is not too suitable for textile purposes. Nevertheless, Hawick, from its d.c. supply, runs three-quarters of the hosiery warerooms, woollen spinning and weaving mills in the town. Galashiels is more fortunate in having a three-phase supply laid down specially for mill requirements. The supply network has recently been extended to Selkirk, and will in time be extended to some of the other manufacturing towns.

The Position of Steam Driving.

Whether the transmission is mechanical or electrical, steam still holds a strong place as prime mover in woollen mills, for the very good reason that most mills require steam for other purposes than power. Where there is a dye-house the steam for process purposes may exceed that used for power. There is here a good field for the pass-out or heat-extraction engine or turbine, or, where public supply is available to supplement the steam power, a plain back-pressure engine or turbine. As an alternative to a generator in parallel with the public supply, one or more of the larger motors might be of the simplified synchronous type, and a simple two-cylinder high-speed engine coupled to each, the throttle being, of course, controlled by the pressure in the exhaust main.

Existing Millgearing.

While individual driving has strong claims where capital is available, most existing mills, and some new mills, will be group-driven, in the former case by using the existing millgearing as far as convenient. In the older mills the drive was invariably by spur gear from the engine to the second-motion shaft, and from this to the other main shafts

FIG. 1.—MOTOR WITH CHAIN AND BELT REDUCTION DRIVING MILL-HOUSE SHAFT.

by bevel gearing, upright and "lying" shafts. In the newer mills, and, by alterations, in many of the older ones, ropes have superseded gearing. Where the shaft speed is so low that double reduction is already necessary an existing rope pulley may be utilised for the motor drive, but even then the diameter of the motor rope pulley is liable to be much smaller than that given by the well-known "thirty diameter" rule. Silent chains form a good drive when the ratio is suitable, *i.e.*, when the shaft speed exceeds 150 revs. per min., or where the cost of an eight- or ten-pole motor is not objected to. Most shafts will be found to run under this speed, common practice being 130 revs. per min. for weaving and finishing, rather less for spinning, and 80 revs. per min. for carding. Millhouse shafts sometimes run as slow as 55 revs. per min. Such speeds mean double reduction, even with a slow-speed motor, and probably the most efficient combination is that of silent chain and belt. Using a belt for the second drive on to the lineshaft gives both freedom in the original alignment of the motor and protection against subsequent movement.

* *See* page 229 of this issue.

The intermediate shaft should be carried in the base-plate of the motor. Alternatives to the chain are worm- and spur-gear drives, but the former are of doubtful efficiency at low loads, and the latter, unless enclosed in an oilbath, are noisy and far from durable.

Wool Scouring, Willeying and Teasing.

The wool from the bales, after being sorted into its various grades, is passed slowly through long tanks of soap solution, the excess liquor being squeezed out under heavy rollers fixed on the end of each tank. After being dried, either on racks or in a mechanical drier, it is opened out in the willey or teaser before going forward to the carding machines. In some mills, willeying precedes scouring and teasing follows it. Oil is applied to the wool either

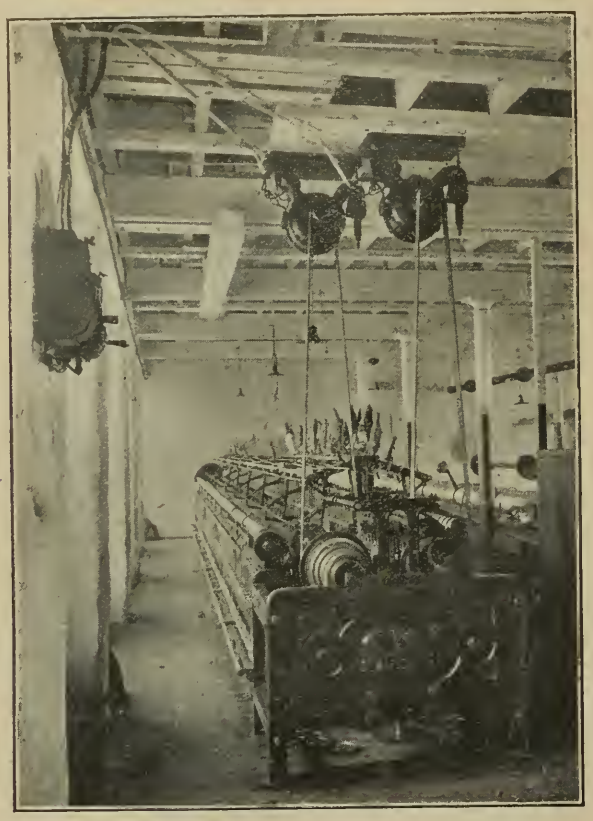

Fig 2.—Individual Driving of two sides of Twisting Frame.

before teasing or by an attachment on the teasing machine, and, for fire prevention, willey and teasers are frequently in a separate building. Direct-current motors and the slip rings of induction motors should be totally enclosed for the same reason. As in carding machines, the drive is heaviest at starting, though the ratio of starting to running torque is not quite so high. Wool scouring is a fairly light drive, but the motors should have damp-proof impregnation.

Carding.

In the carding process the wool fibres are separated from one another, cleaned, remixed and placed more or less parallel, perhaps rather less than more. There are usually three machines in series, the essential feature of each being one or two "cylinders" about 4 ft. in diameter and 5 ft. long, running at 80 to 90 revs. per min., and surrounded by a number of small rollers—"workers" and "strippers." All these are covered with fine wire teeth, and run a few thousandths of an inch clear of each other, the clearance diminishing as the wool progresses. The delivery from the first two machines is in the form of a loose rope or "sliver," which either passes over a small conveyer ("Scotch feed") to the next machine, or is wound in a "ball," sixty balls being placed in a "bank" to supply the next machine of the series. When the ball and bank feed is used the machines are independent of one another, but where the Scotch feed is used the machines so connected must keep the same speed ratio throughout the day. From the third machine of the series the wool is delivered in a large number of small slivers, each containing sufficient wool to make one strand of yarn. To give this small sliver more cohesion it is rubbed between leather aprons, which oscillate cross-wise while travelling forwards, this part of the machine being known as the "condenser." The most modern form, and the heaviest to drive, is that in which the slivers—twice as many as in the older types—are each carried on a narrow leather tape, but it has not found great favour in the high-class trade.

The old millwrights' rule for a set of cards was 10 H.P., but this is well on the top side. Five or six would be nearer the mark, with a starting torque of two to three times normal.

Spinning.

Spinning is almost entirely by mule, the woollen ring frame finding only a limited application. The action of a woollen mule, or, for that matter, any spinning mule, looks almost human in its complexity. The "condenser bobbins"—about 5 ft. long and 8 in. in diameter—from the carding machines are mounted on the stationary part of the mule, part of which is the "headstock" containing the gearing and clutches for the various motions. The moving part or carriage bears the spindles. In the first part of a cycle the carriage runs sharply out, sliver being delivered from the bobbins during the first half of the run. During the second half the sliver, or rather the partially made yarn—for the spindles have been running all the time—is drawn out, the thick parts, curiously enough, stretching most. At the end of the outward travel the speed of the spindles is greatly increased, the carriage remaining stationary or moving slightly inwards in response to the shortening of the yarn as twist is put in. When twisting is completed the spindles are given a few reverse turns to release the loose coils from the spindles, the carriage moving out again a few inches, this time by power. The final operation of the cycle is to return the carriage to the starting point, the spindles being driven slowly in a forward direction to coil on the completed length of yarn under guidance of the faller wires.

An Irregular Power Curve.

It will be obvious that such a cycle of operations gives rise to a very irregular power curve, the highest peak being three or four times the average. Further, steadiness of speed during the spinning period is very important in the high-class fine yarns common in the Scottish trade. Individual driving is well worth while, but, if for reasons of economy group-driving is installed, the groups should be as large as possible. Even with a large group there is always the possibility of a number of mules getting into synchronism, causing severe variations in speed, and even pulling the motor out of step. The practice occasionally adopted of driving the mules in pairs from one motor is the worst possible, as a peak load from one mule, due to the acceleration of the spindles or the running in of the carriage, is bound sometimes to occur during the spinning period of the other mule, when it is essential that the speed should be undisturbed.

Twisting, Winding, Warping.

Twisting or doubling is invariably done on ring frames, usually known as "throstles." The load is a steady one, and fairly heavy. Practically all the yarn is rewound between spinning and weaving, warp yarn being wound in "cheeses" or on large double-ended bobbins, and weft yarn on pirns somewhat similar to those used on the mule, but of smaller bore and more tightly wound. Most winding machines are light, steady drives. Warp mills, which wind the yarn in proper sequence on the loom warp beams, take up a large amount of space, but are quite light.

Weaving.

Space does not permit description of the fundamental mechanism of the loom, and, in any case, it is common to

all textile trades, and familiar to most engineers. The typical loom of the Scottish trade has a 90 in. "reed-space," or maximum width for material, and puts in 90 to 100 picks or "shots" of weft per minute. This is not always the speed of the driving pulley, as there is often a bevel or spur reduction gear embodied in the loom. Shedding, or movement of the warp threads for correct interlacing, is invariably by dobby, this having usually capacity for twenty-four shafts or healds. Picking is always of the "under" variety, and the shuttles for fancy coloured wefts are carried and controlled by drop boxes, usually with four compartments each. The favourite makes are Dobcross, Hattersley and Hodgson. The actual power taken by these looms is sometimes over 1 H.P., but about half this is a sufficient allowance in group driving. For individual drive they are a fairly tough proposition, though less so than the heavy Jacquard looms of the Belfast trade, which have been successfully dealt with by at least one firm. The Scottish field would appear to be a good one, as, in addition to the well-known advantages of regularity, beneficial in so high-class a trade, there may be a substantial saving in power. As pointed out by Dr, Crowley some years ago, the saving in power with individual driving increases rapidly as the percentage of standing time of the machines driven increases. A fancy loom has more and longer stoppages than a loom weaving plain goods, and all the time it is standing its little bit of shafting, its belt and its loose pulley are absorbing power in a group-drive scheme.

FIG. 3.—MOTOR WITH DOUBLE REDUCTION DRIVING WARP MILLS (BACKGROUND) AND WINDERS (FOREGROUND).

Scouring and Milling.

After leaving the loom the "piece" undergoes inspection, also picking and darning—hand processes. From these it passes to the "mill-house" for scouring and milling. Scouring machines take a heavy torque at a slow speed—about 50 revs. per min., the horse-power being about three. Milling machines, or "box mills," take considerably more power at higher speed, and, in addition, are a somewhat jerky drive. In a few mills the old-fashioned fulling stacks, or "wauk mills," large wooden hammers, lifted by cams like tilt hammers, are used, but most firms whose work requires this type of milling use "fast stocks," in which the hammer heads are driven positively. Where both milling machines and stocks are installed they are to some extent alternative processes, and need not be provided for simultaneously in a group drive. Most mill-houses have a hydro-extractor, which is a good case for individual drive, preferably by a self-contained motor.

Mill-house motors must have damp-proof impregnation, starters, slip-rings and d.c. machines being totally enclosed.

Finishing.

Leaving the mill-house partially dried, the pieces are fully dried and stretched to width on the tentering machine. The power taken by this machine is from 2 to 3 H.P., but its location often makes it worth a motor of its own, which should be placed outside the tentering-room, the temperature inside often reaching 180° F.

The finishing house contains an assortment of machines, varying with the class of trade, all very light to drive, and seldom all running. The cropping machine, or "Yankee," which cuts the loose fibres much as a lawn-mower cuts grass, is the chief item in most finishing sequences, some pieces returning to it several times. Other machines are brushes and raising gigs, both of which vary widely in design. Steam blowing machines, fitted with a vacuum pump, are fairly heavy to drive, but not so much so as the pulleys on some would indicate. Pressing is invariably hydraulic, with belt-driven pump.

FIG. 4.—FINISHING FLAT DRIVE WITH RAISING GIG IN THE FOREGROUND.

Photographs.

The illustrations accompanying this article show some of the driving arrangements adopted in the conversion to electric drive of Tweed Mill, Galashiels, belonging to P. and R. Sanderson, one of the leading firms in the Scottish tweed trade. The drive was previously from a Corliss steam engine through the usual gears and ropes, but is now electrical throughout from the mains of the Galashiels and District Electric Supply Company through a 6 600/500 V transformer. It was converted from steam to mechanical drive in 1914 by Dr. J. F. Crowley, the plant being installed by Siemens Bros. Dynamo Works (now The English Electric Company). The installation is remarkable for the arrangement of the drives and the large amount of shafting that was eliminated in the conversion through careful attention to lay-out details. There are over twenty motors in the installation, ranging from 1 to 37 H.P. in output.

Artificial Daylight.

Its Applications in the Textile and Dyeing Industries.

By J. S. DOW.

In this article the author considers the development of "artificial daylight" and how the advances that have been recently made, especially the invention of Chance's "daylight glass" and the Sheringham daylight, are likely to be of use in the textile and dyeing industries.

"Artificial daylight," like many other new developments, was the subject of early pioneering work in this country, was afterwards subjected to comparative neglect, but has recently been taken up *de novo*. The idea of modifying the spectrum of artificial illuminants so as to secure a quality of light closely resembling daylight in colour-revealing qualities was first applied to the arc lamp. The

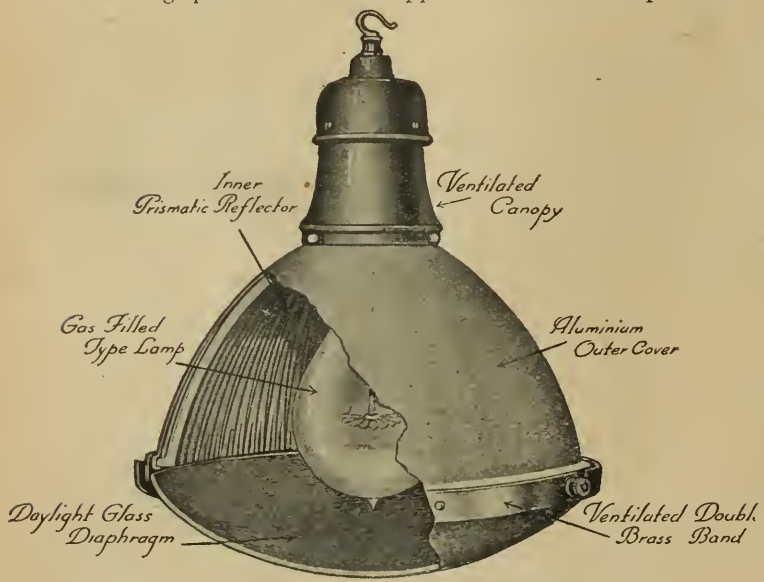

FIG. 1.—SHOWING COMPONENT PARTS OF HOLOPHANE DAYLIGHT UNIT.

Dufton-Gardner lamp, in which light from an arc is transmitted through a special tinted glass, originated in 1895, and is stated to have been used to a considerable extent by dyers. Mr. A. P. Trotter, in a contribution in the "Journal of the Institution of Electrical Engineers" in 1892, also dealt with the problem. The idea of applying a suitable tinted screen to the carbon filament incandescent lamp was obviously scarcely practicable owing to the low efficiency, small candle-power, and the yellow tint of the light, which would involve considerable absorption in the conversion process. However, a metal filament lamp equipped with a tinted gelatine screen, stated to give very faithful reproduction of daylight, was shown before the Illuminating Engineering Society in 1912, and attempts were also made to manufacture metal filament lamps with blue glass bulbs for the same purpose.

Possibilities not Realised.

For some years, however, the idea of obtaining artificial daylight from incandescent lamps was little developed. Probably the candle-power available and efficiency were still inconveniently low, and the possibilities of artificial daylight were not sufficiently realised. With the coming of the gasfilled lamp, with its whiter light, higher efficiency and higher range of candle-powers, the work was taken up again, chiefly in the United States, where quite a variety of "daylight" fittings, equipped with special blue-tinted glass, were developed. According to Mr. Luckiesh, about 15 000 "north-sky" units were already in use in the United States in 1920. The method of grading units in degrees of accuracy had also been adopted.

Chance's Daylight Glass.

In this country the manufacture of suitable "daylight" glass for use with gasfilled lamps has been energetically taken up by Chance Bros. & Company and others, and such glass has recently been incorporated in the Holophane daylight unit, a view of which is shown in Fig. 1.

The lamp is enclosed in a Holophane aluminium-covered reflector terminating in a shallow diffusing tinted glass dish. A curve issued by the company showing the resemblance between the corrected spectrum curve, and that of average daylight, is shown in Fig. 2.

Mr. F. E. Lamplough has recently stated that with a 500 W lamp an efficiency of 40 per cent. is obtained with a thickness of Chance glass giving the correction to average daylight preferred by dyers. Where very great accuracy is desirable, the interior of an upper reflector may be painted with heat-resisting blue pigment, and a somewhat thinner bowl of daylight glass used. This is stated to to have relatively little effect on the over-all efficiency.

Sheringham Daylight.

An entirely different method of obtaining artificial daylight is adopted in the Sheringham daylight, which has been described recently before the Illuminating Engineering Society. In this case the conversion of the light to a resemblance to daylight is effected, not by *transmission* through tinted glass, but by *reflection* from a suitably coloured upper diffusing surface, placed above the lamp. This surface takes the form of a large shallow reflector, all direct rays from the lamp downwards being screened by a bowl, with silvered inner surface, placed beneath it. The Sheringham daylight is thus an indirect lighting unit, with the wide diffusion of light characteristic of such fittings. The design of the coloured surface of the upper reflector involves the use of three pigments, selected with a view to permanency and heat-resisting qualities which have been the subject of much study. The main part of the surface is occupied by ultramarine blue. Originally small discs of emerald green, and a very few discs of vermilion were introduced on the blue field to obtain the desired

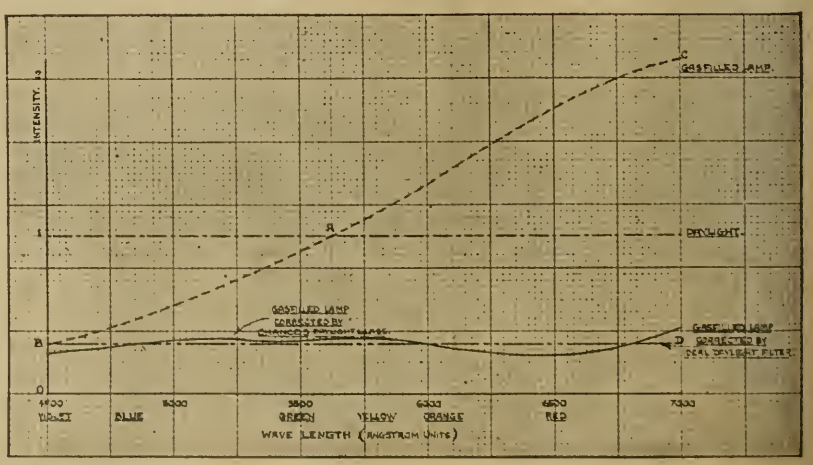

FIG. 2.—CURVES ILLUSTRATING THE APPROACH OF DISTRIBUTION OF LIGHT IN THE SPECTRUM OF THE HOLOPHANE DAYLIGHT UNIT TO THAT OF AVERAGE DAYLIGHT.

colour-correction. Later it was found that by substituting a yellow pigment (about 5 per cent.) for the small amount of red (about 2 per cent.) a more accurate imitation of daylight was secured. At the same time it has been found possible to obtain satisfactory colour effects with pigments

of smaller absorption, with the result that the amount of light obtained for a given consumption of energy has been approximately doubled.

The Fittings Employed.

Fig. 3 shows a general view of the usual pendant type of Sheringham unit. Fig. 4 shows a convenient form of portable unit for demonstration purposes. The small fitting at the side contains an ordinary unscreened lamp. By switching on either light alternately the difference in appearance of coloured objects may be conveniently noted.

The loss of light involved in the conversion of ordinary artificial light into "artificial daylight" is necessarily considerable. But the advantage of having a form of illumination suitable for colour-matching work that can be used at any time, night or day, irrespective of climatic conditions, is so great that this would doubtless outweigh the relative low efficiency in a luminous sense. Much consideration has been given to the degree of accuracy necessary in units of this kind. So far, experience with the best types appears to be favourable. They have been used for such varied purposes as dyeing, colour-printing, grading wheat and tobacco by colour, matching artificial teeth and preparing artificial eyes, &c. In the dyeing and textile industry, where a high degree of accuracy is required, the sacrifice of light in absorption is greater than in the case of units designed for work where only fairly good imitation of daylight is needed. For instance, accurate tests in dyeing works make greater demands in this respect than units employed for demonstration in showrooms and large stores devoted to coloured silks and fancy goods.

Standards of Correctness Necessary.

With a view to the future a common understanding on this point is highly desirable. Standards of correctness for artificial daylight should be arrived at, so that so-called "daylight units" can be graded according to the purpose they are intended to serve. This may be effected by a spectrophotometric examination of the light, supplemented by practical tests of the effect on dyed fabrics by colour-matching experts. One point recently emphasised by Mr. Lamplough is that a light may appear to the eye to resemble daylight very closely, but may nevertheless give quite misleading effects when applied to the testing of delicate shades of colour—especially if there are "kinks" at certain points in the spectrum. It is possible to find dyed fabrics which appear to the eye identical by daylight, but appear widely different under a "spurious" artificial daylight of this description; conversely, tints which are very different by day may be brought into apparent agreement under artificial illuminants.

Fig. 3.—General View of Sheringham Daylight Pendant.

At the same time it must be remembered that we have as yet no absolute standard of white light, and that the quality of daylight differs within wide limits at different times of the day and in different periods of the year. Daylight may be influenced by climatic conditions, and also by the addition of more or less coloured light reflected off surrounding objects, either within or without the room. A room devoted to accurate colour matching should therefore be lighted by a window that receives a clear view of the sky, and does not receive light reflected off the coloured wall of some adjacent building, or trees, &c. The interior of the room should preferably be decorated in neutral tints. Needless to say, windows encrusted with dirt also tend to colour the daylight admitted.

Advantages of Artificial Daylight.

The great advantage of artificial daylight is that, once adopted as correct and properly controlled, it should be subject to much less variation than daylight. Indeed, it has recently been stated that some dyers already consider artificial daylight preferable for this reason. The applications of artificial daylight in the textile industry are probably much wider than is generally supposed. Apart from the evident use of such apparatus in work where dyed fabrics are dealt with, there are some varieties of stain which are not readily detected by artificial light. By artificial daylight, however, it should be possible to distinguish much more easily when the process of scouring crude wool, &c., is complete.

Fig. 4.—Two-Unit Standard. Besides the Sheringham Daylight, a Small Lamp is mounted in a reflector at the side, so that either may be switched on and the effect on coloured objects compared.

Quality and Intensity.

In such processes it should be understood that not only the quality but the intensity of the light should be considered. One reason for the belief that natural daylight is essential for many processes is probably the fact that the intensity of illumination derived from daylight is so much greater than is readily obtained by artificial means. Hence the tendency is towards the use of high candle-power lamps, 500 or even 1 000 W types, with artificial daylight units, as in these circumstances it is practicable to obtain up to 50 foot-candles by bringing the light fairly near the work. Hitherto the flooding of an entire room with artificial daylight has rarely been attempted, though some picture galleries are said to have been lighted in this fashion. Provided considerations of economy are not paramount, general lighting of this kind is feasible. But it is more usual to aim at local lighting in a small booth, set apart from the rest of the room, and devoted to colour-matching. An enterprising merchant, for example, might well provide a series of such booths, equipped with artificial daylight and various forms of ordinary artificial lighting, in order that customers may compare the effect of dresses by daylight and artificial light. This is an important consideration in view of the fact that dresses for evening wear must be selected with a view to their appearance by electric or gas light. Artificial daylight units are now being introduced in a number of London stores, and in the United States their use on the counters of shops devoted to coloured goods of all kinds is already familiar.

The third section of the Report of H.M. Chief Inspector of Mines for 1920 states that 427 445 000 tons of coal were raised, of the value of £116 220 000, compared with 514 113 000 tons, of the value of £116 345 000 in 1919. The coal available for home consumption amounted to 185·8 million tons, and the quantity used for electricity generating stations (not including private stations) was 7 356 757 tons.

The Industrial Future in India.

By J. F. CROWLEY, D.Sc., B.A., M.I.E.E.

Dr. Crowley has recently returned from a twelve months' engineering and lecture tour in India and Egypt, when he visited most of the large industria concerns, hydro-electric plants, &c., and we are glad to have been able to induce him to give his impressions of a country that is so much in the public eye at present.

Remote as India was from the more serious and active operations of the war, it did not escape the many after-effects of that great struggle. Unrest, both political and industrial, interferes to some extent with development, while, at the same time, stagnant waters have been usefully stirred up, and India is to-day probably as alive to industrial development as most European countries.

Reference is made in the important Report* of the Indian Industrial Commission in 1916-18 "to the considerable change in public opinion regarding industrial questions brought about by the war, a change which we also see reflected clearly in the policy of the Government."

In considering the development of a country in accordance with Western ideas the first requisite is power. It has gradually come to be recognised that power is the primary need of an industrial community, and that the limit to the industrial development is usually set by the availability of cheap power.

Power Possibilities.

Generally speaking, the amount of coal available in India, relatively to the size and the needs of the country, is very limited, the chief sources being on the eastern side of the peninsula. To the north and west, on the other hand, lie many fine water-powers, those in the north being, on the whole, too remote from existing industrial activities to be of immediate value to existing industrial centres. There is at present some 95 000 kW of plant installed in licensed electricity supply undertakings in British India, fully 90 per cent. of this being in Calcutta and Bombay. The total number of units generated amounts to 235 millions per annum, and of this total one large hydro-electric undertaking provides nearly one-half. Some 56 per cent. of the electrical energy is generated from water, 41 per cent. being generated from coal. In addition to the installations in British India there are, including a large hydro-electric plant in Mysore, some 30 000 kW of plant for public electricity supply installed in Native States, from which 102 million units are generated per annum. From the above figures it is a natural and safe deduction that outside Calcutta and Bombay, with the addition of Ahmedabad and the great iron and steel works at Tatanaga, there are no really important industrial centres in India.

From the following extract from a recent Report† it would appear that Indian electricity undertakings are, on the whole, not in a flourishing condition:—

> The total working expenses allowing again for Rangoon are some 97 lakhs, or about 50 per cent. of the total revenue. This leaves a balance, before providing for depreciation, reserve, or a return on capital, of 97 lakhs, or 7·6 per cent. only. The report goes on to say that "the wonder is that the undertakings generally have been as successful as they have been."

It is not quite easy to understand this statement, at any rate so far as the larger and better-managed undertakings are concerned, as the Calcutta Electric Supply Corperation, for instance, are paying a dividend of about 11 per cent., the Bombay Electric Supply and Tramway Company pay 18 per cent., while the hydro-electric undertakings generally are doing very well.

Large Hydro-Electric Schemes.

Of these the largest is the Tata Hydro-electric Power Company, which supplies electric power to Bombay from water stored in the Ghats. This company paid a dividend of 7 per cent. in 1920. Small municipal undertakings, on the other hand, are not well managed, and in many cases pay no dividend at all. The existing water-power developments in India total slightly over 90 000 H.P., the Tata-Hydro-Electric Company, to which reference has been made, contributing 50 000 of this, and the Cauvery Power Scheme in the State of Mysore some 22 000 H.P. The remainder is scattered throughout Bengal, Bombay, Kashmir, Madras, the United Provinces, and the Punjab. The Cauvery Falls Scheme, which the writer had an opportunity of visiting, is a well-run undertaking, and the example in initiative it set might well be followed in other Native States. Two further projected schemes in the neighbourhood of Bombay are the Andhra Valley Scheme, totalling 65 000 H.P., and the Tata Power Scheme, with a total ultimate development of 150 000 H.P.

Possibilities of Development.

A systematic survey of the possible water resources of India is now being undertaken under the control of Mr. J. W. Meares, C.I.E., M.I.C.E., and the following estimate of the possibilities based on the so-far published reports, and taken from a recent Paper,‡ may be of interest:—

> The Indian water-power survey has up to the present disclosed the existence of over 130 possible water-power sites, of which, however, only a small percentage have been thoroughly examined. It is estimated that there is a total of 1 774 000 continuous electrical horse-power already in sight in India. This is vastly below the actual available power that the final results of the survey will disclose. Many millions of horse-power could certainly be obtained from the Himalayan Mountains and the great rivers of Burma. For example, the combined minimum discharges of the Indus, Chenab, Jhelum, Sutlej, Beas, Jumna, and Ravi Rivers amounts to over 36 000 cub. ft. a second where they enter the plains, which is equivalent to over 3 000 000 H.P. per 1 000 ft. of fall; and these rivers and the tributaries that feed them rise in mountains up to 20 000 ft. more in altitude.
>
> Similar considerations apply to the Ganges, the Sarda, and many rivers rising outside British India to the east up to the Brahmaputra, and again in Burma to the Irrawaddy and the Salween.

While, of course, it is not possible to agree that the total fall of a river should be taken in combination with its flow where it enters the plains as a basis for the power available, it is, however, equally true that the minimum discharge from the rivers referred to forms but a very small percentage of the maximum discharge, and that in cases where suitable storage can be arranged for, a much higher horse-power than that based on the minimum discharge may be looked for.

The general impressions created by the existing power conditions in India were:—

(*a*) That every encouragement should be given to the development of the available coal resources of India, in connection with which there has recently been some activity, big concessions being opened up in Bihar and Orissa.

(*b*) That steps should be taken in the use of coal to conserve it in the light of experience gained in other countries, and to reserve it, as far as possible, for metallurgical and other processes in connection with which there is no available substitute.

(*c*) That the development of water-power should be facilitated by simplifying and standardising the procedure in connection with the granting of concessions for the sites themselves, and for land acquisition in connection therewith.

(*d*) That a broader policy should be adopted by existing power undertakings so as to popularise to a greater extent the use of electricity from central supply stations.

Further Facilities Necessary.

As regards facilities for water-power development, attention should be drawn to the Paper, to which reference has already been made, in which the important suggestion is made that rules should be drawn up defining—

(*a*) The terms and conditions which properly belong to water-power concessions, and

(*b*) The terms and conditions which should properly be inserted in agreements for the compulsory acquisition of land for water-power schemes.

In connection with this matter, it should be noted that

* Report of Indian Industrial Commission, 1916-18, Superintendent Government Printing, India (Calcutta, 1918).

† Third Supplement to List of Electricity Undertakings in India, October, 1921. Govt. Central Branch Press, Simla.

‡ Hydro-Electric Power in India, by A. T. Arnall, M.I.C.E., East India Association, Feb., 1921.

the usual procedure for the development of a water-power site in India is first to obtain conditional prior claim to the power site for a period of three years, which carries with it the necessary authority to enable the promoters to frame a definite scheme of development for submission to Government with a request for a concession. On obtaining the

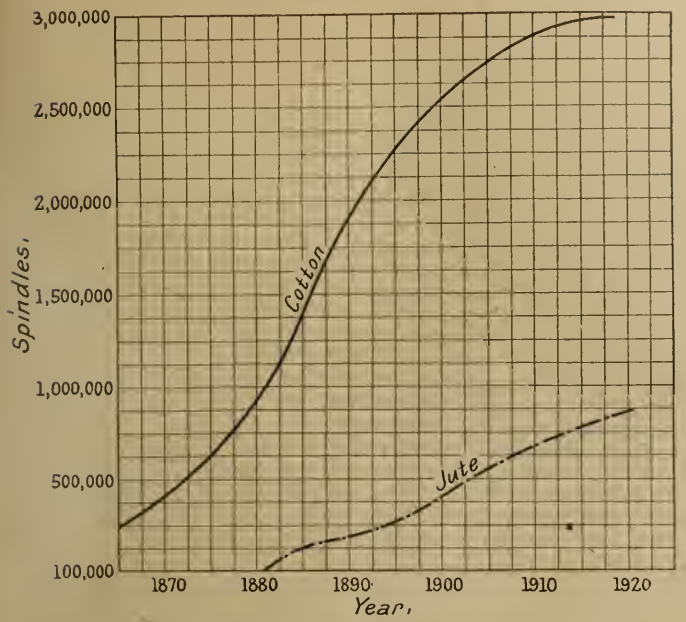

Fig. 1.—The Growth in Jute Spinning in India and in Cotton Spinning in Bombay.

concession the promoter can proceed with the flotation of a company to undertake the work.

Legislative Restrictions.

If, in order to secure the necessary land for the development, it is necessary to apply the provisions of the Land Acquisition Act, the concession should contain some sort of guarantee that the Act will afterwards be applied for that purpose. Further, there should be no doubt as to the terms and conditions governing the compulsory acquisition of the land under the Act, since before the provisions of the Act can be put into force the company must be formed. The company is formed on the basis of the concession granted by Government, and before applying the provisions of the Land Acquisition Act, an inquiry has to be held by an officer appointed by the Local Government to decide—

(*a*) Whether the "acquisition is needed for the construction of some work," and

(*b*) Whether the "work is likely to prove useful to the public."

If the Government officer reports in the affirmative on both points, then, and then only, can the company enter into the necessary agreement with the Secretary of State, so that the powers of the State to acquire land compulsorily can be brought into operation, and the land passed over to the concessionnaire with the terms and conditions it is decided to enforce.

One of the difficulties in connection with the application of this Act is the lack of definition of what constitutes "a work likely to prove useful to the public." This matter, in particular, requires definitely clearing up, and the Act, perhaps, amending, if public developments of this type in India are to be facilitated, and the terms and conditions properly belonging to the Land Acquisition Act Agreement should also be made clear, as well as the terms and conditions that properly belong to the concession.

In addition to the concession, if electricity is to be supplied to the public generally throughout specified areas, a licence is required under the Indian Electricity Act of 1910, but, generally speaking, there is not much difficulty in this connection. It is suggested, however, that the Land Acquisition Act should be made applicable here, even if the transmission of power is not for the purpose of a public utility undertaking in the literal sense of the words, but for a private undertaking of public interest.

A further point militating against the development of water-power is the low rate of interest, viz., 4 per cent., that it is at present permissible by law to pay on the money subscribed during the period of construction. Under the Lochaber Power Act, 1921, which was a private power Act, it is permissible for the directors to pay rate of interest on this money as high as 8 per cent., and this certainly constitutes a distinct advantage in promoting a company for power purposes.

A Bad Practice.

In connection with policy of existing power undertakers, it may be pointed out that some public supply authorities in India so arrange the terms on which they supply current as to offer strong inducements to manufacturers to avoid the installation of transformers and apply high-tension current direct to the motors. This is a practice which, in general, cannot be too strongly deprecated. Motors designed for high-tension work have perforce to be of large size. With such a system it is, therefore, not practicable to install small motors, and the development of a modern system of driving is severely handicapped. Further, because of the element of danger attending the use of high-tension motors, it is not always possible to place them in the best position from a driving point of view. These advantages tend to nullify the flexibility in application of electricity for driving, which, in the author's opinion, forms its greatest claim to consideration.

Penalising the Manufacturer.

The practice also appears to be developing in connection with electricity supply in India of unduly penalising the manufacturer if the power factor of his installation fails to reach a certain figure. This clause in electricity supply contracts works out in practice in a manner which the supply engineers can scarcely have anticipated. The manufacturer, knowing that he is liable to suffer a severe penalty, if not to have his power cut off, if his power factor does not reach the value fixed by the supply undertaking, and, being informed that large motors have a higher power factor than small motors, and high-speed motors than slow, is induced to put down large, and frequently high-speed,

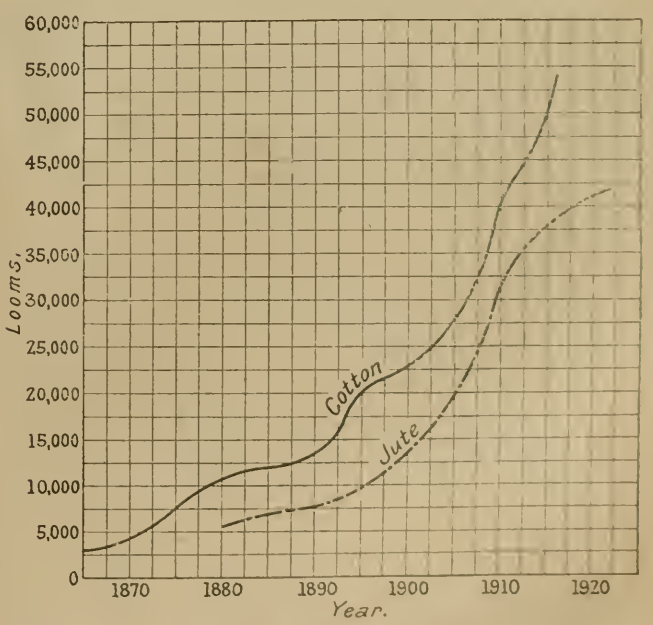

Fig. 2.—The Growth in Jute Weaving in India and in Cotton Weaving in Bombay.

motors where these are not suitable from a technical point of view. This, again, destroys flexibility, and operates indirectly against the more universal employment of electricity on modern lines.

A more general adoption of the system in use in Calcutta by which the reduction in power costs that would

accrue to the supply undertaking from an increase in power factor is calculated, and the greater part of the saving is credited to the customer in the form of reduced charges, is desirable, a corresponding provision being made for an increase in charges for a low-power factor.

The writer was informed that under the present terms of this arrangement it would pay a customer to install apparatus to raise his power factor, since by so doing he would obtain a reduction in current charges sufficient to

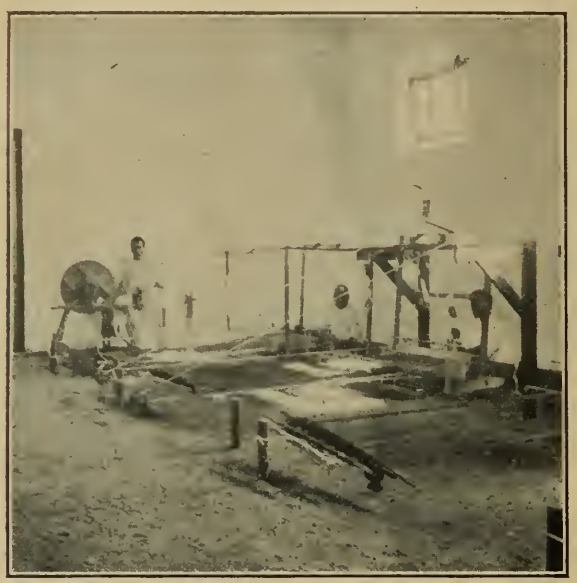

Fig. 3.—Typical Handlooms in the Industrial School, Madura.

pay a dividend on his investment. Without such an equitable contract the supply undertaking stands in a narrow sense to gain, and the manufacturer to lose, by a too rigid adherence to standards which militate against good engineering.

Industrial Developments.

The staple industry of India is agriculture. Of other industries textiles occupy by far the most important position. In 1917-18 raw cotton exports amounted to 18 per cent., and raw jute and manufactured jute exports to 21 per cent. of the total exports, while of the remainder, food, tea, and seeds together amounted to 35 per cent. Of imports in the same year, cotton manufactures, including twist and yarn, amounted to 38 per cent., and machinery to only 3 per cent. of the total.

Of these imports. the United Kingdom supplied 54 per cent., other parts of the Empire 10 per cent., Japan 12 per cent., and the United States 8 per cent., as compared with pre-war figures of 63 per cent. for the United Kingdom, 7 per cent. for other parts of the Empire, 2 per cent. for Japan, and 3 per cent. for the United States.

As indicated in the After-War Report of the Senior Trade Commissioner,* "India was, before the war, and still is, the most important market in the world for United Kingdom manufactured goods."

In 1913, 16 per cent. of the total exports of the United Kingdom of a total value of £70 000 000 went to India, 96 per cent. of this total representing manufactured articles. In 1917, notwithstanding the inflation of prices in the interim, this figure had fallen to £60 000 000, but was still 13 per cent. of the United Kingdom export trade. It is easy to understand in this connection the comment of the Trade Commissioner that "The prosperity of the country and the maintenance of the purchasing power of the Indian people is, therefore, of vital importance to the United Kingdom."

Of British exports to India, textiles amount to not less than £40 000 000, or 60 per cent. of the whole; metals and machinery cover £17 000 000, or a further 25 per cent.

Japan and the United States as Importers.

A notable feature of Indian trade since the war has been the almost complete elimination of the importation of goods from the Central Powers, and the very great development in the importation of goods from Japan and the United States. These latter countries now export to India goods which were formerly obtained exclusively from the United Kingdom. As an indication of this increase, it may be pointed out that in 1913-14 American shipments to India amounted approximately to £3 000 000, while in 1917-18 they stood at nearly £8 000 000.

The improvement in the position of Japan in the Indian markets is still more remarkable. That country now occupies a place in the Indian import and export trade only second to the United Kingdom. The Japanese imports to India in 1918-19 amounted to £22 000 000, as compared with £51 000 000 for the United Kingdom in the same year. In 1913-14 it is the remarkable fact that the Japanese imports amounted only to £3 000 000, as compared with £78 000 000 from this country. There has, on the other hand, of recent years been a very definite development in Indian manufacturing industries, notably in the textile industries. The centre of the cloth industry is Bombay, while the jute industry is almost wholly confined to Calcutta.

Jute and Cotton Developments.

A glance at the curves shown in Fig. 1 will show the growth in the development in jute spindles, and the remarkable development in cotton spindles in Bombay in recent years. Similarly, Fig. 2 shows the growth in jute looms in India, and in cotton looms in Bombay. The more rapid increase in cotton looms as compared with cotton spindles should be noted.

Since nearly one-half of the Indian cotton industry has its centre in Bombay, the curves showing the development of the industry there give quite a good indication of its general development throughout the country. Until quite recently very little engineering work of any kind was carried out in India, practically the whole of the engineering material being imported. The development of the Great Tata iron and steel works at Tatanaga, where some

Fig. 4.—Warp-Sizing in Madura.

10 000 men are employed, has, however, made a difference in this connection, and there now appears to be a definite tendency towards manufacturing heavier engineering machinery in the country and even towards manufacturing the heavier parts of more complicated machines, working in conjunction in this case with the home manufacturer.

There is every reason to think that the development in this direction will continue. Further industrial develop-

* Report on the Conditions and Prospects of British Trade in India at the Close of the War. Cmd. 442, 1919. T. M. Ainscough, C.B.E.

ments in India comprise the putting down of oil mills, sugar plants, cement works, and chemical industries on a small scale.

The Indian Textile Industries.

In connection with the textile industries it must always

Fig. 5.—A Heald Maker in Madura.

be remembered that there still exists in India a large hand-loom industry, and that a certain amount of hand spinning is still done. The writer had an opportunity of visiting this industry as carried on under native conditions, and was very struck with the efficiency of the system so far as the weaving side is concerned, and the good character of those engaged in it.

Madura, in the Presidency of Madras, is one centre of this industry, in which many thousands of weavers are employed, and it is interesting to note that the weavers there claim to be of the Brahmin caste, and cannot be induced, under any circumstances, to work in factories.

Fig. 3 shows the type of native hand loom which is employed in Madura, and is from a photograph taken in the Industrial School, Madura, in which Lord Willingdon has taken a keen interest. Fig. 4 shows cotton warp being sized in Madura, and Fig. 5 shows a native heald maker manufacturing the harness for a loom. The work is carried on in watertight compartments, the spinning being carried on by one group of people, the warping and sizing by another, the weaving by a third, and the dyeing by a fourth.

There is no reason to think that, in the near future, the development of weaving in the factory will destroy the native industry. This is largely because of the small difference in efficiency between power-loom weaving as carried on in an Indian factory and hand-loom weaving as carried out in an Indian cottage. In this connection it does not seem to be fully realised that it is only comparatively recently that the last hand loom was employed in the Scotch woollen industry, and that there are even to-day people who consider that, provided proper arrangements could be made for supplying warps to the weavers and disposing of the finished goods, hand-loom weaving need not die out in this country.

(To be concluded.)

Electricity in the Lace Industry.

By J. F. CROWLEY, D.Sc., B.A., M.I.E.E.

There is a close association between cloth as manufactured in the loom, hosiery as made on the knitting machine, lace on the lace machine, or by hand, and embroidery. In the case of weaving on the loom, weft threads are caused to cross and interlace with the longitudinal and parallel warp threads. In the case of hand-knitting, on the other hand, loop after loop is formed out of a single thread, while in machine knitting the machine, instead of making one loop at a time, makes many loops across the width of the fabric, which is, therefore, manufactured at a more rapid rate.

Evolution of the Knitting Machine.

The first machine for knitting was invented by William Lee, in the sixteenth century. With this machine a flat fabric was made, which had afterwards to be joined together along its length to form a circular hose. Many improvements were subsequently introduced, the most notable of which was the invention by William Cotton, in 1868, of a machine capable of turning out 70 dozen pairs of hose per day, at a cost of fourpence per dozen pairs, instead of twenty-nine pence per dozen pairs, as was previously the case. To-day greatly improved machines are employed, some of them suitable for making flat hose, some for making circular hose, some again designed for hand operation, but the majority for power operation.

Lace in its original and simple form is a cord or narrow band, of which the familiar boot lace may be taken as an example, and in this form it is very old. The real development of lace, however, came in the middle of the sixteenth century, when "needle-point" lace and "pillow lace" are first mentioned definitely, and instructions for making them found.

"Needle-point" lace is so called because it is made with needle and thread, while "pillow lace," or "bobbin lace," as it is sometimes termed when manufactured by hand, is made by twisting and intertwining threads which pass over pins fixed in a hard pillow, or cushion. The two types of manufacture are sometimes employed to produce a combination lace. Embroidery, which is the ornamentation of a cloth or a net base with suitable designs, is a very old

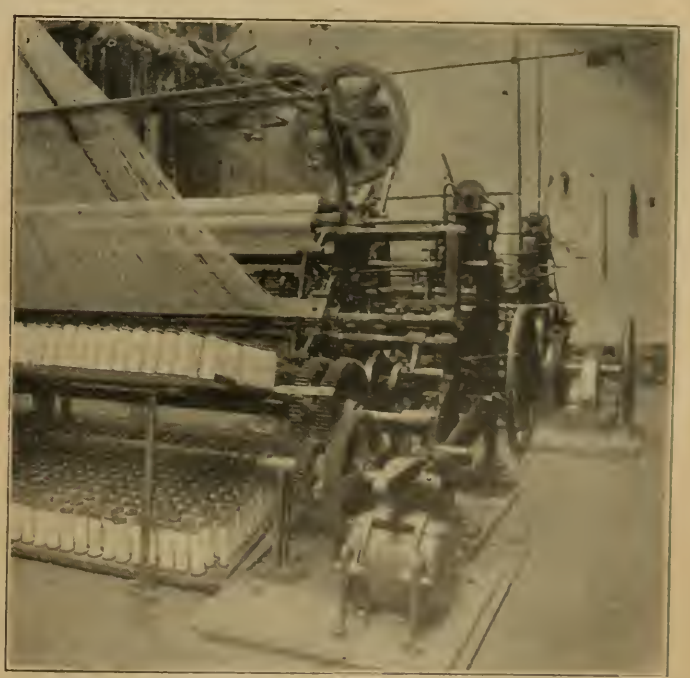

Fig. 1.—View showing Lace Looms driven by 3 b.h.p. Motor.

art, embroidered linen fabrics having been found in the tomb of Thotmes IV., in Thebes (*circa* 1500 B.C.).

Machine-Made Lace.

The first machine-made plain lace net was produced about 1768, upon an adaptation of Lee's knitting frame, the

machine being arranged to form open looped fabrics with the appearance of net, the open spaces being in regular order, and the net-like fabric being afterwards ornamented by the needle.

Frames for making " needle point " nets by machinery were first used at Mansfield about 1786, and later at Nottingham. Later still these machines were modified so as

Fig. 2.—View of 3½ h.p. Cop Winder.

to permit of the introduction of meshes into the point nets, which were then termed " figured nets." It was not until 1809, however, that any real advance was made in the manufacture of machine-made lace. In that year John Heathcoat patented his machine for making " bobbin " net, or " pillow lace," employing for the purpose a simpler mesh and one easier to make than that of the point net just mentioned. The first factory of John Heathcoat was put down at Nottingham, but he removed later to Loughborough, and when, owing to labour troubles, his factory was destroyed, in 1816, Heathcoat transferred his works to Tiverton, in Devonshire, where he installed improved machines, the factory being driven first by water power and afterwards by steam.

This historic factory still exists, and is, to this day, driven partly by water power, improved modern water turbines being now employed. The writer carried out a series of experiments on the driving of lace machines there a few years ago, and installed a number of electric motors for the individual driving of lace and auxiliary machines. Most of the lace machines used were designed on the premises, and, in many cases, even made there.

A Complicated Machine.

The making of lace by machine presented many difficulties to the inventor, and the lace machine to-day is, undoubtedly, one of the most complicated in use in industry. Heathcoat's own comment on one single aspect of the problem he had to face may be of interest —

> The single difficulty of getting the diagonal threads to twist in the allotted space was so great, that if now to be done, I should, probably not attempt its accomplishment.

Heathcoat was also responsible for inventions for making ornamental designs in the net during the course of manufacture.

In 1813 the lace machine was improved by Levers, and later by other inventors, but it was not until the Jacquard, which enabled complicated pattern and design work to be done, had been introduced to lace machines that real progress was made, and lace manufacturers were able to produce designs of all kinds, and so imitate the best hand-made lace. The Jacquard, prior to its introduction into lace work, had already become a familiar feature in the production of woven fabrics on the loom, and the success it met with there has been continued in the lace industry.

Machines of the Levers type for " needle point " lace are largely used in this country, and employ flat bobbins to enable them to pass between the stretched warp threads, the bobbins being designed to carry a large quantity of thread.

When the last Census of Production for the United Kingdom was taken, in 1907, from replies received from 85 per cent. of the lace manufacturers in the country, it was found that they employed 1 438 lace net machines, 2 147 Levers lace machines, 692 lace curtain machines, 294 warp lace machines, 669 muslin and other looms, and 248 embroidery machines. The gross output of the lace industry in the United Kingdom, according to the census referred to, was £10 718 000, employment being given to 36 840 operatives. The total horse-power installed was 10 399 h.p., of which approximately one-third was converted into electricity for driving motors and for lighting, while, in addition, 586 000 units of electricity per annum were purchased. The net output of the industry was £3 595 000, or £98 per operative employed. Of the above United Kingdom figures, approximately one-tenth would represent the figures for Scotland.

Details of Lace Machines.

The principal features of a lace machine from the point of view of the power engineer are: (*a*) The high starting torque required; (*b*) the great cyclic variation in the torque; and (*c*) the delicacy of the mechanism of the machine, and the liability to serious and expensive " smashes."

Largely because of these conditions, the drive *par excellence* for a lace machine is the individual electric drive. The machine is usually long, occasionally as much as 40 ft., and has heavy reciprocating parts. For such machines a steady drive, unaffected by causes external to the machine tending to produce variations in torque or speed, is essential to

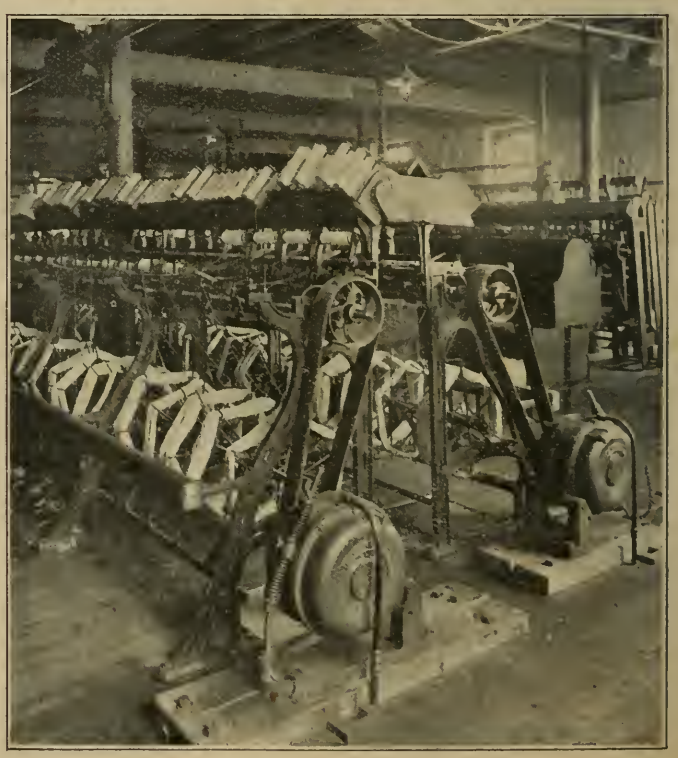

Fig. 3.—2½ h.p. 86-Spool Winder.

good production. The electric drive with three-phase motor provides this, and if the application is correctly made the conditions produced by the cyclic variation in torque of the machine itself can be satisfactorily met. Attempts have been made by Continental engineers to meet this latter

condition by providing springs which cushion the motor through a gear drive and permit it to adjust itself for varying torque during the cycle. So far, however, this arrangement, a feature of which was the frequent breaking of the springs, has not proved satisfactory. Experiments carefully carried out show that with a suitable design of motor and a mounting designed to meet the difficult driving conditions, such cushioning is not necessary.

Fig. 1 shows the type of drive designed by the writer for an important lace factory in the Scottish lace centre of Darvel, Ayrshire. The motor is strongly mounted on a specially designed support, the adjustable mounting being through the end-shields, so that any shocks due to driving are communicated direct to the supports, and not through the register between the motor and its end-shields, as would be the case if the motor were mounted from the stator frame in the ordinary way. This arrangement has the further advantage that the points of support are almost in the same plane as the point of application of the driving torque. The drive is by machine-cut gears, and full provision is made for the ready changing of pinions if different speeds are required. The whole of the motor mounting is

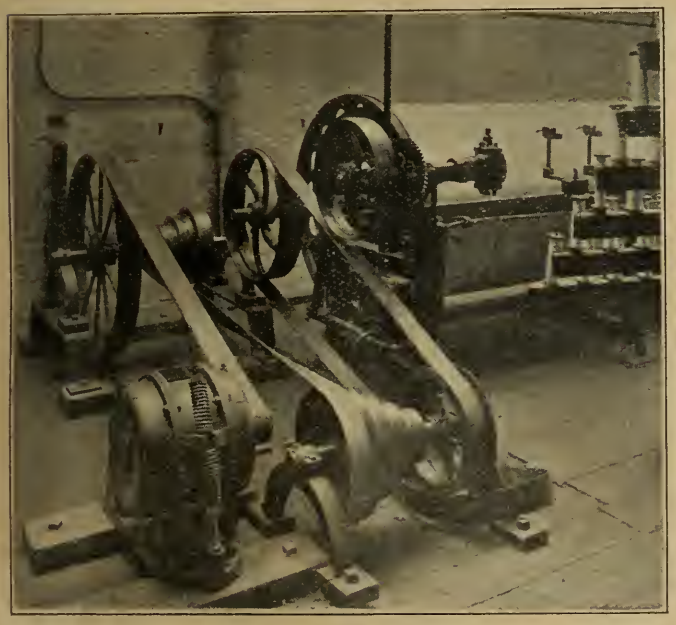

Fig. 4.—160 Beaming Machine driven by 2 b.h.p. Motor.

arranged to be rigidly bolted to the frame of the lace machine to prevent any relative movement.

"Smash" Difficulties.

As regards the third condition, it should be pointed out that the bobbins in a lace machine frequently number from 10 to 30 per inch, while a single lace machine may have as many as 30 000 threads. The carriages and bobbins generally pass through a slotted comb, and if through any irregularity in the drive, or fault in the mechanism, a bobbin misses its allotted path at entry to the comb, the result is a "smash," which, apart from loss of production, is generally an expensive matter to put right. It is, therefore, essential to arrange that the power is cut off at the earliest possible moment if such a "smash" arises. This is secured in the installation in question in two ways. A patented slipping coupling is inserted between the motor and the driven machine, and graded fusible cutouts designed to have a uniform rating are also employed. Should the fuses not cut the power off with sufficient rapidity when the excess load caused by a "smash" comes on, the coupling slips until the operator shuts the motor down, or until the fuse melts on the continued overload. It can also be arranged that the motor is shut down through an independent mechanical automatic trip on the no-voltage release of the starting switch.

It may be pointed out here that it is not possible to "anticipate" a "smash," and so no part of the frame mechanism can be brought into play to shut off the power before the "smash" actually occurs. The stopping

Fig. 5.—View of Sewing Machine Benches arranged in Groups of 12, driven by 1 b.h.p. Motor.

mechanism, however, responds with such rapidity that little or no advantage would accrue from such "anticipation," even if it were possible.

Advantages of the Individual Drive.

In addition to the steadier drive and consequent increase

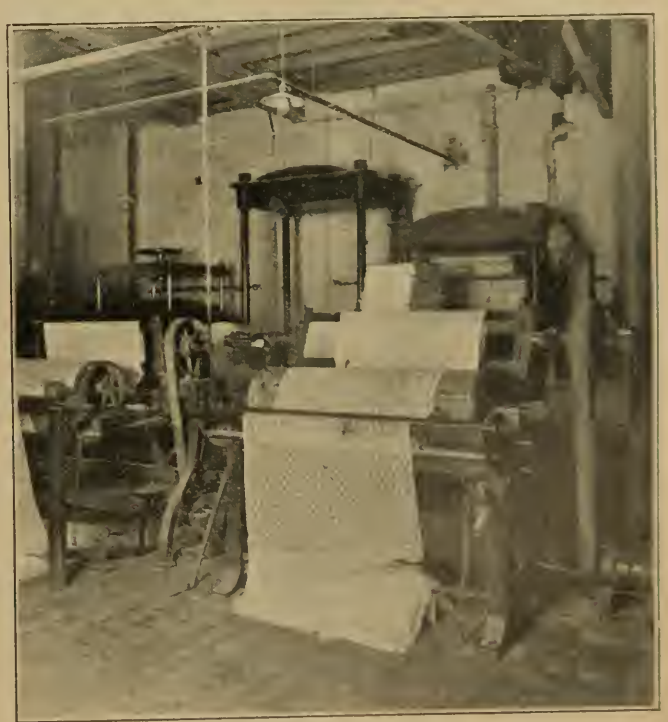

Fig. 6.—½ b.h.p. Rolling Machine Motor in top right hand corner driving Hydraulic Pumps to supply Presses behind.

in production which follows from a proper application of the individual drive principle to lace machines, there is also a considerable saving in power. With machines of

unusual length it is, in the majority of cases, difficult to arrange a shafting drive without employing shafting of considerable length.

With the individual drive, on the other hand, shafting and belting are eliminated, and power is only taken during the period when the machine is actually running.

Individual drive also lends itself very well to the driving of the other machines in a lace factory.

Illustrations.

As regards illustrations, Figs. 2 and 3 show an individually driven cop winder and spool winder respectively. A beaming machine 160 in. wide is shown in Fig. 4. This is driven by an individual motor through cone pulley reduction gear, the whole being mounted on the floor. Fig. 5 shows the driving of sewing machine benches, twelve sewing machines being driven from one motor. In Fig. 6 is shown a rolling machine driven by an individual motor, while at the back can be seen a motor driving hydraulic pumps for the operation of the baling presses. A folding machine is shown in Fig. 7. This is also driven by an individual motor.

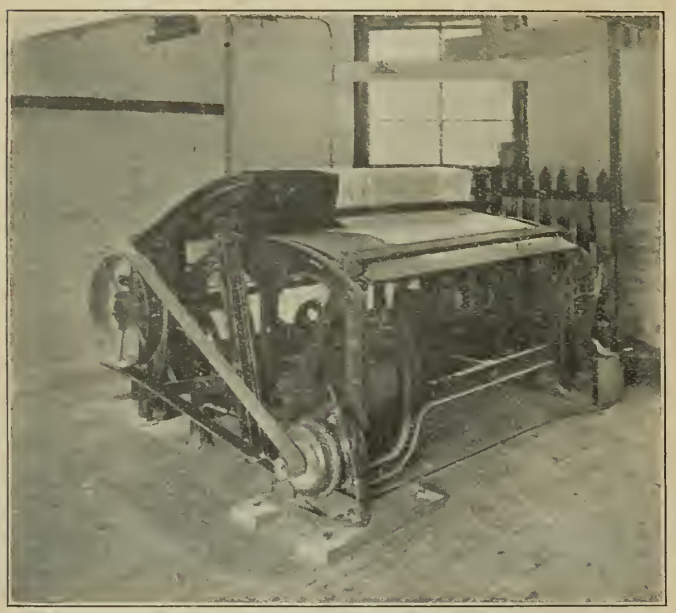

Fig. 7.—Folding Machine driven by 1 b.h.p. Motor.

Embroidery Machines.

The driving of embroidery machines is an even more complicated matter than the driving of lace machines, two motors being generally employed for each machine in Continental practice.

The driving of lace machines furnishes one more example of the importance of a detailed study of the peculiarities of particular machines if the application is to bring all the advantages that should follow from it. On the Continent, and latterly in the United States, considerably more attention has been given, in making electrical applications to industry, to the study of the conditions of the industry, of the peculiarities of design, and of the operating conditions of the individual machines, than has been the case here. It is to be hoped that the problems associated with the correct application of electricity to industry will meet with greater attention than has hitherto been the case in this country, and so help to secure that in this connection also we attain the high reputation that the manufacturers of industrial machinery, and particularly of textile machinery, have maintained for the country.

The writer wishes to acknowledge his indebtedness to The English Electric Company for the use of the photographs illustrating the plant.

Ball Bearings for Textile Works.

As evidence of the advantages to be gained from the employment of ball bearings in textile work, Mr. John Squires of the Skefko Ball Bearing Company sends us details of a series of tests conducted some months ago on two 80 spindle jute frames spinning 7½ lb. jute warp yarn. Both frames were by the same maker, but one was fitted with ball bearings on the tin roller and spindles, while the other was equipped with ordinary bearings. The ball bearing frame had been running for five months and was lubricated with grease, which is replenished every three months. This had been done fourteen days previous to tests and the frame had not been prepared in any way for the tests. The plain bearing machine had been in operation nine months, so was right at the top of its form, and to make the comparison still more favourable to plain bearings it was thoroughly flushed with oil before the tests started, and was oiled twice during each day's run. After four hours running the plain bearing frame recorded an increase of 15 per cent. in power consumption:—

	Ball Bearings.	Plain Bearings. Thoroughly flushed with oil	Plain Bearings. Good average condition.
Cyl. and spindles only	1·5 h.p.	1·8	2·5
Frame empty ..	1·8 h.p.	2·2	2·8
Spinning empty to full bobbin	25·23 spindles per h.p.	23·18 spindles per h.p.	16 to 18 spindles per h.p.

It was unfortunate, Mr. Squires points out, that the auxiliary or band tension cylinder of the ball bearing frame was on plain bearings, which rather detracts from the value of the figure for cylinder and spindles only in comparison with the plain bearing frame. Production tests were also run using the same spinner, and rove from the same machine in each case. Speed was increased from 2 700 to 2 850 revs. per min., and the ball bearing frame produced 23·5 lb. of yarn in 37 min. against 27 lb. in 38 min. in the case of the plain bearing frame—average figures being given in each case.

Of course, tests of short duration have little practical significance except to point the way, and encourage installations on a reasonably larger scale. Production must be recorded over a long period to establish so great an increase definitely. The smooth easy start on ball bearings is claimed to be of great value. For no matter whether the operation is spinning, winding, dressing or weaving, a smooth jerkless start is of the first importance.

Ball Bearing Motors.

As is well known, the development of electric motors has reached such perfection that even small motors of ½ h.p. and less are made having a very high efficiency. This has largely been made possible by ball bearings. The extreme accuracy of the bearings and their resistance to wear, reduces vibration to a minimum and permits a very narrow air gap. In effect these motors are greatly superior to the usual commercial motor. The efficiency and power factor of a 1 h.p. loom motor so equipped is 87 per cent. and 0·8, as against 66 per cent. and 0·59 of the commercial motor of the same type. The starting torque in addition is 2 times greater.

The temperature rise of the loom motor is only 35 deg. as against 50°C of the same type of commercial motor. In addition, their greater compactness recommends their installation in places where space is at a premium, as the overall length of the ball bearing motor is from 10 to 20 per cent. less—a very material saving in floor space or aisle room.

Individual Driving of Machines.

The individual motor drive of most types of textile machines, Mr. Squires continues, will develop sooner or later—the sooner the better for the textile trade. So far, the electrical engineer has been handicapped by the high capital cost involved, due principally to the fact that the textile machinist has given very little consideration to the matter of making machines suitable for such driving. On all, or nearly all, of them the effort required to start is from three to five times greater than that required to keep running, and most of the machines running light (without material in process) require 75 per cent. of the power required to maintain them in full operation, *i.e.*, the design and construction of the machine is responsible for 75 per cent. of the power consumption, and of two machines of the same type one may require 35 per cent. more power than the other, and one machine may vary as much as 30 per cent. in mechanical efficiency during a day's run. The electrical engineer either has to risk overloading his motor for considerable periods and risk a very heavy overload at starting, or sacrifice his power factor by providing a motor of far greater capacity than should be necessary.

Mechanical Storage of Water Power as a Factor in Textile Production.

This article describes the hydro-electric installation at Henry Ballantyne & Sons' Tweedvale and Tweedholm Mills. A special feature of the equipment is the method adopted for water storage, whereby, during non-working hours, water is pumped into the high level reservoir, whence it drives the turbines during the day. In this way the 220 H.P. *available by ordinary methods is increased by* 230 H.P. *Attention is called to the advantage of an hydro-electric supply from the textile manufacturer's point of view.*

A water power installation which possesses many novel features has lately been put into operation, and is now supplying the necessary power for driving the Tweedvale and Tweedholm Mills at Walkerburn, Peebles-shire. It is interesting to note that this village became a thriving community when these two mills were established in 1854, and that they owe their existence to the water power which was available in the Tweed. For a long time this was the only power used in the mills.

The fall available was divided between the two mills, the water leaving the wheels of the upper mill and passing through the wheels of the lower mill before returning to the river. The falls utilised were respectively 5 ft. 3 in. and 5 ft., for although a total head between the intake and the point of return to the river was 15 ft., nearly 5 ft. was lost in the long head and tail races. The mills, which covered a considerable area, had long grown beyond the power available from the old breast wheels, which together yielded only about 110 H.P., and other means of driving had from time to time been added to supplement this water power. A great loss of power in transmission to the scattered buildings by means of long lines of shafting and bevel gearing was also unavoidable

Utilising the Power to Advantage.

Full development of the water power was impossible until the ownership of the rights for the whole of the fall passed into the hands of one owner. Henry Ballantyne & Sons, Ltd., owners of the Tweedvale Mills, purchased the Tweedholm Mills in July, 1918. They decided to utilise the water available to the best advantage and to eliminate the heavy losses of transmission by introducing electrical drive. Boving & Company (London), Ltd., were asked to prepare a suitable scheme, and their proposals were adopted.

The first point decided was that the head available should be developed in one place. The obvious advantages of this are that an economical head is available for driving the turbines, and the duplication of plant and operating staffs is avoided. It was decided to concentrate the fall at the upper mill by deepening the race between the two mills, as it was impossible to concentrate it at the lower mill in view of the flooding of the intermediate buildings which would have occurred. This involved a considerable amount of excavation. The head anticipated was 10 ft. 6 in., but further improvements in the hydraulic conditions have been made, and the operating head is now, under normal conditions, slightly over 11 ft. The size of the existing races is such that their carrying capacity is limited to about 240 cub. ft. per second, and it was not found economical to increase this. Whilst this quantity is normally available throughout the year, there are especially dry years when the flow falls below this figure, so that further expenditure in increasing the capacity of the races was not desirable.

The power available under these conditions was 220 H.P., which, it will be noted, is exactly double that given by the old breast wheels. A survey of the power requirements of the two mills showed that a total of 450 H.P. was required, and the problem was then to find the balance required, *i.e.*, 230 H.P.

Mechanical Storage of Power.

The mills work for about 50 hours a week, so that for two-thirds of the week the power available would not have been used. With the low head of 10 ft. 6 in. the storage of the water was quite impossible, as the quantity would have been so great it would have involved the flooding of valuable lands. Electrical storage of the surplus power was also deemed impracticable, and it was finally decided to store the power mechanically in the following way: During the idle hours the turbines were to be run for the purpose of driving pumps. The water from these was to be delivered to a high level reservoir and stored for use during the working hours. During these working hours the water would run down from the high level reservoir through the same pipe as it flowed up, and by driving a Pelton wheel would generate the extra power required.

A survey of the conditions proved this to be quite feasible, for the hills immediately behind the mills rose up steeply to a height of over 1 000 ft., offering an ideal site for the reservoir in contemplation. Fig. 1 shows the general plan of the site; the two mills standing on the mill lade close to the bank of the Tweed are clearly shown, as are the positions of the reservoir, 12 in. cast iron pipeline, surge tank, and steel riveted 9 in. pipeline.

Pipeline and Reservoir.

The 9 in. high pressure pipeline, to save expense, was brought as steeply as possible down the hillside. The reservoir had to be placed on a saddle some little distance away, and it was connected to the top of the high pressure pipeline by a 12 in. cast iron pipe running practically on the level round the contour of the hill. A surge tank is necessary at the junction point to provide or absorb water at times of change of load, for the 9 in. pipe being on a steeper slope will more readily accommodate itself to changes of load, and on increasing loads will draw off more water than the 12 in. pipe can immediately supply.

This scheme provides the extra 230 H.P. required, for in spite of the fact that a good deal of the energy available during the idle hours is absorbed in the pumps, in pipe friction and in losses in the Pelton wheel, the fact that the idle hours are more than the working hours fully compensates for this and enables the effective power to be more than doubled.

Power-Station Arrangements.

The general arrangement of the power station is shown in Fig. 2, whilst side and end elevations are given in Figs. 3 and 4. The low pressure turbines consist of two large double runner, horizontal

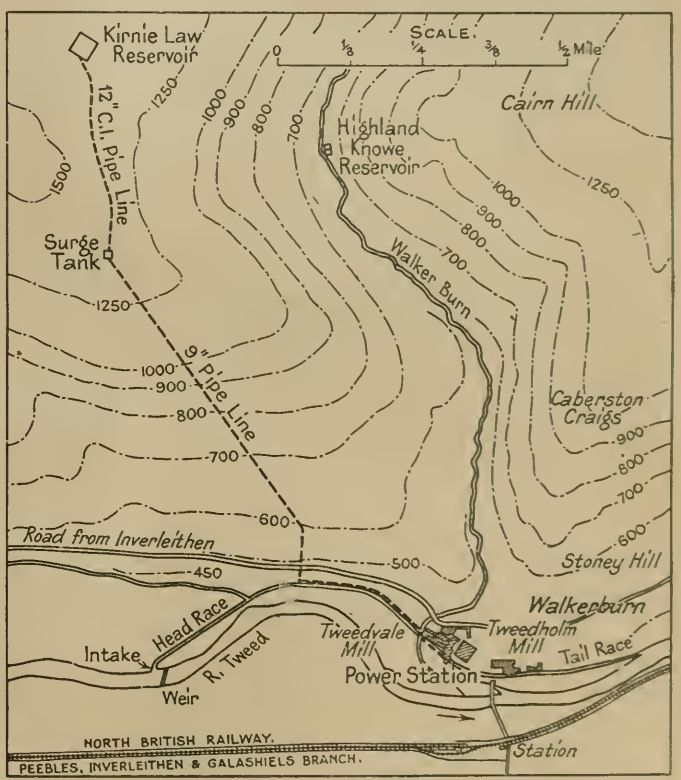

Fig. 1.—Plan of Hydro-Electric Power Scheme, Walkerburn, Peebleshire.

Francis turbines of 110 H.P. each, running at a speed of 200 revs. per min. It will be seen that between these turbines is left a water-tight chamber.

Each turbine is furnished with a large flat-faced belt pulley of double width, the diameter being 100 in. The outlets from these turbines are inclined at an angle to reduce the amount of disturbance to existing buildings, and also to give a cleaner exit for the water. Both these low pressure turbines drive on to a single generator of 145 kW running at 600 revs. per min., each end of the generator shaft having an overhung crowned pulley for the purpose. Under normal operations the low pressure turbines are run on hand control. During the day all variations of demand are met by the high pressure turbine. Thus the low pressure turbines run on full load, and only the balance of power is drawn from the reservoir. At night, since the pumping load is constant, hand control suffices.

The duplication of the low pressure turbines has a considerable advantage apart from that of overhaul. On occasions it is necessary to work overtime: the central generator would be driven by one low pressure turbine, and for this purpose one turbine is

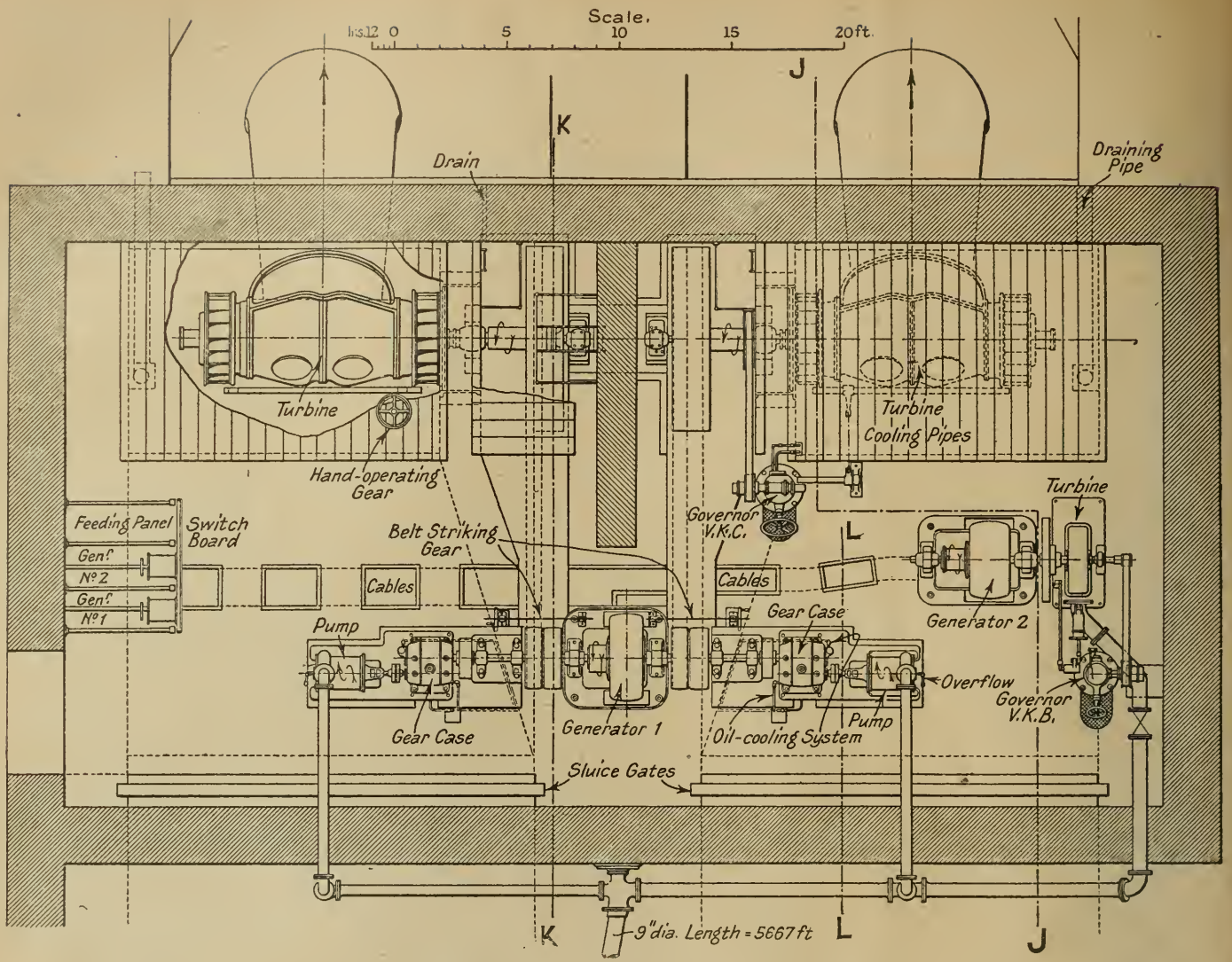

FIG 2.—PLAN SHOWING GENERAL ARRANGEMENT OF PLANT.

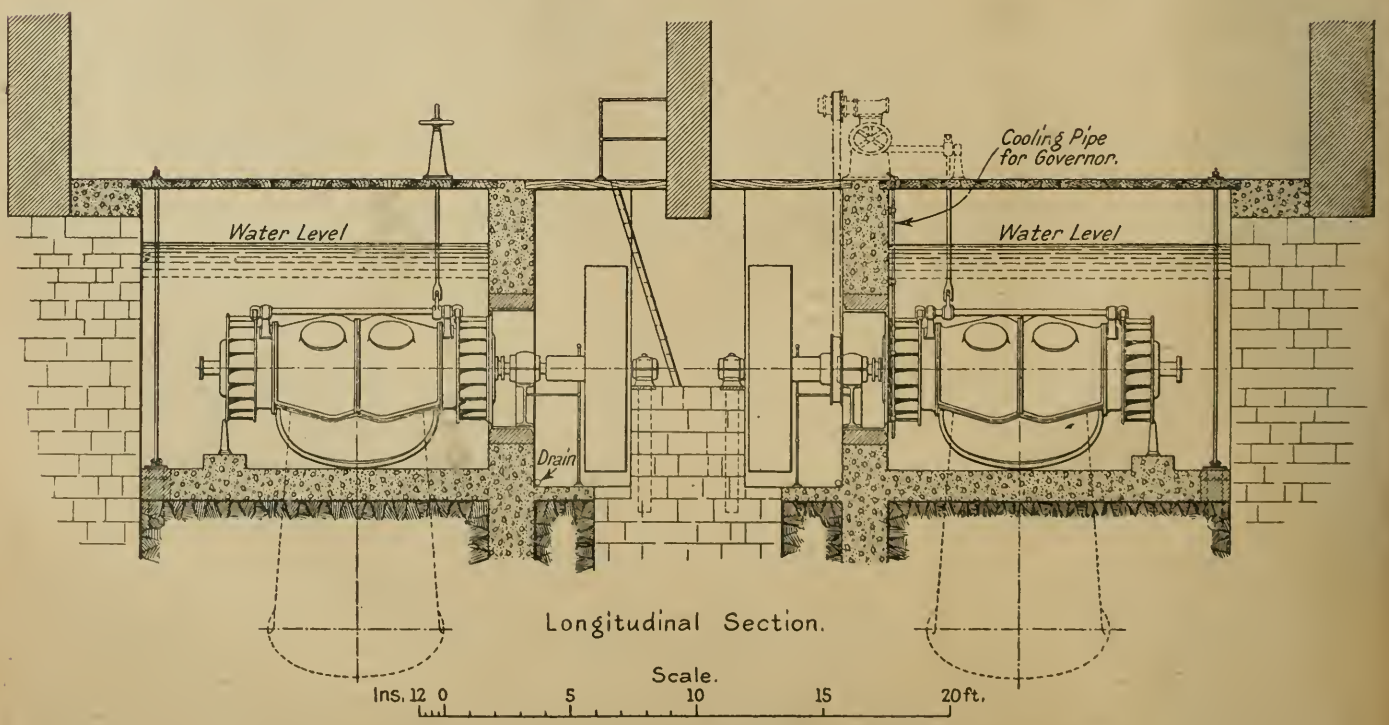

FIG. 3.—LONGITUDINAL SECTION OF HYDRO-ELECTRIC AND ACCUMULATING POWER PLANT.

provided with a governor, the other turbine on hand regulation drives its pump all the time.

In line with the generator driven by the low pressure turbines are shafts carrying crowned pulleys exactly similar to those on this generator. These shafts drive the high pressure pumps which are necessary to create the head of 1 050 ft. which is required. During the idle hours the belts are changed over from the generator pulleys to the pump pulleys.

The Pump Drive.

Since the quantity of water delivered by each pump is relatively small, *i.e.*, 220 gallons per minute, it would have been quite impracticable to have run at a speed of 600 revs. per min., and therefore a gear drive had to be resorted to, and the pumps themselves run at 3 000 revs. per min. To isolate the gear case and prevent any side pull interfering with the correct meshing of the gears, flexible couplings are provided on each side of the gear boxes.

These pumps deliver through 4 in. pipes into a bus pipe immediately outside the power-house wall, and this bus pipe is connected both to the 9 in. high pressure pipe leading up the hill to the reservoir and to the 6 in. pipe for supplying the high pressure turbine. This high pressure turbine is of the Pelton type, and under an effective head of 897 ft. develops 230 H.P.

Owing to the long pipeline, precautions had to be taken for dealing with the water hammer effect on shutting down the turbine suddenly in the event of the load coming off, and Boving's patented system of combined needle and deflector regulation has been incorporated. On the load coming off, the deflector cuts into the jet of water issuing from the nozzle and throws the power off the wheel. The needle is then allowed to move slowly forward to reduce the jet to the size corresponding with the new load, the deflector meantime taking up its position immediately above the reduced jet. In this way the waste of water only takes place during the few seconds of the regulating period. The rapidity of the action of the deflector and the economic control by means of the needle are thus combined.

The Pelton wheel runs at 1 000 revs. per min., and is coupled direct to a 155 kW. generator. The whole electrical system is direct current, the pressure adopted being 250 V. The switchboard for distributing this is accommodated at the end of the machine room.

Figs. 2, 3, and 4 make the general lines of the scheme clear, but the interior view in Fig. 5 will be of some interest. This shows a view taken from the switchboard end; the belts coming up from the low pressure turbines and driving the central generator can be clearly seen. On the right hand side will be seen one of the high pressure pumps and the gear box through which this is driven.

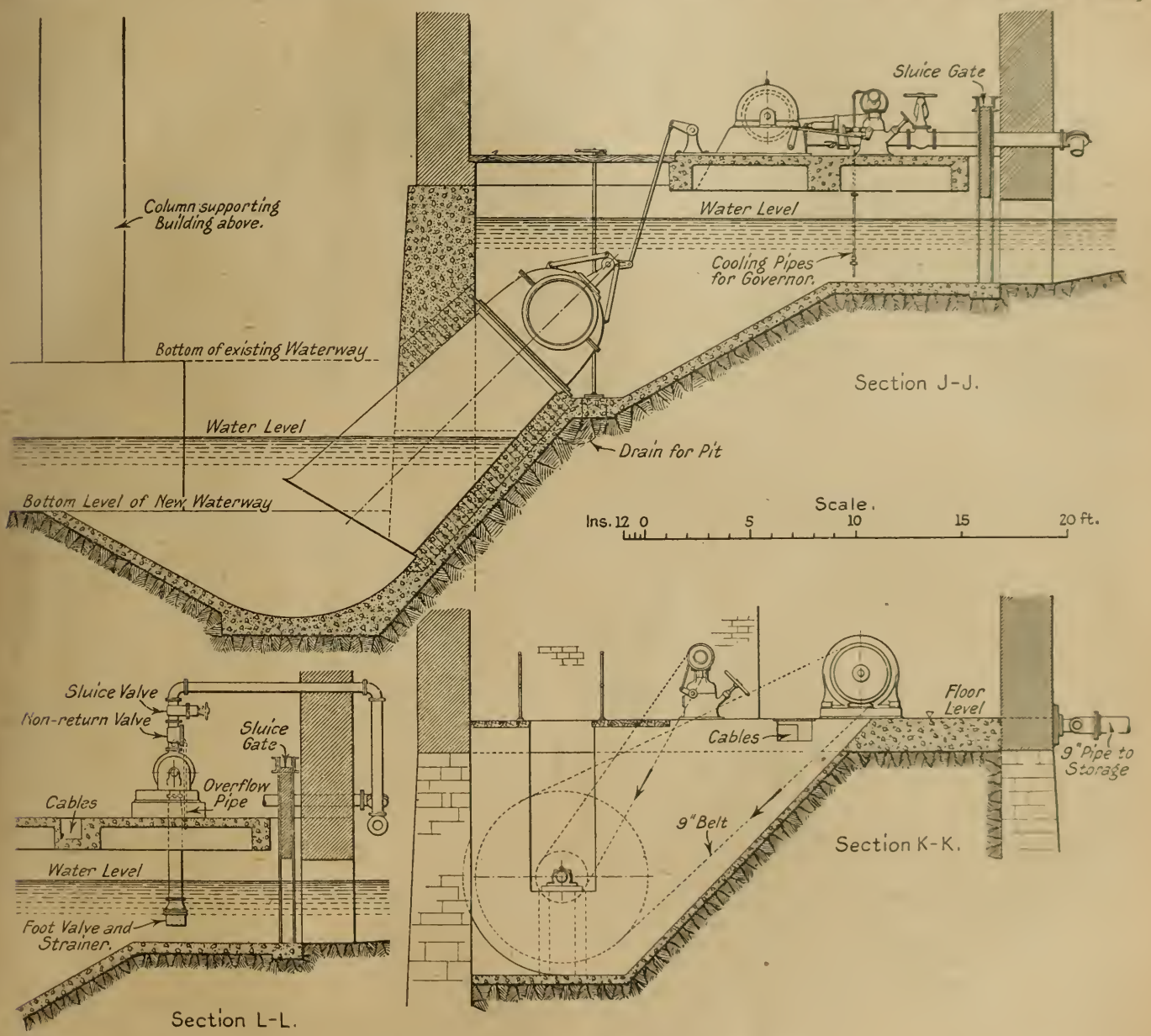

FIG. 4.—CROSS SECTIONS OF THE WALKERBURN STATION.

It is interesting to contrast the size of the 230 H.P. Pelton wheel, with its generator and governor, with that of the low pressure turbines, each of which is only half the H.P. of this small Pelton wheel.

Constructional Pipeline Work.

Leaving the interior of the little power-station, we come to the 9 in. pipe through which the water is pumped to the reservoir, and which brings the water down to the Pelton wheel. Fig. 6 shows this pipeline being laid in the trench up the hillside. For

the upper portion where the head is less than 300 ft. an ordinary slip joint is satisfactory, but as seen in the photograph, for higher heads the pipes are flange jointed, the faces of the flanges being machined and rubber packing rings provided to make the joints watertight. The static pressure at the lower end amounts to 455 lb. per sq. inch. As the pipes are buried underground except for a small portion near the mill, and as the water will either be flowing up or coming down through the pipe, practically the whole time, no danger from frost is anticipated.

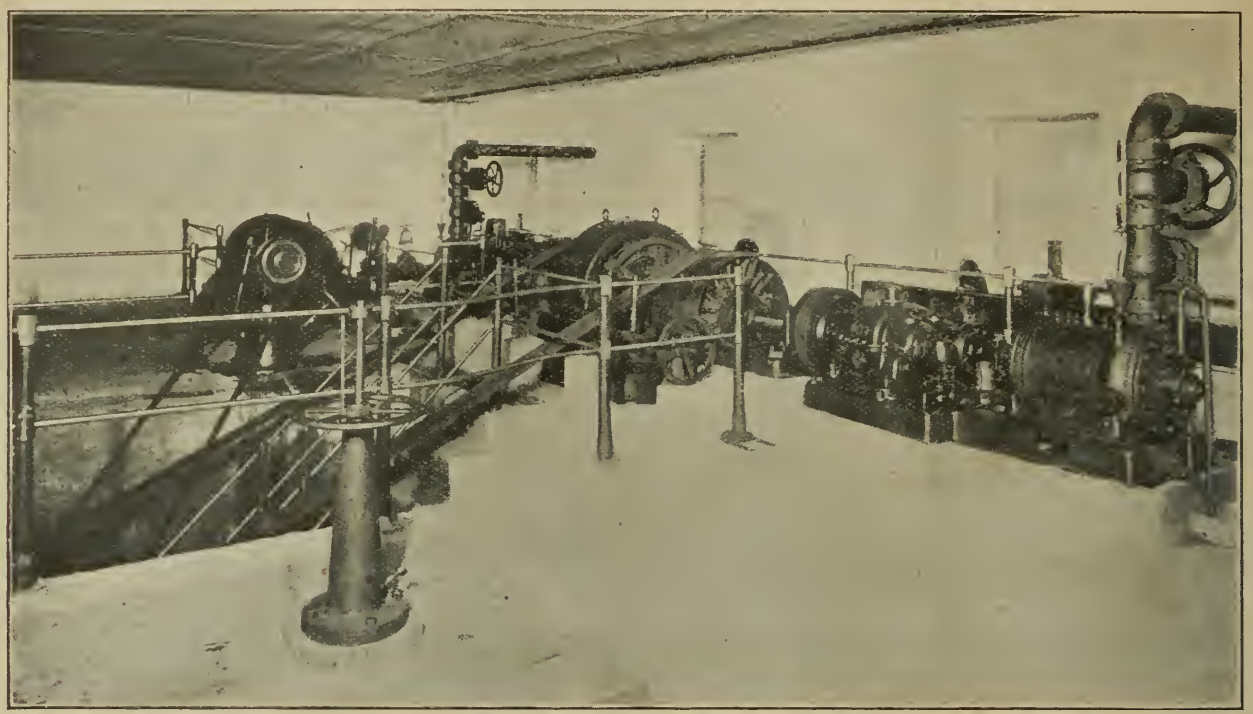

Fig. 5.—Interior View of the Walkerburn Station.

Fig. 6.—View of the Pipe Line.

At the outlet from the surge tower an automatic butterfly valve is fitted. If by any accident a burst should occur in the 9 in. pipe this valve is operated by the increase of velocity; the valve is tripped and slowly closes under the control of a dashpot, thus cutting off the waste of water and preventing any possibility of a washout occurring. The surge tank and 12 in. cast iron pipe going to the reservoir have already been noted. In the design of the surge tank, which is 4 ft. 6 in. square, a 12 in. rectangular gauge has been incorporated through which the whole of the discharge from the pumps can be diverted by closing down the valve to the reservoir. In this way the efficiency of the pumps can be checked from time to time. The top of this surge tank has been covered in with expanded metal to provide against the possibility of children throwing in stones, which might work down the pipe and damage the Pelton wheel.

The Reservoir.

One of the biggest works in connection with the whole installation is the reservoir, and a few figures may be of interest. The longest period of pumping is from midday on Saturday till Monday morning, *i.e.*, 42 hours, and at their rated capacity the pumps will in this time deliver 1 108 800 gallons. During the working hours of any one day, if the Pelton wheel were kept continuously on full load it would consume 546 750 gallons in 9 hours. Allowing that one hour of the remaining 15 hours is lost each day in changing over and at mealtimes, the pumps could run 14 hours and replace 369 600 gallons, the deficit being 177 150 gallons per night. This, with the 5 hours' draw off on Saturday, would lead to a total deficit when the week's work was finished of 1 189 500. It will thus be seen that the water used during the week in the reservoir would slightly exceed the quantity pumped into it. It must be noted, however, that this would only occur if the Pelton wheel was kept on full load during the whole of the working hours, which is a contingency that cannot normally arise.

Theoretically, then, a reservoir capacity of slightly under 1 200 000 gallons would be adequate. A certain margin has to be allowed to provide against the pumps being stopped for overhaul of any part of the plant, and in times of exceptional drought it might not be possible to run the pumps at full capacity. It was therefore decided to enlarge the reservoir so as to provide a surplus storage to carry over from favourable to unfavourable weeks, and a reservoir of 3½ million gallons was ultimately decided upon. The reservoir is 192 ft. square by 15 ft. 6 in. deep.

Constructional Details.

Owing to the possibility of the ground not being watertight, the bottom of the reservoir was formed of a 9 in. slab of reinforced concrete laid directly on the solid ground. This slab contains a light mesh of steel reinforcement to provide against any upward stresses due to changes of temperature or to hydrostatic pressure from the outside when the reservoir was empty.

The walls, which vary from 8 in. thick at the top to 21 in. at the bottom, are heavily reinforced, the reinforcement being tied into

the floor, so that the walls can distribute their load on the cantilever principle. The taper of the walls was increased near the foot to provide against the bending moment which increases more rapidly as the floor is approached. The tensile stress in the vertical rods of the wall was limited to 6 tons per sq. in., with a view to minimising the possibility of surface cracks taking place. A mixture of 1 to 2 to 4 was used, and great care was exercised in the selection, grading, and mixture of the constituent parts. During the recent test no leakage or sweating in any part of the reservoir was observed. This is particularly satisfactory in view of the very difficult conditions obtaining at this altitude during construction.

The plant has been in successful operation now for several weeks. As has already been pointed out, the scheme was proposed by Boving & Company, Ltd., who have acted as main contractors for the supply of the hydraulic equipment, including turbines, governors, generators, pumps, gears, pipes, and valves. The generators were supplied to them by Bruce Peebles, the pipes by Mechans, Ltd., and the valves by Glenfield & Kennedy. The reservoir was designed in detail by the Considere Construction Company, Ltd. Melville, Dundas, & Whitson, Ltd., were contractors for the construction work. Mr. J. Sharp, of Glasgow, acted as consulting engineer during the construction and erection of the whole of the scheme.

From the Textile Manufacturer's View Point.

From a textile manufacturer's point of view the main advantage of a hydro-electrical scheme of power generation, such as the foregoing article describes, is steadiness of drive in the highest obtainable degree. This steadiness of drive is one of paramount importance to manufacturers of fine woollen goods. It is well known in the trade that an irregular drive produces not only defective yarn, but a very high proportion of waste; the one affecting the quality of the cloth, the other, as may easily be seen, the price or profit.

In comparing this power (the hydro-electrical drive) with that generated by other means it will be apparent that departments such as carding, spinning, weaving, finishing, &c., can be worked individually much more economically than where it is necessary to start up, or maintain the running of a plant consisting of steam, gas and other engines.

The firm who have had the enterprise to install the particular system that we describe, Henry Ballantyne & Sons, Limited, of Walkerburn, Peeblesshire, have already realised these advantages in a very marked degree. Being manufacturers of only the highest class Scotch suitings they use a large proportion of very fine yarns. These, under the old drive, were apt to come from the spinners "pointy" and defective, and no amount of subsequent picking or mending of the cloth would bring it to the same state of perfection as that in which it is now being produced. At present the taste in tweeds, being largely in the direction of "pick and pick" styles in strongly contrasting shades, level yarns are of the utmost importance.

The Effect of Short Time.

To take the second point. The woollen trade is suffering at present from very acute depression in sympathy with most other trades, and it is, unfortunately, frequently necessary to run short time. This is most effectively done by running departments in rotation, and producing only the electric current necessary for the time being; a great source of economy and tending to minimise the loss in running short hours.

Water power being very reliable, the comparative immunity from breakdowns is a great boon. In finishing operations a piece may be seriously damaged by a machine stopping at an inopportune moment.

It may be added that this scheme is the only one of its kind in Great Britain, and there are probably not more than two or three others in operation in the world.

Recent Developments in Textile Drives.

The requirements of the textile industry have always been closely studied by the Société Anonyme Brown, Boveri & Cie., and a considerable amount of research and experimental work has been carried out by this concern with the object of evolving designs of textile driving machinery which will give the most economical working results commensurate with low initial costs and unfailing reliability in service.

The Economics of the Electric Drive.

As an example of the saving that can be effected by taking advantage of recent progress in electrical design, the case of the S. A. Tissage Mécanique de Soie may be quoted. This firm recently decided to extend its mill, and, on completion of the extension, tests were made to ascertain the efficiency of the newly-installed Brown-Boveri motors as compared with that of the motors supplied for driving the original plant, which, although they have seen over twenty-two years' service, representing three quarters of a million working hours, are operating to-day in a perfectly satisfactory manner. It was found by the engineers of the S. A. Tissage Mécanique that the current consumption of the new motors was no less than 42 per cent. lower than that of the old ones working under the same conditions.

The Application of the A.C. Commutator Motors.

The improved economy effected in recent installations is largely due to the use of alternating-current commutator motors, which possess the great advantage of a high starting torque combined with economical and easy speed regulation by moving the brushes. The efficiency of these motors is almost constant for any working speed.

The principle of speed control by brush displacement was first embodied in the single-phase Deri motors built by Brown, Boveri, but this firm has for many years been building three-phase motors which embody the advantages of the Deri type, and are so wound that the phases of the circuit to which they are connected are as equally balanced as when induction motors are employed.

Having regard to the fact that no hard and fast rule can be laid down in the matter of textile drives, so much depending on the individual case, Brown, Boveri have developed a number of different types of motor, to cover the whole range of the requirements of the industry. Although it has been found that individual drive of looms, ring frames, and presses has often resulted in more economical working and the avoidance of a large amount of millwrights' work in erection, it has always to be considered, the firm points out, whether the saving thus effected will compensate for the higher initial costs involved. Very often it is found that a combination of individual and group drive gives the best results. Again, in certain cases, it may pay to construct special motors to meet the prevailing conditions.

An Efficient Textile Motor.

It so often happens that the speed of the machine to be driven is at variance with that at which the most suitable motor will

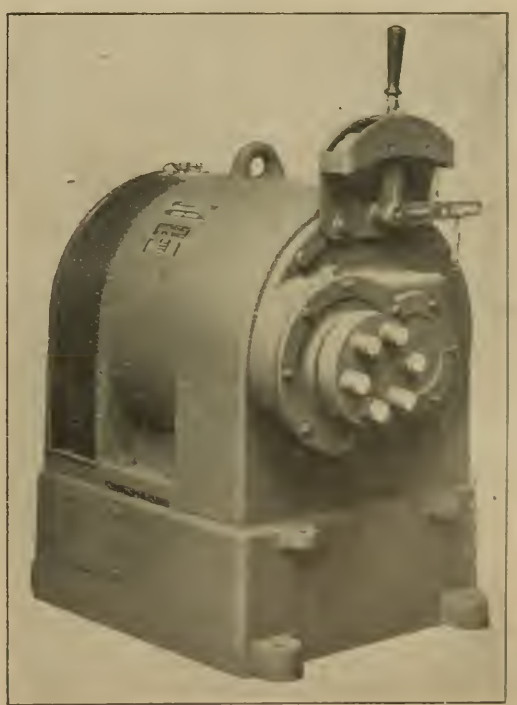

Fig. 1.—Single-Phase Commutator Motor, with Built-on Reduction Gear.

run economically, that Brown, Boveri have developed a type of motor in which an enclosed reduction gear is built on to the frame. This gear has ground pinions and runs in an oil bath, and has an efficiency of 98 to 99 per cent. Although originally designed for motors to be direct coupled to ring spinning frames, it has proved

so satisfactory in service that similar gears are about to be designed for loom and other motors. The gain in safety and cleanliness over the crude open reduction gear is obvious. Fig. 1 shows a single-phase commutator motor with a built-on gear of this type, and Fig. 2 a 4 in. lift dry-spinning machine (constructed by Fairbairn, Naylor, Macpherson & Company), in the mill of the S. A. Industrie Linière Suisse at Niederlenz, driven by two three-phase commutator motors in this way. Another advantage of

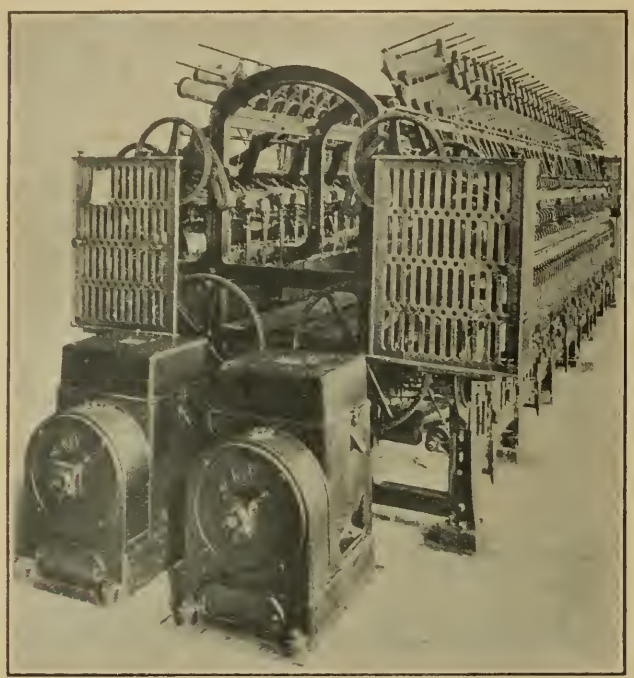

Fig. 2.—4 in. Lift Dry-Spinning Machine with Two Spindle Shafts, driven by Two Independent Three-Phase Commutator Motors, with Built-on Reducing Gear.

this type is that it permits of the independent drive of each shaft of the ring spinning frame, as motors with built-on gears take up far less space than if they were not so fitted. This is illustrated by Fig. 3, which shows two single-phase commutator motors with reduction gears and a hand speed-controlling device built-on.

Ring Spinning Drives.

Automatic variation in speed has proved to be of great advantage in the case of ring spinning machine drives, and some 4 000 motors

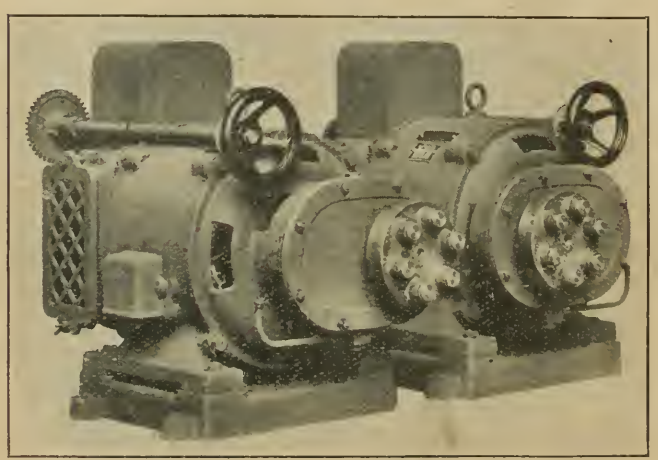

Fig. 3.—Two Single-Phase Commutator Motors, with Built-on Gears and Hand Speed-Controlling Device.

have been supplied to various mills on the Continent and elsewhere equipped with Brown, Boveri automatic speed-regulating gear. This gear ensures that the tension on the thread is kept constant, the motor speed being kept low during the initial stages of the formation of the cop, and gradually increased as the diameter grows by altering the position of the brushes, thus giving a very evenly-wound cop, and minimising the breakages of the thread. For driving machines in which only an occasional decrease in speed is required, a very much cheaper and simpler arrangement can be made use of. The motor is belted to the machine to be driven, and the belt is kept taut by means of a jockey pulley which is kept pressed against the belt by means of a weight. If it is desired to decrease the speed of the machine, it is only necessary to lift up the pulley and allow the belt to slip. It has yet to be seen whether this very simple device will always give good results, but it has operated with complete success in a number of cases. Fig. 4 shows an induction motor driving a frame in this way in a Swiss mill.

It is not too much to say that no Continental mill of recent construction employs anything but the electric drive, and, in some cases, mill owners themselves generate locally the necessary power. For instance, the mill of the S. A. Industrie Linière Suisse has its own power house, the equipment of which comprises a three-phase alternator of 150 kVA, distribution panels, and panels for the alternator and incoming line from the Argovie power station. This Company recently reconstructed its mill, and converted its equipment to independent, instead of group, drive. For this purpose Brown, Boveri three-phase commutator motors with built-on reducing gears were ordered, together with a number of motors for the direct drive of the frames.

These alterations have resulted in a vast improvement in the

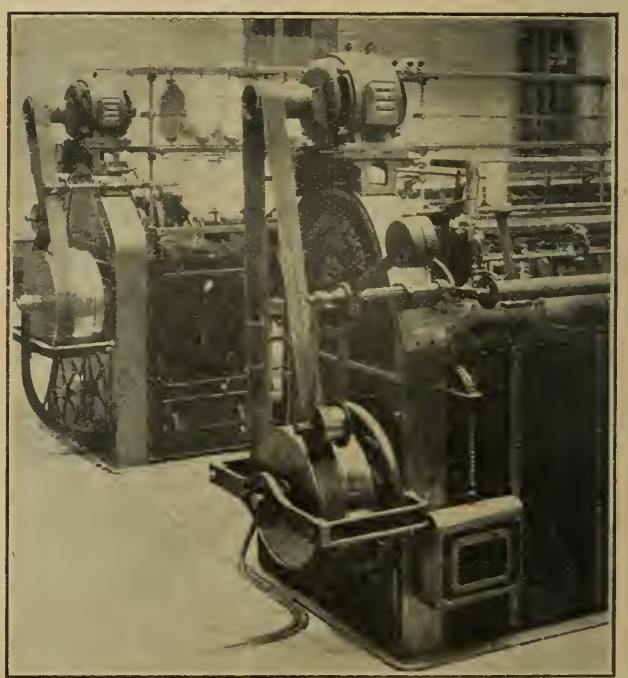

Fig. 4.—Belt Drive of Spinning Frame, with movable Jockey Pulley.

working efficiency of the mill, and the S. A. Industrie Linière Suisse have reported that not only has a large increase in production been obtained, but also the amount of skilled attention necessary for the operation of the various frames, &c., has been considerably reduced.

British Non-Ferrous Metals Research Association.

Of the several research associations, which, apart from the British Electrical and Allied Industries Research Association, interest the electrical industry, none is more important than the British Non-Ferrous Metals Research Association. The annual report of this association for 1921 has recently been issued, and shows a gratifying record of progress achieved during the year. Several important electrical firms are members of the association, and users as well as manufacturers are admitted to membership.

Apart from the researches, of chief interest to those in the non-ferrous industry, even to those possessing small foundries, such as the investigations on brass casting and on the electrical melting of non-ferrous metals, we note a number of investigations in progress of particular interest to electrical manufacturers, notably those on metal polishing and grinding, the jointing of metals, including soldering, brazing and welding, the last named being conducted by the Metropolitan-Vickers Electrical Company. Of fundamental importance is the investigation being conducted by Dr. W. Rosenhain at the National Physical Laboratory on the influence of impurities up to 1 per cent. on the working properties of copper. The increased speeds and stresses in modern electrical apparatus are such as to render increased knowledge of non-ferrous metals and alloys of enormous importance to electrical manufacturers, and we trust that the association will continue to show its present interest in electrical affairs.

The New Oerlikon Geared Individual Drive for Looms.

In this article is described a geared individual drive for textile work which has been devised by the Oerlikon Company to combine the advantages of ordinary gearing and at the same time to eliminate the difficulties which occur when the loom is suddenly stopped. The device employed consists of a centrifugal coupling with a fast and loose part which, at starting, begins only to grip when approximately normal speed is reached and when running adjusts itself automatically to the normal torque.

In general, it may be said that the speed of looms ranges between 80 and 220 revs. per min., the actual speed depending upon the construction of the loom and the class of fabric it is to produce. Consequently, with a loom motor running at 950 revs. per min., the speed ratio between loom and motor will have any value between 1 to 12 and 1 to 4·3. In view of the limited space available for driving, it is not advisable, as a rule, to exceed a ratio of 1 to 6 in the case of belt drives, otherwise the angle of contact of the belt on the motor pulley would be too small. This would not only render the drive unreliable, but would also mean large losses due to belt slip and friction in the bearings. It therefore follows that the overall efficiency of an individual drive by a belt decreases rapidly as the speed ratio increases. Attempts have been made to obviate to a certain extent the disadvantages encountered with this type of drive when used for high speed ratios, by utilising large pulleys and belt tightening pulleys. No success has, however, been attained in this direction, for the provision of larger pulleys has proved impracticable owing to the short distance between the shafts. On the other hand, it has been found that, in the case of drives fitted with a belt tightening pulley, the strain thrown upon the loom, in the event of the latter coming to a sudden standstill through the shuttle being trapped in the shed, is sufficient to break both the loom frame and shaft.

Fig. 1.—New Oerlikon Geared Individual Drive, with Motor arranged symmetrically between pillars.

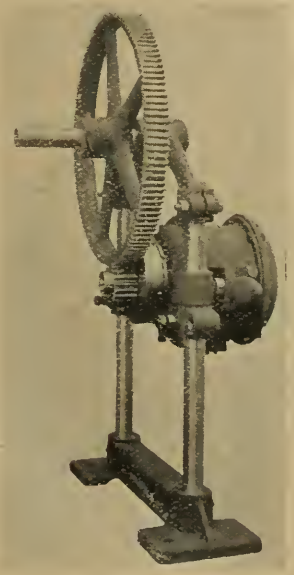

Fig. 2.—New Oerlikon Geared Individual Drive, with Motor projecting on outer side of gear support.

Fig. 3.—Drive with Motor swung out and loose part of coupling removed.

Gearing the Most Rational Solution.

Under these circumstances, the adoption of a gearing instead of a belt drive seemed the most rational solution of the problem, more especially in view of the fact that very efficient gearing can be built for the speed ratios in question. Furthermore, such an arrangement ensures sharp and reliable starting up, and perfectly steady speed, owing to absence of slip between the motor and the loom.

All these advantages, which are obtainable by the use of gearing, have, it is true, been universally known for some time, but the design of a geared individual drive presented very serious difficulties. It was found quite possible to build such drives, under the most favourable conditions, for looms fitted with a loose reed arrangement or for ribbon looms. These drives were, however, found entirely inadequate for looms of heavy construction, and more especially for the type of loom with a fast reed as are most generally used. The following considerations will explain wherein resided the main difficulty.

Difficulties of the Gear Drive.

In all looms it is necessary, in the event of a shuttle failing to reach a shuttlebox, to bring the loom to rest immediately so as to avoid damage to the warp lying above and below the shuttle. In the case of looms with the fast reed arrangement, the loom is brought to rest by a stop rod and tongue engaging in the shoulder of the frog, the latter releasing the starting handle and rendering the drive inoperative. When the loom is stopped in this way the kinetic energy in the rotating parts of the loom and motor is abruptly degraded so that a heavy and sudden strain is thrown upon the gearing. This check inevitably results, especially in the case of looms with a fast reed, in the ripping off of the gearing teeth or in the deformation of the shaft or even in the breaking of the loom frame. It will, therefore, be obvious that when the motor and loom are rigidly connected together by means of gearing, it is impossible to ensure the flexibility required for the safe operation of the loom and drive that can be attained with belt drives.

The Oerlikon Coupling.

The Oerlikon Company has, however, been successful in overcoming the difficulties mentioned above in a very simple and satisfactory way, and has brought out a geared individual drive which constitutes a notable advance in this class of design. This type of drive is shown in Figs. 1 to 5. It has, we understand, been in continuous service for a period of two years under severe working conditions and has given excellent results. The main feature about this drive is the Oerlikon patent automatic centrifugal coupling, which is illustrated in Fig. 3. This coupling consists of a loose and fast part and is mounted on the motor shaft. On the loose portion is fitted a pinion working with a gear wheel on the main shaft of the loom. The motion of motor is communicated to the loose part of the coupling, and consequently to the loom, by means of two shoes on the fast portion of the coupling, which are pressed against the friction surface of the loose portion by the centrifugal action of two weights.

Operation of the Coupling.

At starting, the coupling begins to grip only when approximately normal speed is reached. The loom, therefore, starts up very quickly, with the result that the same tension is obtainable for the first pick of weft as for any of the others. When the loom is running, the coupling adjusts itself automatically to the normal torque, which is about 1·8 to 2·5 times less than the starting torque. With this coupling, it is claimed, the stresses in the gearing between the motor and the loom never exceed those encountered in normal service, even though shocks should occur or the loom should stop suddenly; this is due to the fact that whenever these stresses tend to increase, a slip takes place in the coupling. If any temporary

irregularity in the movement of the loom takes place, there will be a slip between the motor and the loom as long as these conditions obtain. In this way the necessary flexibility of drive is ensured. This coupling also affords effective protection for both motor and fuses, as, in the event of an overload lasting any length of time, the speed of the loom drops and the irregularities in its motion

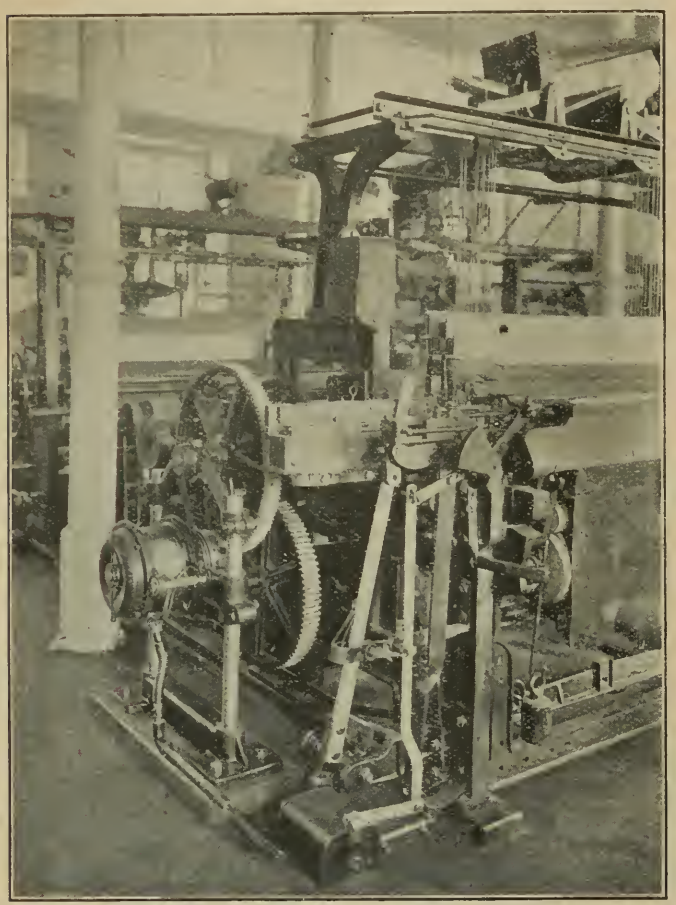

Fig. 4.—Loom fitted with the New Oerlikon Geared Individual Drive.

are thus brought to the notice of the weaver before the fuses melt or the motor is damaged. In cases of sudden stoppage, where the motor circuit is broken at the same time, the coupling slips until the rotating masses of the motor come to rest. During this gradual slowing down, which takes place without shock, the various parts of the coupling gear return to their original position. The coupling, therefore, ensures a very rapid starting up of the loom and effectively prevents breakage of the gearing teeth or distortion of the shaft in the event of the loom being stopped suddenly. It is claimed for the Oerlikon coupling that it is extremely simple and requires no attention during operation, as it acts entirely automatically after having been set once for all.

Arrangement of the Equipment.

In spite of its very substantial construction, the new Oerlikon geared individual drive has a pleasing appearance, as will be seen from the illustrations reproduced herewith. The motor is mounted on two strong pillars of best quality steel, which are pressed into a wide base. At the top of pillars is fitted a yoke, which is provided with bearings to serve as the end bearing for the loom shaft. This yoke has also the effect of strengthening the whole structure supporting the motor and gearing. Both motor and yoke can also be clamped, independently of each other, at any level. In this way this type of individual drive can be mounted at any desired distance between the loom and motor shaft and with any height of motor shaft above floor level, these dimensions varying necessarily with the type of loom and the speed ratio. Furthermore, the arm fitted to the motor frame is provided with a slot, by means of which it is possible to ensure that the pinion and gear-wheel are engaging exactly. This slot is so dimensioned that four consecutive pinion sizes, between which there is a difference of one tooth, can be fitted, and the speed of the loom thus altered. In this way the same looms can be used for various fabrics, and the speed necessary in each case can be obtained. The pinion can be replaced rapidly and without trouble; this is done by means of a simple device for drawing out and driving in of the key. It will be seen from Figs. 3 and 5 that by unscrewing a nut it is possible to make the motor pivot about one of the pillars, so that, even when the space available is limited, the coupling and pinion can be inspected, without dismantling the whole drive. Furthermore, by removing a screw, the loose portion of the coupling on which the pinion is fitted can be withdrawn from the motor, the whole coupling gear being thus entirely uncovered (see Fig. 3). As will be seen from Figs. 1 and 2, the motor can be arranged symmetrically or unsymmetrically on its support, this being, in many cases, a further advantage when adapting this drive to various types of looms. It is, therefore, possible, even in weaving sheds where looms of different types are in use, to have individual drives similar in design and appearance, thus greatly facilitating their supervision and maintenance.

Efficiency Figures.

Owing to the high efficiency of the gearing and the low friction losses in bearings, the current consumption of this type of drive is, it is claimed, considerably less than that of a belt drive, all conditions being equal. Even in the case of the most favourable speed ratio for belt driving, a saving in current of 6 to 10 per cent. can be effected by using the geared drive, while with a speed ratio of 1 to 9·5 tests have shown that a saving of about 26 per cent. could be ensured. Furthermore, as the motor starts up light, it reaches normal speed very rapidly, and then sets the loom in motion immediately.

In the foregoing, only the main features of the new Oerlikon geared individual drive have been considered, as a complete study of its various parts would hardly be possible within the limits of this article. A detailed description of this interesting drive will, however, appear shortly in one of the numbers of the "Bulletin Oerlikon," where full particulars of the Oerlikon patent automatic

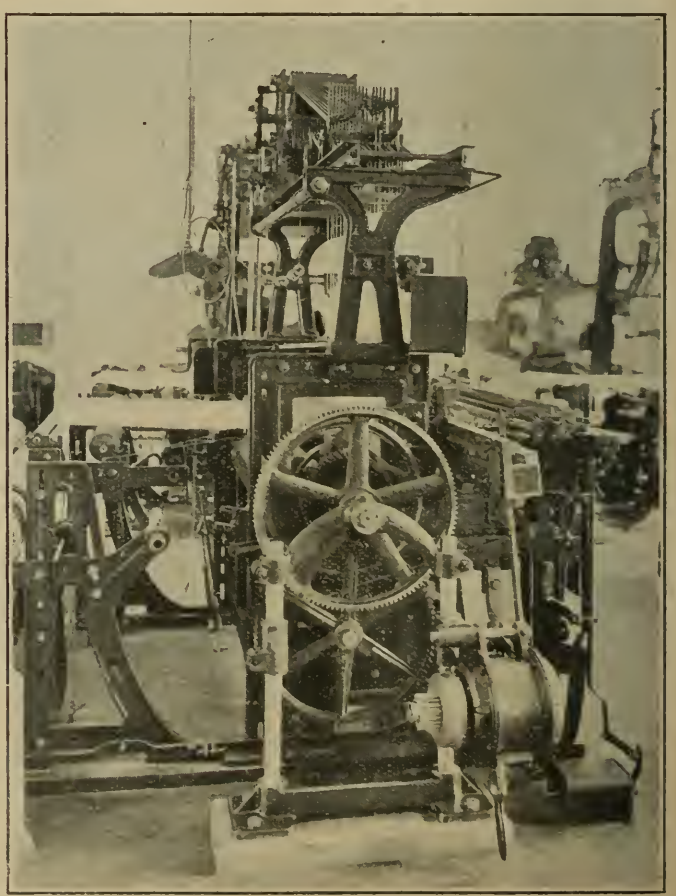

Fig. 5.—View showing Loom Motor swung out for Inspection of Gear.

centrifugal coupling will be found. Mr. G. Wüthrich, M.I.E.E., General Manager and Chief Engineer of Oerlikon, Ltd., 34-35, Norfolk Street, London, W.C. 2, will be pleased to forward this Bulletin to all interested in the matter and also to give any information that may be desired regarding the textile specialities of the Oerlikon Company.

Hydro-Electric Power in India.*

By A. T. ARNALL.

The development of the water-power resources of a country depends not only on the facilities provided by Nature, but also on the facilities afforded by its Government for the exploitation of this national asset. It also depends on the demand that exists for power within an economic transmission distance of the power sites. But many successful schemes have been promoted where no demand existed for power and an outlet was provided for the energy by the establishment of new industries. In British India the necessary authority to develop water power is obtained in the form of concessions from the Local Governments; and the Native States, speaking generally, have power to grant water-power concessions within their territories on their own terms. Before a concession for a water-power scheme is granted, the applicant must submit a definite scheme, and for this purpose the Local Government will usually grant a conditional prior claim to the power site for three years. In order to put the provisions of the Land Acquisition Act into force, there must be an enquiry by an officer appointed by the Local Government into (*a*) whether the proposed acquisition is needed for the construction of some work, and (*b*) whether such work is likely to prove useful to the public. If the officer reports affirmatively on both points, the company must then enter into an agreement with the Secretary of State for India in Council. The interpretation of the words "likely to prove useful to the public" has been the subject of much discussion and it would also appear desirable that rules should be issued on (*a*) the terms and conditions which properly belong to water-power concessions, and (*b*) the terms and conditions which should properly be inserted in agreements for the compulsory acquisition of land for water-power schemes.

Licence for Supply of Electricity.

In addition to the concession and the land acquisition agreement, the power company in most cases will need a licence under the Indian Electricity Act of 1910. Such a licence would be required by a company supplying electric energy to the public generally within specified areas, but it would not be required by an undertaking supplying power exclusively to a number of electrochemical factories located adjacent to the generating station. For transmission lines from the generating station to distant areas of supply, the Governor-General in Council has authority to confer upon a licensee such powers as may be necessary. These powers cannot be conferred upon non-licensees, and if a company desires to transmit power in bulk to distant towns and electrochemical factories, it may be necessary for the company to obtain a licence, although it does not contemplate the actual distribution of the power to the public. For important lines, transmitting power to large industrial centres or to railways, it will generally be found desirable to purchase a strip of land on which to erect the line.

Interest During Construction.

The Local Government has power under the Indian Companies Act to sanction the payment by a registered company of interest out of capital during the period of construction, on the share capital paid up, at a rate not exceeding 4 per cent. per annum. The Act now requires amendment to permit of a higher rate of interest being paid.

Compulsory Purchase.

The local authority, or, in certain circumstances, the Local Government, has the option of purchasing compulsorily a licensed undertaking after the expiration of a period not exceeding fifty years, at the fair market value of the lands, buildings, works and plant of the undertaking, but excluding the generating station, unless it be declared in the licence to form part of the undertaking for compulsory purchase. The Indian Electricity Act is not clear as to whether the term "generating station" includes all the lands, reservoirs and other hydraulic works of a water-power undertaking. The author believes the more expeditious way of encouraging the development of India's water-powers lies in inducing Government to review its policy regarding water-power concessions, with the object of seeing how it can be stablised and how water-power concessions can be made more attractive in future. If the Government is in a position to render financial assistance in the development of the country's water-powers, that assistance could best be given in the construction of the roads and railways, which are usually in any large scheme.

Water Power Resources.

The Indian water-power survey has up to the present disclosed the existence of over 130 possible water-power sites, of which only a small percentage have been thoroughly examined. It is estimated that there is a total of 1 774 000 continuous E.H.P. already in sight, but this is much below the actual available power that final results will disclose. Many millions of horse-power could certainly be obtained from the Himalayan Mountains and the great rivers of Burma. For example, the combined minimum discharges of the Indus, Chenab, Jhelum, Sutlej, Beas, Jumna, and Ravi Rivers amount to over 36 000 cub. ft. a second, where they enter the plains, which is equivalent to over 3 000 000 H.P. per 1 000 ft. of fall; and these rivers and the tributaries that feed them rise in mountains up to 20 000 feet or more in altitude. Similar considerations apply to the Ganges, the Sarda, and many rivers rising outside British India to the east up to the Brahmaputra, and again in Burma to the Irrawaddy and the Salween. In a table the author gives a list of the existing hydro-electric plants in India, totalling 91 325 E.H.P. installed, and in another table a list of plants being installed, totalling 148 750 E.H.P. Out of a total capacity of 240 075 E.H.P. of plant installed and under construction, 189 000 E.H.P. or 79 per cent. of the total for India, is for the supply of power to Bombay City, and is due to the enterprise of Tata, Sons & Company.*

Objects of the Survey.

The objects of the survey for the present are limited to ascertaining—(1) where water-power can be developed, (2) how much power can be developed, (3) on what lines the development should proceed, and (4) whether a particular development will be (comparatively speaking) a cheap one, or otherwise. Information valuable to the water-power engineer already exists in India, in maps published by the Government Survey, and in the rainfall and river gauging records of the Meteorological and Irrigation Departments. The new survey sheets give definite contours from which, generally a rough idea can at once be formed of the possibilities of a water-power site when studied in conjunction with available rainfall records. In a few years all essential information for the development of India's water-powers should be available in a concise form for general public use.

Western Ghats Schemes.

The hydro-electric schemes constructed and under construction in the Western Ghats constitute about 80 per cent. of the total hydro-electric undertakings in hand in India and Burma. There are four hydro-electric schemes under the managing agency of Tata, Sons & Company—namely, the Andhra Valley Power Supply Company, the Tata Hydro-Electric Power Supply Company, the Tata Power Company, and the Koyna River project. These four schemes completed would be capable of supplying Bombay City and neighbourhood with 915 000 E.H.P. (for 3 600 hours each year) at a maximum of three-farthings per unit. The Igatpuri project, which is not as yet designed in detail, may find an outlet for its power in the electrification of the Thull Ghat section of the G.I.P. Railway near Igatpuri, and in providing power for industries at Igatpuri, in the Deccan. The writer believes that a catchment area of about 60 square miles can be utilised, with a head of 1 000 ft. on the turbines and an available storage capacity of some 3 000 million cub. ft. in the proposed reservoirs. The scheme is probably capable of an output of 20 000 E.H.P. *ex* power-house for 3 600 hours per annum. The Andhra Valley Power Supply Company's undertaking which has been under construction about five years is now nearing completion. The entire project was designed by Mr. H. P. Gibbs, and the generating plant consists of six 8 000 kW sets, generating current at 5 000 V, 50 cycles. The energy will be transmitted to Bombay City at 100 000 V, over a transmission line 53 miles in length, where it will be transformed down to 20 000 V and distributed at that pressure to consumers by underground cables. The company was able through co-operation with the Bombay mill-owners to secure a contract price of 0·725 anna per unit for the supply at 20 000 V. The mill-owners will bear the cost of transforming from that pressure to 2 000 V, the standard pressure for mill-driving in the city, and provide and install their own electrical equipment for driving the mills. The whole output of the undertaking is sold and the success of the enterprise well assured.

The Tata Company and the Textile Load.

The Tata Hydro-Electric Power Company's undertaking has been in operation for six years, and was designed by Mr. Alfred Dickinson, consulting engineer to the company. It was the first scheme of such magnitude to be undertaken in India, and its success is largely responsible for the extensive development of water-power in the Western Ghats now in progress. It is supplying the cotton industry of Bombay with an average load of about 40 000 H.P. A charge of 0·5 anna (½d.) per unit is made for the supply at 2 000 V, and 0·55 anna per unit for supply, including the equipment of the mills by the power company with motors, cables, switch-gear, &c., and their complete upkeep. The company is paying a dividend on its ordinary shares of from 7 to 8 per cent. per annum. The construction of the Tata Power Company's undertaking, also originated and designed by Mr. Gibbs, was commenced in 1919, and is being carried out by the company's own constructional

* Abstract of a Paper read before the East India Association.

* Particulars of these plants have been published in THE ELECTRICIAN.

staff under the advice of the Tata Engineering Company. It is designed for the ultimate supply of 150 000 H.P. to Bombay, but for the present only sufficient plant will be installed for the supply of 75 000 H.P. Applications aggregating 50 000 H.P. have already been registered on the waiting list of the undertaking, which, inter-connected with the Andhra Valley and Tata Hydro-Electric schemes, will assist in the supply of power for the electrification of the Bombay City, suburban and Ghat sections of the railways. An unfortunate delay has occurred owing to the opposition of the inhabitants of the lands that will be submerged by the storage reservoir to the acquisition of their properties.

The Koyna River Project.

The Koyna River project, originated and investigated by the writer, is capable of an output of 650 000 E.H.P. (for 3 600 hours each year), and is intended to provide energy for electrometallurgical and electrochemical industries near the power stations, for public electric supply in Bombay City (as an extension to the supply by the existing three power-supply companies) and for public electric supply to all towns within economic range of transmission. The proposal to establish electrometallurgical and electrochemical industries at Koyna is the first comprehensive scheme of its kind thoroughly investigated in India.

Development of Bombay.

Bombay City is the premier port of India, has a population of about 1 200 000, and is by far the most important centre of cotton spinning and weaving in India. The chief industry of the city is the spinning and weaving of cotton, but there are many important woollen and flour mills, general engineering and railway workshops, oil-mills and chemical factories. In 1916 there were 266 cotton mills in India, containing 6 839 877 spindles and 110 268 looms, and employing on an average 274 361 hands daily ; of these, Bombay City possessed eighty-six mills, containing 2 984 575 spindles and 53 205 looms, and employed 118 303 hands. If this number of spindles and looms, in Bombay City in 1916 had been driven electrically, they would have required a supply of approximately 100 000 E.H.P. At present about 1 000 000 bales of cotton are consumed annually by the city mills, and in addition about 1 700 000 bales are exported from its port. It is obvious that this industry will expand indefinitely, if proper industrial town-planning schemes are carried out, for Bombay City and its neighbourhood offer all necessary facilities in an abundant and cheap supply of raw materials, cheap power, a suitable climate, experienced labour, low transport charges by sea and land, and in possessing one of the largest markets for cotton goods in existence.

Textile Mill Motors.

As we show in other articles published in this issue there is every reason to suppose that the future hydro-electric development in India will be very great. Some progress is, however, being made at the present time in which we are glad to learn British electrical manufacturers are taking part. As an example we may quote a recent order obtained by BRUCE PEEBLES & COMPANY for textile mill type slip-ring induction motors which are to form part of a complete hydro-electric installation of an important mill in India.

Fig. 1 shows these motors which collectively have an output of 400 H.P. Each machine is fitted with textile mill enclosing covers, and Peebles' patent short circuiting and brush lifting gear.

The motors are all of Peebles standard construction, the stator and rotor cores being of electrical steel laminations of the highest permeability, each carefully insulated while the slots are of nearly closed form. Each core is rigidly clamped between heavy cast-iron end-plates, and spacing discs are inserted at frequent intervals to provide ventilation channels. The end-plates are secured by keys the use of through bolts being thus avoided.

The windings of both stator and rotor (the motors illustrated are all of the slip-ring type) are either of the wire or bar type, depending on the amount of current ; the core slots are lined with insulating tubes of such composition that ample mechanical strength is combined with the best insulating properties. All windings are thoroughly treated with insulating varnish by a special process which ensures every part of the windings being thoroughly impregnated.

All motors are provided with air gap adjusting arrangements, each end cover being fitted with four set-screws, by means of which a very fine adjustment can be obtained at each end of the machine. The motor shafts are of special mild steel designed so as to operate safely under the most severe working conditions.

All the motors on the installation in question are fitted with Peebles patent short circuiting and brush lifting gear, which is claimed to be the most efficient and simple device of its kind on the market. Both the functions are performed with one continuous movement of the lever handle, a safety catch being provided, by means of which the operating lever is locked in either the " starting " or " running " position.

The Coming Electricity Bill.

Speaking at the annual luncheon of the BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION on Wednesday, Mr. Arthur Neal, Parliamentary Secretary of the Ministry of Transport, made the interesting announcement that Lord Peel would shortly introduce a further Electricity Bill in the House of Lords. This would be a non-controversial measure designed solely to clothe the joint authorities with the necessary financial powers, and to deal with other matters upon which the electrical industry desired legislation. Mr. ATKINSON speaking earlier had said that one of the things that the electrical industry most earnestly needed was stability. Rumours that electrical legislation on a drastic scale was in contemplation made it impossible for those concerned with the larger issues to move. It had been amply demonstrated recently that capital was plentiful for the development of the electrical industry, and that, given stability, there was no reason why it should not move forward more quickly than any other. Mr. ARTHUR NEAL also remarked that given good will no further legislation was contemplated by the Government, and that the industry had nothing to fear from Government interference.

The B.E.A.I. Research Association.

The annual general meeting of the BRITISH ELECTRICAL AND ALLIED INDUSTRIES RESEARCH ASSOCIATION was held on Feb. 3, at the Institution of Electrical Engineers.

Mr. W. O. SMITH (elected to the chair) expressed regret at the unavoidable absence of Mr. C. H. Wordingham, and appreciation of his many services in the past. During the course of his remarks in introducing the first annual report he referred to the good work done by some fifty committees, and the indebtedness of members to those gentlemen who gave so much of their time to this service.

Mr. D. N. DUNLOP, in seconding the adoption of the report, referred to Mr. Wordingham's indefatigable interest and assistance in all the work of the Association, and the indebtedness of members to those firms who had allowed members of their staffs to give so much time to the work of the Association. He mentioned Mr. A. R. Everest in particular, without whose help the B.E.A.M.A. Research Committee would have laboured under great disadvantages. Whilst a good beginning had been made—and the manufacturers had agreed, in a public-spirited way, to find £8 000 per annum for co-operative research for five years for the benefit of all concerned with the electrical industry—it was becoming exceedingly difficult to find money for such purposes whilst orders were being placed with foreign competitors. He thought that purchasers did not properly appreciate what manufacturers were doing to advance the common interests, and how difficult the position was, due to the conditions of international exchange and foreign competition.

Mr. C. P. SPARKS, in seconding the adoption of the accounts and balance-sheet, which had been moved by the chairman, expressed appreciation of the continuous services of the Finance Committee, of which Mr. W. O. Smith was chairman, and of the invaluable assistance of the B.E.A.M.A. in finding the sinews of war, and the personal services of Mr. D. N. Dunlop in establishing the Association.

FIG. 1.—BRUCE PEEBLES TEXTILE MOTORS FOR INDIA.

Institution of Electrical Engineers' Dinner.

The annual dinner of the INSTITUTION OF ELECTRICAL ENGINEERS was held at the Hotel Cecil on Tuesday night in connection with the Jubilee Commemoration. In the absence of the President, which everyone deplored, the chair was taken by Dr. W. H. ECCLES, F.R.S.

Among those present were the Postmaster-General (Mr. F. G. Kellaway), Lord Southborough, Air-Marshal Sir H. M. Trenchard, Mr. Justice Sargant, Sir Charles Parsons, Sir A. Bowlby (President of the Royal College of Surgeons), Dr. H. S. Hele Shaw (President of the Institution of Mechanical Engineers), Sir William Pope (Acting President of the Society of Chemical Industry), Sir A. Durrant (Office of Works), Sir W. H. Bragg, Sir R. T. Glazebrook, Dr. S. Z. de Ferranti, Prof. E. Barker (Principal of King's College), Prof. A. W. Porter (President of the Faraday Society), and Prof. J. W. Nicholson (President of the Rontgen Society).

At the commencement of the proceedings a telegram was sent from those present to Mr. Highfield, and an answer reciprocating the wishes expressed for his speedy recovery was received during the course of the evening.

Congratulatory Messages.

A letter from H.R.H. the Duke of York regretting his inability to be present was read by the President. The DUKE expressed his hope that the Institution would continue to prosper and render the same yeoman service in the future as it had done in the past for the benefit and advancement of the science, commerce and industry of the country.

Greetings were also read from kindred societies in America, Italy, France and Holland, from Mr. T. A. Edison and from the Institution of Gas Engineers.

Fifty Years' Progress.

The POSTMASTER-GENERAL proposing the toast of the "Institution of Electrical Engineers," said that it was not unfitting that the head of the Post Office should propose this toast, because during the fifty years of the Institution's existence the relations between it and the Post Office had been close and nearly always friendly. In that short period the membership had not only grown from 100 to over 10 000 but the science and art of the electrical industry had made one of the most remarakble developments in the whole history of human endeavour. At the time when the Society of Telegraph Engineers was founded nothing was known of telegraphy, and nothing of course of wireless telegraphy and telephony; and no man in those early days, however audacious his imagination, could have foreseen the changes which that period of fifty years had produced.

If such advances had been made in fifty years no limits could be placed on the progress of the science and the art in which the Institution of Electrical Engineers was engaged. They had a right to be proud of the fact that the greatest contributions to the science of electricity had come from Britons, and comparing the electrician's work with that of the politician's he had to admit that the electrician had the more excellent part to play, a sentiment with which his listeners uproariously agreed. The politician's task in relation to electrical engineers was to see that their energy and genius was set free to develop under the most favourable conditions.

Dr. W. H. ECCLES, in reply, called attention to the fact that this was the first dinner which had been held since the Royal Charter was granted and the King had become their patron. The Institution of Electrical Engineers was the largest professional institution in the country, and the reason perhaps was that electrical engineering had many more varied applications than any other kind.

Electricity and the Air Services.

In replying to the toast of the "Visitors" which was proposed by Mr. LLEWELYN B. ATKINSON, Air-Marshal SIR HUGH TRENCHARD remarked that the youngest of the nation's armed services depended entirely for its development upon electricity, for without wireless it would be impossible to develop all the power there was in the air, and they therefore hoped to receive in the future the most valuable assistance from the Institution.

Mr. JUSTICE SARGANT, who also replied, said he had come very closely into contact with electrical engineers as chairman of the War Inventions Board. His difficulty had been to hold the balance between claims of the inventors and the claims of the taxpayers, and he hinted that both as regards scientific and financial ability there was not much to choose between electrical engineers and other classes of the community.

The evening concluded with a crowded reception in the Victoria Hall, and it may also be noted that the cloak room arrangements were rather worse than they were last year.

On Wednesday next (March 1) Princess Alice will open the "DAILY MAIL" IDEAL HOME EXHIBITION at Olympia at 3.30 p.m., when admission will be by invitation only. The building will be opened to the public at 5 p.m., but each other day (until March 25) the exhibition will be open from 10 a.m. to 10 p.m., at a charge of 2s. The varied display includes a vast working demonstration of newest devices and inventions for houses and gardens.

Duke of York at Osram Lamp Works.

The DUKE OF YORK paid a visit last week to the Osram lamp works of the General Electric Company, Ltd., at Brook Green, Hammersmith. He was attended by Wing Commander Louis Greig, and was received on arrival at the works by Mr. C. Wilson and Mr. J. Y. Fletcher, directors of the company (in the unavoidable absence through illness of Mr. Hugo Hirst), and other members of the Board and officials of the company.

The Duke of York proceeded to make a tour of the works, displaying throughout the keenest interest in the workpeople, 1 500 of whom out of a total of 2 100, are girls. All the principal processes connected with the making of Osram lamps were inspected, from the making of the filament from scheelite, through the various departments to that in which the finished article was seen. Of all the processes none appeared to impress him more than the ease and skill with which the work girls handled the extraordinarily fine tungsten wire for use in the lamps.

Throughout his tour the Duke chatted freely with the workpeople and asked them about their length of service, their hours, and their general conditions of employment. Noticing an invalid-carriage, he inquired what possible use they could find for an appliance of that kind in their lamp works, and learned with satisfaction that wherever it was possible to do so disabled ex-service men were employed in the works, and the invalid carriages were provided for them. His Royal Highness' attention was called

DUKE OF YORK AT THE OSRAM WORKS.

to two volumes prepared by the firm, a Roll of Honour giving the names, short histories, and the photographs of the men who fell, and a record of the various war activities of the G.E.C., a copy of both of which he accepted.

As President of the welfare movement he emphasised the importance of welfare work in so extensive an industrial concern; at the same time expressing his appreciation of the admirable arrangement which he had inspected during his tour. His Royal Highness went to the Red Cross department, to the dining rooms, and to various other departments connected with the welfare of the workers.

When he was about to leave the Duke of York told Mr. Wilson that he had inspected many industrial concerns, but never one that afforded him greater interest than these works. He expressed regret that he could not go into every section, but explained that he was due to leave London for hunting in Warwickshire. He hoped, however, that opportunity might arise for a further visit. Hundreds of girls thronged the exit and gave an enthusiastic farewell to the Prince. So persistent were they that it was found difficult to get his car away.

"Sweet are the uses of advertisement." One of the first remarks passed by the Royal visitor to Mr. C. Wilson, upon arrival, was "Your lamp is the one advertised with the Elephant, is it not?"

At the GLOUCESTER SPRING ASSIZES recently the manager of Messrs. Pearks' branch shop at Cheltenham, who was prosecuted by the G.W.R. Company for causing an attempt to be made to obtain certain sums of money, with intent to cheat and defraud, was found guilty and sentenced to three months in the second division. Railway companies have been frequently the victims of misrepresentation and fraud, and it has been found necessary to inaugurate a system whereby these malpractices are brought to light. In the case in question the accused made claims upon the company for loss and pilferage, but a special examination and check of the consignments prior to delivery proved that such claims were false.

The Wimbledon Emeute.

There is evidence that public opinion in WIMBLEDON has been roused by the Council's action in summarily dismissing their chief electrical engineer, Mr. Tomlinson Lee. As soon as the decision became known, a petition was started asking that a town's meeting should be called to consider the subject, and in a short time over 1 600 signatures were obtained.

This illustration of public opinion has, however, failed to move the MAYOR, who, in a letter acknowledging the petition, gives it as his opinion that public discussion upon the question whether the Council should or should not dispense with the services of one of their officials can lead to no useful results, and he does not think it desirable in anybody's interest to debate in public an official's qualifications for his office, or the reasons which have led up to and culminated in the decision complained of. He goes on to point out that the members of the Council are elected by the ratepayers to look after the town's business, including the electricity undertaking. If the actions of the Council do not meet with the approval of the electors, the latter may exercise their constitutional rights and refuse to re-elect them when they next offer themselves for re-election. But whilst they are the representatives of the town they must act according to their best judgment, and they must face the consequences, pleasant or unpleasant.

The Mayor points out that the termination of Mr. Lee's engagement was unanimously decided upon by the Electricity Committee, in consultation with the General Purposes Committee, and that the decision was carried into effect in a way which would give rise to the least possible friction. Mr. Lee refused to resign except upon financial conditions which were impossible, and no other course was, therefore, left open to the Council.

A Public Meeting.

This restatement of the case, which throws a little further light on the inner workings of a municipal body, has, however, failed to satisfy the petitioners, who have issued a notice calling a public meeting to discuss the whole question. This meeting will be open to all, and will be held in the Baths Hall, Wimbledon, at 7.45 p.m. on Monday next, Feb. 27. We shall be interested to see the result, but in the meantime we call attention of the electors of Wimbledon to the hint given by the Mayor on how to deal with the matter. The procedure suggested, though slow, will be nevertheless sure, and is one which should be more widely adopted in local affairs than has often been done up to the present.

Post Office Engineering Progress.

Proposing the toast of the "POST OFFICE ENGINEERING DEPARTMENT" at the annual dinner in London last Friday, Mr. H. Pike Pease, M.P., said the Department had made great strides in the past year, and the future seemed very bright. There had been increased efficiency all round. With regard to main underground wires, good progress continued to be made. Seven hundred and twenty miles of single duct were laid, and 116 730 miles of double wire drawn in. In connection with the extension of local telephone facilities, 1 000 miles of single-way duct were laid and 100 000 miles of double wire drawn in. About 500 overhead trunk telephone circuits were provided, involving the erection of approximately 10 000 miles of double wire. Referring to automatic telephones, Mr. Pike Pease said automatic exchanges were of an enormous advantage, and plans had been prepared for six new exchanges with 11 000 lines, and 3 500 extensions to four other exchanges. With regard to the telegraph development, the chief feature had been the installation of machine printing apparatus. He had no hesitation in saying that the telephone system in this country to-day was far ahead of any other country in the world. A new method of automatic through-switching on telegraph circuits had been devised on the same principle as the automatic telephone switching. This was being developed and promised good results.

Trade Terms and Conditions.

An informal meeting between representatives of the PRINCIPAL ASSOCIATIONS WITHIN THE ELECTRICAL INDUSTRY, which was recently convened by the E.D.A., took place last week at the Engineers' Club. Some of the more important commercial issues between the different branches were discussed freely, and although the proceedings were private, we are able to say that the representatives went away with something of interest to report to their associations. There is also reason to believe that negotiations now in progress will be assisted by the interchange of views which took place.

It is possible that this conference may be followed by others of a similar character, and it is hoped that problems which may occasionally be beyond the "give and take" limits of a purely sectional meeting will appear less difficult after they have been examined for further points of view of the whole industry.

This method of handling the more obstinate difficulties will increase understanding and sympathy between the several groups who after all must, to enjoy individual success, achieve a common end.

After further considering the application for a reduction of 6s. per week in wages, the Joint Industrial Council for Electrical Workers in SOUTH WALES AND MONMOUTHSHIRE, meeting at Cardiff last week, decided to forward it to the National Joint Council. The application had previously been referred to arbitration, but this was found to be the wrong procedure.

Legal Intelligence.

Dispute About a Petrol-Electric Lighting Set.

In the Shoreditch County Court, on the 16th inst., Louis Newmark sued Semco, Ltd., for the recovery of £99 15s. for fraudulently misrepresenting that a 2 kW air-cooled petrol electric generating set was practically new, and had only been run for two hours, whereas it was old, and in an unfit condition. It was explained that the set was required for a house plaintiff was having built at Rickmansworth, and was sold at the end of December, 1920, for £80.

HERBERT NEWMARK, plaintiff's son, said that early in December, 1920, he went to defendants' premises with a Mr. Jay, an electrical engineer, and saw the generating set. He was told it was practically new, and had been run for only two hours. After it was installed it was continually misfiring, and usually stopped. He was never told it was second-hand. Later, after his visit to defendants, his father saw it with an architect and an electrical engineer, and the purchase was decided upon. When it was supplied it was guaranteed to carry a full load. In April, an unsuccessful attempt was made to work the engine. A second attempt was made in May, when it was found that, owing to faulty wiring there were some dead shorts. Captain Wood had the matter in hand for defendants, and in August there was a fairly successful trial. After that, witness (aged seventeen years) was running the plant. He denied that Captain Wood told him constantly that it was under-lubricated. About this time the fly-wheel broke, and later the crank shaft. He agreed that Captain Wood complained that the concrete bed was not right, but he understood it was put right.

Mr. H. BRINE, architect, said he heard the representative of defendants say it was practically new, and run only two hours; and Mr. King, electrical engineer, gave similar evidence, the latter stating he put the faulty wiring right in half an hour.

Mr. L. NEWMARK said he understood the plant to be unused war stores. Before buying, he asked if it was in perfect condition, and got the same said to him as the other witness had deposed to. The machine had never done its full load. He concluded he had been defrauded when the crank shaft broke.

Mr. WM. PAYNE, general manager to Jones & Sons, electrical engineers, said he was asked to look at the set, and advised a lot of things to be done, which would certainly not have been necessary had it have been in perfect running order. Defendants had those carried out by Messrs. A. Thompson & Son, electrical engineers.

For the defence, Mr. CLARENCE RAPSON, managing director of defendants, said the set was purchased in September, 1920, and he had never authorised anyone to make the representations suggested; and ERNEST ANDERSON, the salesman, denied using the words attributed to him.

Captain N. WOOD said that not a word was said by him about guaranteeing the set. He gave directions as to the concrete bed which were not carried out, so that it was impossible to ensure sufficient cooling. In April, when started up, the engine back-fired, and so hurt his arm that he was unable to go on with the work for some time. On Aug. 9 he got a perfect test, and it took a full load for the required time. After that the Newmark family took it over. He saw it after, and it was under-lubricated. On Oct. 1 he gave it an economy test, when it ran well for twelve hours on paraffin.

In giving judgment, Judge Cluer said he did not think defendants had satisfied their guarantee that it was in perfect running order, and although it was tested up to two hours, that did not mean it was to just do that and stop. On those grounds only he should award plaintiff £35 damages and costs.

B.T.-H. Company v. Corona Lamp Works.

The hearing of this action was concluded on Thursday last, and Mr. Justice Astbury reserved judgment.

Mr. HORATIO BALLANTYNE gave evidence for defendants. He had read the plaintiffs' specification, and it certainly conveyed to him the meaning of obtaining a coefficent of expansion corresponding to that of glass. He thought he appreciated what the patentee had in view in aiming at getting the same coefficient of expansion in the wire and glass, and he knew what to do to carry that out. The procedure, as he understood it, was to ascertain the co-efficient of expansion of the wire—that was to say, to take a length of wire, heat it, measure it, and note its increase in length throughout the period of heating. That was the standard method of ascertaining the co efficient of expansion of the wire. That was what he supposed was intended to be done in that specification.

HIS LORDSHIP.—In taking a metal or an alloy there is absolutely no difference in measuring the co-efficient, whether you do it longitudinally or laterally?—No.

In answer to Sir D. KERLY, witness said, assuming that the specification was addressed to a lamp-maker, the latter would be familiar with the fact that wire and glass might have different expansions. It was common knowledge that one must have a wire with the appropriate expansion of glass. Cross-examined by Sir A. COLEFAX, K.C., for plaintiffs.—Do you agree with this, that you do not find disclosed in any of the alleged anticipations the subject-matter of the plaintiffs' patent?—I certainly do not find in them anything about proportioning so as to get the coefficient of expansion of a certain kind.

The answer is that you do not find the subject-matter disclosed?—If that be part of the subject-matter, I do not.

Dr. HOLST, head of the physical laboratory of Messrs. Phillips' Lamp Works at Eindhoven, Holland, said they began making copper-clad nickel-iron core leading-in wire for their lamps in 1914. He did

not know at that time of plaintiffs' specification. They came to use copper-clad nickel-iron core leading-in wire in consequence of a communication they had that it was used by other factories, and so they began to try it themselves, without any assistance as to how they were to make it.

Mr. Augustus C. Hyde, a maker of leading-in wires, said he was with the late Sir Joseph Swan. He and the Vactite Company worked on friendly terms with the Société Fourchambault, whose patent had also been put in, and they were both concerned with nickel-iron leading-in wires.

Mr. Cecil M. Masters, stores manager of the Corona Lamp Works, gave evidence as to identifying certain lamps complained of as infringements. They had been dealt in by his company, and they had been got from America, being delivered to them by the Express people.

Edison Accumulators, Ltd. v. Cox Bros.

In the Outer House of the Court of Session (Edinburgh) on Saturday last, Lord Blackburn delivered judgment in this action for the recovery of £702. 7s. 5d., the price of an electric tractor and other apparatus which defendants purchased from plaintiffs on May 6, 1920. The tractor was intended to be used for transport purposes within defendants' works, for which hitherto they had used horse traction. An essential and important part of the work for which the tractor was desired consisted in the backing of wagons or lorries into bays. Defendants said that some time after the tractor was delivered it was found that it could not push an ordinary horse-drawn lorry backwards into the bays, which, they alleged, was contrary to what plaintiffs' representative had led them to believe, and they rejected the tractor. Plaintiffs submitted that the machine was sold as a tractor, and could not be used for backing, for which it was not intended.

Lord Blackburn gave judgment for plaintiffs, with costs. He held that no warranty was given that the tractor would be suited for pushing ordinary lorries into the bays.

Charges of Alleged Fraud.

At Leeds, on Tuesday, Wm. Aaron Davis, electrician, of Farnley, was committed for trial on five charges of obtaining money from persons in different parts of the country for investment in alleged bogus companies. It was stated for the prosecution that about £10 000 was involved, and at the previous hearing the magistrate had decided to convict on four charges of obtaining sums, ranging from £2 to £250. On Tuesday he decided to commit on a fifth charge of obtaining £10, and he declined an application for bail.

Exhibition Notes.

One of the features of the exhibition of modern homes, which was opened at Harrods on Monday, is a model laundry, in which all the work is done by electricity.

Special excursions at greatly reduced fares are to be run by the railway companies in connection with the British Industries Fair, which will be held concurrently at the White City, London, and Castle Bromwich Aerodrome, Birmingham, from Monday next, February 27th to March 10th. The fare will in most cases be approximately the price of a single ticket for the double journey where passengers making use of the special excursions, return on the same day. For passengers who desire to make a stay of from two to six days the cost of a return ticket will be about one-third more than the usual single fare.

Obituary.

The death is announced, from pneumonia following influenza, of Dr. James Francis Bottomley, at the age of forty-seven.

We regret to record the death of Mr. H. Eeles, secretary of the Oxford Electric Company, Ltd., which took place suddenly while he was addressing a meeting at Oxford on Tuesday.

The death is reported, at the age of seventy-seven years, of Mr. Wm. E. Kenway, who formerly, for eleven years, was generat manager of the Birmingham and Midland Tramways.

Trade Inquiry.

A Canadian Company desire to receive quotations, with samples and particulars of delivery, from United Kingdom manufacturers of the following materials :—½-in., ¾-in., 1-in., 1½-in. cotton tapes, in 36-yd. rolls. (Approximate quantity at a time, 100 gross yards); 0·005-in., 0·010-in., 0·015-in., 0·020-in. press-board or press pahn insulating paper. (Quote in 100 lb. lots); 0·005-in., 0·010-in., 0·020-in., 0·030-in. sheet flexible mica, for moulding purposes, also for commutator use. (Quote in sheets, giving dimensions, 50 lb. lots.) Red and black fibre sheets and tubes in all sizes. (Varying quantities required); 0·005-in., 0·010-in. oiled cambric cloth and tapes cut on bias. (Quote per gross yards.) Particulars may be obtained on application to the Department of Overseas Trade. (Reference D.O.T.7 866/E.D./S.C.2.)

The Stock Exchange Committee have ordered the following securities to be quoted in the Official List :—£750 000 6 per cent. second mortgage debenture stock of the Newcastle-upon-Tyne Electric Supply Company, Ltd., and £300 000 7½ per cent. debenture stock of the Shropshire, Worcestershire and Staffordshire Electric Power Company. Dealings in 200 000 £1, fully paid, 8 per cent. cumulative preference shares of the Scottish Power Company have been specially allowed.

Parliamentary Intelligence.

Scottish Private Bills and Orders.

It has been decided that the following Scottish Provisional Orders are to be proceeded with as private Bills :—The Grampian Electricity Supply and the electricity part of the Ayr Burghs Order.

The following Provisional Orders have complied with the Standing Orders :—Aberdeen Corporation, Ayr Burgh (Electricity, Tramways, &c.), Glasgow and Rutherglen Corporations, and Grampian Electricity Supply.

In the case of the Glasgow Corporation Order the general orders have not been complied with, as the consent of the local authorities beyond the city of Glasgow has not been proved as regards the whole of the proposed tramways Nos. 6 and 7, and so much of tramways Nos. 1 and 5 as are beyond the city of Glasgow.

Railway Electrification Schemes.

A meeting of the Industrial Group at the House of Commons on Monday discussed railway electrification schemes in the South of England from the point of view of providing employment. Sir William Pearce presided, and among those present were Sir William Forbes, representing the Brighton Railway, and Mr. Tempest, representing the South-Eastern Railway. After a long discussion a committee was appointed to investigate the proposals put forward, and report to a further meeting of the group to be held on Monday. The committee consists of Sir Alexander Richardson, Mr. A. M. Samuel, Mr. Frederick Wise, and Mr. P. J. Hannon.

Tramcar and Omnibus Stopping Places.

In reply to Mr. Gilbert (House of Commons, Feb. 20), Mr. Neal stated that it had been suggested that a regulation should be made requiring vehicles passing on the near side of a stationary tramcar to slow down whilst so doing, but it was doubtful whether the Ministry of Transport had power to make such a regulation, and in any case it seemed undesirable to do so. It would be difficult to enforce it effectively in view of the large number of tramcar stopping places, and in the opinion of the police authorities it would probably increase the number of accidents rather than prevent them, and would also lead to further congestion.

Telephone Service (Isle of Man and Jersey).

In reply to a question by Mr. R. Richardson, the Postmaster-General (Mr. F. G. Kellaway) stated that as the telephone systems in the Isle of Man and in Jersey are self-contained, it was not essential that they should be administered by the Post Office in common with the telephone system of the United Kingdom. The terms on which he was prepared to issue a licence to the Insular Government for the conduct of telephone business in the Isle of Man were communicated to the Lieut.-Governor some months ago; but an application for a licence had not yet been received.

The Telephone Service.

On the motion of Colonel Gibbs, the House of Commons have reappointed the Select Committee to inquire into the organisation and administration of the telephone service and the method of making charges. The members of the Committee are Sir Evelyn Cecil, Mr. Hayward, Mr. Hodge, Mr. Hohler, Mr. Holmes, General Sir Archibald Hunter, Sir Evan Jones, Mr. Lynn, Sir W. Lane-Mitchell, Capt. Moreing, Mr. Perring, Sir Alex. Richardson, Mr. Rodger, Mr. Royce, and Mr. Waterson.

Social Notes.

Mr. W. E. Warrilow will take the chair at the third Annual Smoking Concert of the Institution of Electrical Engineers (Informal Section) on Monday next, at the Engineers' Club, Coventry-street, London, W.

The Faraday House Old Students' Association will give a smoking concert on March 17, at 8 p.m., at the Queen's Hotel, Leicester-square, London. In view of the fact that the accommodation is limited, members are advised to apply early to the hon. secretary of the F.H.O.S.A., Faraday House, W.C. 1. for tickets.

The foremen of Johnson & Phillips, Ltd., held their annual dinner at the Shakespeare Hotel, Woolwich, last Saturday, the proceedings being presided over by Mr. J. Bayne. This year, for the first time, the managing director with his departmental heads and other staff members were invited. Between fifty and sixty members of the company were present, and after dinner an excellent musical programme was given.

In connection with the recent transference of the Airdrie and Coatbridge tramway system to Glasgow Corporation, a luncheon was given in the North British Hotel, Glasgow, last week by Mr. P. N. Gray, a director of the Tramway Company. The guests included Provost Lavelle, Coatbridge; Provost Kennedy, Airdrie; Mr. James Dalrymple, tramway manager, Glasgow; Bailie M'Whirr, convener; and Bailie Laing, sub-convener, of Glasgow Tramways Committee; and Mr. Archibald Robertson, ex-manager of the Airdrie and Coatbridge Tramways. A number of speeches were made, in the course of which it was pointed out that within the last decade the tramway receipts in the Airdrie and Coatbridge district had increased threefold, and the hope was expressed that when through running was established with Glasgow this expansion would be maintained. In the evening at Coatbridge Mr. Archibald Robertson, who has been manager of the Airdrie and Coatbridge Tramway Company for twelve years, was presented by the staff with a silver rose bowl, suitably inscribed.

Electricity Supply.

Preston Electricity Committee recommend that Mr. J. A. Robertson be retained as consultative engineer for the construction of the new generating station.

Douglas (Isle of Man) Electricity Committee has adopted the two-rate system of payment, a smaller charge being made during the daytime, in order to encourage the use of electricity for power and other purposes.

An amendment that the proposal to transfer £60 000 of the electricity supply profits to the consolidated rate be referred back, as being a financially unsound move, was defeated at last week's meeting of Liverpool City Council.

Mr. H. A. Howie, electrical engineer and manager of Walsall Electricity Department has intimated to the General Purposes Committee his willingness to accept their proposal of a 10 per cent. reduction on his salary as from April 1 next.

The London County Council have decided to oppose the application of Stepney Borough Council for a Special Order so far as it relates to the provision to exempt the Borough Council against proceedings for nuisance created by the operations of its generating station.

The Electricity Commissioners have practically concluded the task of provisionally determining the area of the East of Scotland Electricity District which will include the county and city of Edinburgh, the county of Midlothian, East Lothian, and certain parts of the counties of Linlithgow and Peebles.

Mr. G. Morley New, the Cardiff City Electrical Engineer, Mr. R. L. Horsfield, the City Tramways Manager, and Mr. O. S. Hosgood, the Station Superintendent, conducted a large number of delegates of the Cardiff Trades and Labour Council over the Roath Power Station last Thursday, and explained to them the plant and machinery.

Colonel Sinclair, Chairman of Swansea Electricity Committee, at the Council meeting last week stated that during the year 1920-21, Swansea generating station held the record for the lowest consumption of coal per unit generated (2·501b.) for all the towns in the Kingdom whose consumption was between three and fifteen million units.

The Carlisle Electricity Committee have made unsuccessful attempts to purchase coal direct from the collieries. The chairman, Mr. Dalton, states that four collieries refused to deal with them direct, but the Committee have entered into a couple of contracts with two firms for a six months' supply of coal at a reduction on previous rates of 14s. a ton.

At Wolverhampton on Tuesday the Electricity Commissioners (Sir John Snell, Sir H. Haward, Mr. H. Booth, and Mr. W. W. Lackie) opened the inquiry into the proposals for the reorganisation of electricity supply in the North-West Midlands Electricity District. Mr. Tyldesley Jones, K.C., appeared for the Conference of Authorised Undertakers, and after counsel's opening statement, Ald. H. Leese, of Stoke-on-Trent, gave evidence. The inquiry is proceeding, and a report will appear in our next issue.

A serious condition of affairs has arisen in connection with the Hull Corporation Electricity undertaking, which, it is stated, shows a big loss on the year. When the report of a special subcommittee, appointed to consider the matter, was discussed by the Electricity Committee, the Chairman (Ald. J. Pybus) tendered his resignation, and that of his son (Mr. H. Pybus), a member of the clerical staff, was also accepted. The sub-committee recommended that the whole committee should resign, but this was rejected by seven votes to four. The assistant engineer was asked to resign on purely personal grounds, and a consulting engineer will be called in to report on the undertaking

New Schemes and Mains Extensions.

Aylesbury Town Council has applied for loans of £5 000 for meters, and £2 400 for the wiring of houses.

Llandrindod Wells Urban Council are in negotiation with the local Electric Light Company with a view to purchasing the undertaking.

Rochdale Electricity Committee is making application to the Electricity Commissioners for sanction to borrow £36 198 for mains and house services.

Shoreditch Borough Council have decided to lease their electric light standards for the display of illuminated advertisement signs at an annual rental of £30 each.

The Ministry of Transport have granted the Westgate and Birchington Gas & Electricity Company an extension of fifteen months, to May 26, 1922, to carry out their statutory electric supply powers.

Swadlincote Urban Council has authorised Burton-on-Trent Town Council to lay electric cables for the supply of electricity to the Britty Colliery, the Hearthcote Potteries, and Thomas Wragg & Sons.

Experiments are to be made in the illumination of the great clock in the City Hall tower at Cardiff, and Mr. G. Morley New, the City Electrical Engineer has been authorised to instal two projectors for throwing light on the dials.

Chasetown Parish Council has, subject to the sanction of the Electricity Commissioners and the approval of County Council, accepted the offer of the Cannock Chase Colliery Company to supply electricity for public lighting at £3 per 120 c.p. lamps per annum.

Barry Urban Council held a private meeting last Thursday to receive a letter and report from Sir Charles Bright on the proposed electricity schemes, and to meet the electrical engineer of the Barry Railway Company on the question of the provision of a supply of electricity for the district.

Runcorn Council has approved of plans for a new electricity sub-station to be erected at Latchford Without. Some members took exception to the building being erected in a residential district and although the plans were passed, it was decided to ask the Warrington Corporation to consider erecting the building on an alternative site.

Lynn Town Council has approved a cable extension from the Docks main to Pattrick and Thompson's, at a cost of £368, and is considering the extension of a cable from the Customs House to a sub-station in Saddlebow Road, at £4 812, so that the overhead cable can be removed. It is also proposed to lay a distributor along High Street, fed from a sub-station at Purfleet Quay, at a cost (less buildings) of £2 592 10s.

In connection with a big coal development scheme in Ogmore Valley, estimated to cost about one million pounds, Messrs. Cory Brothers propose to erect a large power-house and transmission lines for conveying electricity to three or four new pits. For the supply of electricity from the Ogmore Vale power station electric light cables will be carried on concrete standards to the various collieries. Steel transmission lines, claimed to be the first example of the kind in the United Kingdom, will run from Ogmore Vale through the mountains for a distance of about six miles. Electricity will be used to drive the haulage plant, elevators, fans, &c., and will also provide the energy for the steel lattice tower carrying an aerial rope with buckets for tipping rubbish. In the Rhondda a rubbish aerial road is in course of construction at Pentre.

Alteration of Charges.

Taunton Electricity Committee announce a reduction of 10 per cent. on the price of electricity.

Newport (Mon.) Chamber of Commerce passed a resolution on Friday asking the Corporation to follow the Gas Company's example and reduce the price of electricity, which is at present 100 per cent. above pre-war rates.

Rochdale Electricity Committee recommend the following reduction in the charges for electricity, as from April next. Lighting from 7d. to 6d., heating and domestic purposes from 2½d. to 1¼d. per unit, and power, over 15 h.p. 0·55d. to 0·5d. per unit.

Huddersfield Town Council have decided to reduce by 2d. a unit the price of electricity for lighting supplied from the single-phase circuits, but firms under power agreements for 3-phase current are excepted. The reduction takes effect from the December meter readings.

Farnborough Urban Council has decided to protest against the action of the Aldershot Gas, Water, and District Lighting Company, in increasing their charges for electricity for power and heating to 6d. per unit, and also against the manner in which the notification was made. It is alleged that this was only given in an advertisement in the local press.

Darlington Electricity Committee recommend the following reductions in electricity charges, amounting to about £6 000 in yearly revenue: lighting ½d. per unit decrease from April 1st, which will bring the price down to 3½d. per unit, the pre-war charge; power, 12½ per cent. reduction, which will leave the figure 12½ per cent. above the 1914 standard, or ⅓d. against ¾d. The Committee also recommend a reduction of ¼d. per unit to consumers for heating purposes.

Telegraph and Telephone Notes.

A new telephone call office has been opened at Cholsey, Oxfordshire.

It is stated that the proposed international conference to consider the allocation of the Atlantic Cables formerly owned by the Deutsch Atlantische Telegraphen-Gesellschaft will be convened at Washington this week.

Subject to legal formalities, the Commercial Cable Company has received permission of the Cork Harbour Commissioners to establish a cable base at Queenstown, where a cable ship with a crew of sixty-five will be permanently stationed for repairs to the company's Atlantic cable.

As from March 1, the prices of official telephone directories will be as follows:—"London Directory" (Vol. I.), cloth bound 2s. 6d., paper cover 1s. 6d.; Provincial directories, East, South, and West of England (Vol. II.), 2s. 6d.; North of England and Midlands (Vol. III.), 5s.; Scotland (Vol. IV.), 2s. 6d.; Ireland (Vol. V.) will remain at 2s. The charge for the complete set of five volumes will be reduced from £1 to 10s.

The telegraph cable connecting the Outer Hebrides with the mainland having been interrupted during recent storms, the Postmaster-General announces that arrangements have been made for the establishment of a temporary wireless service between the wireless stations at Tobermory, Mull, and Loch Boisdale, South Uist. Post office wireless stations are also available for use in the event of cable difficulties at Guernsey and Lerwick for communication with corresponding stations on the mainland.

Electric Traction.

Tipton Urban Council have decided to oppose the Bill now being promoted by local tramway companies.

Since penny fares were reintroduced on the Birmingham tramways at the beginning of this month, the returns show an average decrease of £765 per week of six days.

Kirkcaldy Corporation has approved the recommendation of the Tramways Committee to borrow £93 000 for new plant. This sum includes £7 000 already spent and £4 000 for d.c. feeders to relieve the overloaded Porthhead district.

The London County Council have put on record an expression of regret at the decision of the Minister of Transport not to take any practical steps at the present time for dealing with the regulation of omnibus and other traffic at tramway stopping places.

Newcastle-on-Tyne Corporation are applying to the Light Railway Commissioners for an amendment of their application for a Light Railway Order in respect of which a local inquiry was held on July 22nd, 1921, by providing for the construction of an additional line.

The deputation recently sent by Dover Corporation to Yorkshire towns to inspect the railless trolley system have reported favourably on it, especially for opening out routes for traffic not covered by the present electric tramways. The Corporation are applying for a Provisional Order to instal the railless system.

The Sunderland district tramcar men who went on strike nearly three weeks ago are still holding out. A new staff has been engaged by the company, and it was expected that the strikers would in consequence want to resume work, but the miners' lodges in the area now threaten to boycott services run by men who have taken the place of the strikers. The directors have, therefore, decided to reconsider the position.

Walsall Tramways Department is able to contribute £8 500 to the relief of the rates, in spite of the fact that the number of passengers carried since last April has shown a decrease of 3 023 137. So far the results of the recent reintroduction of the penny fare has not proved successful from the financial point of view, and the situation is to be reviewed in three months' time. The undertaking was one of only five in the country which managed to pay its way last year.

Traffic receipts on the Cardiff electric tramways from April 1, 1921, to the 11th inst. show a decrease of £10 269. At a meeting of the Committee last Friday, Mr. R. L. Horsfield, the tramways manager, attributed the loss entirely to trade depression. If it had not been for football matches the decrease would have been very much greater, as a home match meant an increase of £150 to £200. The distress tickets sold in the cars had produced £694 for the Lord Mayor's Fund.

Personal and Appointments.

We are pleased to learn that Senator Marconi, who has been suffering from bronchial trouble, is progressing favourably.

Mr. Douglas Hay has been appointed to the Chair of Mining at Sheffield University, rendered vacant by the death of Prof. E. F. Armstrong.

Mr. T. M. Johnson, late of the English Electric and Siemens Supplies, Ltd., has been appointed branch manager of Drake & Gorham Wholesale, Ltd., at their Liverpool office, 61a, Bold-street.

M. Gaston Roux, directeur du Bureau de Contrôle des Installations Electriques of Paris, has resigned in order to be able to devote his whole time to consulting work. M. Leon Arnand succeeds M. Roux.

Capt. A. R. H. Morrell, of the West India and Panama Telegraph Company's service, has been elected acting Elder Brother of Trinity House, in the vacancy caused by the retirement of Capt. A. S. Thomson.

The Rouville quinquennial prize of 10 000 frs. for the most important technical work has been awarded by the French Minister of Public Works for the years 1916-20 to M. Blondel for his work and discoveries in optics, sound and electricity.

Manchester Tramways Committee on Tuesday accepted with regret the resignation, owing to ill-health, of Mr. McElroy, manager of the department since 1899. Mr. J. A. S. Wood, the assistant manager, is retiring on superannuation after forty-nine years' service.

Hackney Borough Council have appointed Councillor C. W. Jackson, chairman of the Electricity Committee, and Mr. L. L. Robinson, borough electrical engineer, to represent the Council at the forthcoming annual convention of the Incorporated Municipal Electrical Association.

Owing to ill-health, Mr. Ernest Hatton has decided to retire in three months time from the position of manager of Newcastle-on-Tyne Corporation Tramways, which he has held for seventeen years. Under his management the undertaking has contributed materially to the relief of the rates, a sum of £14 000 having been given in this way for several years in succession. The system has been greatly extended during his tenure of office. When the war broke out a considerable number of the staff joined the army, and Mr. Hatton organised a system of volunteer drivers and conductors to assist in the transport of the thousands of munition workers employed in the district.

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Institution Notes.

On Saturday, March 4, Sir Ernest Rutherford will begin a course of six lectures on Radioactivity at the Royal Institution.

The Electrical Federation (Victoria) was formed in December last, and Mr. T. Malcolm Ritchie, managing director of Electric Equipment Manufacturers Pty., Ltd., of Melbourne, was elected President.

A general survey of what wireless telegraphy and telephony is doing and is capable of doing was given by Major J. Erskine Murray last week in the course of a lecture on "The Uses of Wireless, Past and Future," which he delivered in Glasgow to the Scottish Centre of the Institution of Electrical Engineers.

The Association of Engineers-in-Charge is holding an informal discussion on Saturday, Feb. 25 (to-morrow), at 7.30 p.m., at St. Bride's Institute, Bride-lane, Fleet-street, E.C. 4, to discuss "Mechanical Stokers v. Hand Firing, both with forced draught." Visitors are invited to be present and take part in the discussion.

Owing to the growth of the organisation and the work entailed, Mr. A. G. Beaver, who has been hon. secretary of the Electrical Wholesalers' Federation for the past seven years, finds that he is no longer able to devote the time necessary to look after the Federation interests. Mr. Reginald Cooper, who has had considerable experience in association work, has, therefore, been appointed general secretary, and the registered offices will now be located at 19-21, Hatton Garden, E.C.

Dr. S. S. Richardson read a paper on "An Oscillograph Investigation of the Gulstad Relay," before the Liverpool Sub-Centre of the Institution of Electrical Engineers, on Monday. The paper was illustrated by lantern slides of oscillograms and details of circuits. Dr. Richardson also exhibted and operated a Gulstad relay and a new form of frequency meter. Mr. T. E. Herbert, Dr. Marchant, and Mr. Reeve were among those who contributed to the discussion.

At the annual meeting of the Physical Society of London, held on Feb 10, the following officers and members of council were elected :—President, Dr. A. Russell; Vice-Presidents, Lord Rayleigh, Prof. T. Mather, Mr. T. Smith, and Prof. G. W. O. Howe; Secretaries, Mr. F. E. Smith, "Redcot," St. James's Avenue, Hampton Hill, and Dr. D. Owen, 62, Wellington Road, Enfield; Foreign Secretary, Sir Arthur Schuster; Treasurer, Mr. W. R. Cooper; Librarian, Dr. A. O. Rankine; other members of Council, Mr. C. R. Darling, Prof. C. L. Fortescue, Dr. E. Griffiths, Dr. E. H. Rayner, Mr. J. H. Brinkworth, Mr. J. Guild, Dr. F. L. Hopwood, Dr. E. A. Owen, Dr. J. H. Vincent, and Dr. G. B. Bryan.

Wireless Notes.

A "Central News" message states that a powerful radio station, capable of direct communication with Germany, England, Denmark, and Norway, is nearing completion at Dietskoye Selo. It has been planned entirely by Russian engineers and erected by Russian labour.

A meeting of the Wireless Section of the Institution of Electrical Engineers will be held in the Lecture Theatre of the Institution, Savoy Place, Victoria Embankment on Wednesday, March 1, at 6 p.m., when a paper on "The Thermionic Triode as Rectifier." by Messrs. E. B. Moullin and L. B. Turner (member) will be read.

A new radio-telegraph office was opened on Sunday by Marconi's Wireless Telegraph Company at Radio House, 2-12, Wilson-street, E.C. 2. This will be the principal office for the receipt of Marconigrams, and will also be the company's traffic headquarters. Radio House, which is claimed to be the most up-to-date office of its kind in the world, is in direct communication with all the company's wireless stations, and also with its telegraph offices at Marconi House, Fenchurch-street, and the Baltic Exchange.

Communication has been established between the Leafield (Oxfordshire) and the Abu Zabal (Cairo) stations, but no commercial facilities are yet available. In reply to a question in the House of Commons on Tuesday, the Postmaster-General said that experimental transmission had been commenced between the two stations, and as soon as the preliminary trials were completed a public service would be inaugurated. The Leafield station had been working satisfactorily for some months, and its messages were regularly picked up practically all the way by liners on the Australian route. The total cost of the two stations was estimated at £250 000. The cost of the remaining five stations of the Imperial Chain is estimated at £853 000, but without provision for patent royalties.

Business Items, &c.

The business known as the Thanet Electrical Company, 262, Northdown-road, Margate, will in future be known as the Margate & District Electrical Company, Ltd., and will be under the control of Mr. J. M. Keenan.

The Electro-Mechanical Brake Company have received an order, per the English Electric Company, for seventy-five car sets, and per Metropolitan-Vickers Electric Company, for fifty car sets of "E.M.B." unbreakable resistances for above equipments.

Companies' Meetings, Reports, &c.

The Yorkshire Electric Power Company.

The thirtieth ordinary general meeting of the Yorkshire Electric Power Company was held at the Hotel Metropole, Leeds, on Tuesday, Mr. A. Greenhow Lupton, J.P., presiding.

In the course of his remarks, the chairman said :—The year under review has been an anxious one. The dispute in the coal industry came in the first half of 1921, and during three whole months no coal was obtained from the collieries. For this period the use of our current was much reduced owing to the general stoppage of industry. The company's supply was maintained throughout, and was of essential service, though the large reserve stock of coal held by the company had to be supplemented by additional supplies at high prices.

In spite of this three months' set-back, and of the slump which has persisted for the whole year, the output of current has been practically the same as for 1920, which, as you know, was a great increase on any previous record of the company. The company's scale of charges for current are based on a sliding scale, varying with the price of coal, and the great and satisfactory decrease in this charge which has taken place in the latter part of the year has resulted in a reduction of revenue.

On the costs side a still greater reduction has been made, which enables the company to declare the same satisfactory dividend of 8 per cent. on the ordinary shares, after paying interest upon a capital which has been largely increased to meet the growing demands on the company and after putting the same amount as before to reserve and leaving a slightly larger amount to carry forward.

To fulfil our duties to the area it has been necessary to make considerable additions to our mains and to the plant at Thornhill and Barugh, which will bring in proportionate additions of revenue during the present year from customers already connected or contracted with. As the company's business grows, generating machinery of a larger size is brought into use, and with its use there is a substantial saving of coal and other items which affect the cost of electricity. The extensions now in progress at the company's stations should, therefore, not only deal with the increasing demands for electricity, but should also result in substantial saving of cost.

In view of future needs, power is also being asked for the company to double its present authorised capital from £2 000 000 up to £4 000 000, as the money may be required.

The growth of the company will shortly involve the erection of our new station at Ferrybridge and the laying of powerful trunk mains; but I may remind you that, although the first year of supply given by our company was 1905, when the whole revenue for the year was about £1 000, in the sixteen years that have since passed our revenue has grown to very nearly £370 000, that we have now 440 miles of mains, and that every expansion has brought increased revenue and profits to the company.

At subsequent meetings held after the ordinary meeting, the shareholders approved the issue of 111 672 6 per cent. cumulative preference shares of £5 each, the promotion of a Bill in Parliament to convert both the ordinary and preference shares into shares of £1 denomination, and the increase of the capital of the company from two to four millions, with proportionately increased borrowing powers.

North Metropolitan Electric Power Supply Company.

The North Metropolitan Electric Power Supply Company held its annual meeting on Thursday. Mr. E. Garcke, who presided, stated that the net revenue for 1921 reached the record figure of £131 695. With the amount brought forward there was a total of £136 128 at the credit of the net revenue account. There was available for dividends and reserve £101 007, compared with £82 695 for 1920. The directors had placed £25 000 to reserve, and recommended a dividend on the ordinary shares of 10 per cent. for the year, compared with 7½ per cent. for the preceding year, carrying forward £5 006, as compared with £4 433 a year ago. In the course of two years the balance of the company's net revenue had more than doubled, while during the past twelve months, described as a "period teeming with difficulties," there had been a gain of over 20 per cent., and this in spite of the fact of the coal strike. The capital expenditure during the year had amounted to £240 000. This had been mainly in connection with the new generating plant, main transmission lines and distribution mains. The company was affording bulk supplies to eight separate local authorities and companies, who themselves distributed electricity to their consumers. In addition they were operating, in conjunction with their allied distribution company, no fewer than thirteen separate undertakings, and supply was given for power and general industrial purposes to manufacturers of every description throughout the area of supply. The result of the inquiry held by the Electricity Commissioners during the year in connection with the London and Home Counties Electricity District had now been published. Although this company's area would be included in the district of the proposed joint electricity authority, the rights of their company would not be interefered with, and the supply powers of the joint authority within the company's limits of supply would be carried out by the company. Their rights were thus confirmed and their interests safeguarded. During the past year an additional 5 000 kW turbine had been installed, and it was anticipated that a further 15 000 kW of modern and efficient plant would be in service during the present year. Further mains extensions were carried out. During the past year nine new substations had been erected and put into service. Under the Bill which the company was promoting in the present session of Parliament they were seeking powers to revise the methods of charge and prices for electricity, and to take over the undertakings of their distribution company. The report was unanimously adopted.

London, Brighton and South Coast Railway.

Referring to electrification schemes at the annual meeting of the London, Brighton & South Coast Railway Company last week, Mr. C. C. Macrae (the chairman), who presided, stated that the extension of the company's electrical system to the railway from Balham Junction to West Croydon was nearing completion, and it was hoped that this section would be open for electrical traction by Sept. 1. This section, however, formed only a very small part of the scheme submitted to the Minister of Transport, which included the electrification of the whole of the company's suburban area, extending to Coulsdon towards Brighton and to Cheam towards Portsmouth, as well as the equipment of the main lines, with which, in course of time, it was hoped to proceed at any rate as far as Brighton and Lewes. The outlay of capital would, of course, be very considerable, and as the present time was not opportune for raising money, the board had determined for the present to confine electrification to those sections of the suburban system where the needs were greatest.

If they were independent, they could carry out the entire scheme now, but they were hampered by the Railways Act, which had a paralysing effect on independent action. The Act provided that the company should be amalgamated with the London and South-Western, the South-Eastern, and the Chatham and Dover Railway Companies to form the Southern Group, and those companies were given to the end of this year to arrive at an agreement for amalgamation. For some months past communications had been taking place between the companies to endeavour to arrive at terms upon which the details of the amalgamation could be worked out, but at once they were confronted with the contention that no electrification work involving large expenditure should be undertaken by any one of them without the consent and approval of the others. On the surface this appeared perfectly reasonable, but when it transpired that each of these companies had a different system of electrification, and naturally thought its own the best, the result was that the condition placed a distinct veto on their company going ahead with its own programme.

The Scottish Power Company announce a dividend on the ordinary shares of 7 per cent.

Bruce Peebles & Company recommend a dividend on the ordinary shares for the year ended Dec. 31 last at the rate of 10 per cent., less tax, together with a bonus of 5 per cent., less tax.

The Telegraph Construction & Maintenance Company announce a final dividend of 7½ per cent., tax free, for 1921. In July an interim dividend of 2½ per cent. was paid. The dividend for 1920 was the same.

The North Metropolitan Electric Power Supply Company on Monday offered for public subscription £250 000 8 per cent. cumulative second preference stock at par. The issue was over-subscribed in a short time.

Kensington & Knightsbridge Electric Lighting Company recommended a dividend of 6 per cent. on the ordinary shares for the half-year ended Dec. 31, making, with the interim dividend paid in August last, 10 per cent. for the year.

Bournemouth & Poole Electricity Supply Company is paying a balance dividend on the ordinary shares at the rate of 7 per cent. per annum, less tax, for the half year ended Dec. 31, 1921, making 6 per cent. for the year (same as for the previous year).

Charing Cross, West End & City Electricity Supply Company recommend a dividend on the ordinary share capital of the West End undertakings of the company, for the half-year ended Dec. 31, 1921, at the rate of 6s. per share, making, with the interim dividend already distributed, 9 per cent. for the year 1921.

The City of London Electric Lighting Company recommend, subject to final audit, the payment of the following dividends: 7 2d. per share on the 6 per cent. cumulative preference shares, making with the dividend paid in September, 6 per cent for the year ended Dec. 31 last; 9·6d. per share on the 8 per cent. cumulative second preference shares, being 8 per cent. for the half year; 1s. 9·6d. per share on the ordinary shares, making, with the dividend paid in September, 14 per cent. for the year. These dividends are subject to income tax.

The report and accounts of the Westminster Electric Supply Corporation for the year 1921 states that the total power of the lamps, motors and apparatus connected to the company's mains, which on Dec. 31, 1920, was the equivalent of about 56 652 kW, had increased by Dec. 31, 1921, to the equivalent of about 59 132 kW. An interim dividend at the rate of 8 per cent. per annum on the ordinary shares and the dividend on the 4½ per cent. preference shares, for the half-year ending June 30, 1921, have been distributed. After allowing for depreciation, sinking fund and other charges, the balance is £65 036, from which must be deducted the second half-year's dividend on the preference shares, which absorbed £12 375, leaving a balance of £52 661. Out of this the board recommend the payment of a dividend at the rate of 12 per cent. per annum, less income tax, for the past half-year, making 10 per cent. for the year, carrying forward a balance of £7 324.

Tenders Invited and Accepted.

UNITED KINGDOM.

West Hartlepool County Borough. Feb. 27.—Supply, delivery, and erection of material for the electric lighting of fifty houses now in course of erection. Particulars from the Borough Engineer, Mr. W. F. Dennis, Municipal Buildings, West Hartlepool.

Stockton-on-Tees Corporation. Feb. 28.—Extra high-tension, low-tension and pilot cables. Specification from the Manager and Engineer, Electricity Works, Stockton-on-Tees.

Clacton-on-Sea Urban Council. March 1.—900 yards paper-insulated, lead-covered and armoured cable and joint boxes. Specification from the Electrical Engineer.

Metropolitan Asylums Board. March 1.—Electric lighting and power, telephone and fire alarm installations at the Eastern Fever Hospital Extension, Homerton, E. 9. Specifications can be obtained at the Board's offices, Embankment, E.C. 4.

Islington Guardians. March 4.—Six months' supply of electrical supplies for several institutions. Particulars from the Clerk, Mr. A. King, Guardians' Offices, St. John's-road, Upper Holloway, London, N. 15.

Standing Joint Committee of Glamorgan Quarter Sessions and County Council. March 4.—Electric wiring and fitting (Henley system) of Bridgend Police Station and Court, Cilfynydd Police Station and Llanharan Police Station. Specifications can be obtained at the Police Station or at Glamorgan County Hall, Cardiff.

Merthyr Tydfil Guardians. March 5.—Electrical fittings for six months. Particulars from the Clerk, Mr. F. T. James.

St. Pancras Borough Council. March 7.—E.h.t. three-phase switchgear for two sub-stations. Particulars from Mr. C. H. F. Barrett, 57, Pratt-street, Camden Town, N.W. 1.

Wigan Corporation. March 13.—Steam turbine, 5 000 kW three-phase alternator, exciter and surface-condensing plant. Specification, &c., from the Manager of the Electricity Department.

Croydon Corporation. March 14. Crushing plant for house refuse, with conveyers, motors, switchboards, &c. Specification, &c., from the Borough Engineer.

Edinburgh Corporation. March 14.—Steel tramway poles. Specifications, &c., from the Tramways Manager, 2, St. James-square, Edinburgh.

Hampstead (London) Borough Council. March 15.—Supply of various stores for six or twelve months, including electrical engineers' stores and oils for the electricity station. Form of tender, &c., from the Town Clerk.

Blackpool Corporation. March 16.—Supply, delivery and erection of h.t. switchgear and switchroom equipment for West Caroline-street power house, and Bispham and Cleveleys sub-stations, suitable for controlling 6 600 V, three-phase, 50 periodicity supply (section 4); h.t. armoured transmission three-core cables suitable for above supply; 12 miles 0·2 sq. in. three-core feeder, 5 miles 0·175 sq. in. three-core feeder, and 8½ miles six-core pilot cable (section 5). Particulars from the Borough Electrical Engineer and Tramways Manager, Mr. C. Furness.

Bristol Docks Committee. March 17.—Four 30 cwt. movable electric jib cranes. Specification, &c., from the Engineer, Avonmouth Docks.

Edinburgh Corporation. March 20.—Auxiliary plant and pipework for Portobello power station. Specifications from Sir A. B. W. Kennedy, 17, Victoria-street, Westminster, S.W. 1.

AUSTRALIA.

Municipal Council of Sydney (Electricity Department). April 24.—*Supply, delivery, and erection of two 2 000 kW rotary converters; one 10 000 to 12 000 kW turbo-alternator.

State Electricity Commission of Victoria. April 29.—22 000 V three-core cable and accessories for Morwell Power Scheme (Spec. No. 200). Copies of tender from and specification available on application to the Agent-General for Victoria, Melbourne-place, Strand, London, W.C. 2.

Siemens Bros. have secured a contract for 6 000 telephone lines at Winnipeg.

Liverpool Board of Guardians have accepted the tender of the Electrical Contracting and Motor Company for an electrical installation at £21 000.

Leyton Urban Council have placed an order with the Brush Electrical Engineering Company for a motor-generator for the electric vehicle garage at £410.

Llandudno Urban Council have accepted the tender of Bruce, Peebles & Company for 500 kW and 330 kW converters, at £2 450 and £1 725 respectively.

Aylesbury Town Council has accepted the following tenders:—Hackbridge Cable Company, for cable, at £295; British Electrical Transformer Company, for transformers, at £168; General Electric Company, for transformer plant, at £2 739.

In addition to the large order for electrical equipment for the Brighton Railway recently obtained by the General Electric Company, big contracts have been secured by the company for the supply of generating plant in China and India, one being for the Bombay and Baroda Railway, and three lesser orders, of the total value of £40 000, for the Colonies, including a £15 000 contract for Pretoria.

* *Particulars from the Department of Overseas Trade.*

Arrangements for the Week.

FRIDAY, Feb. 24th (to-day).

Royal Society of Arts.

4.30 p.m. At John-street, London, W.C. Paper on "Brown Coals and Lignites," by Prof. W. A. Bone, F.R.S.

Physical Society.

5 p.m. At the Imperial College of Science, London, S.W. Papers to be read: "The Number of Radio-active Transformations as Determined by Analysis of the Observations," by Dr. H. Levy; "A Graphical Method of Treating Fresnel's Formulæ for Reflection in Transparent Media," by Prof. C. H. Lees, F.R.S.; Demonstrations of a Sensitive Method of Determination of Density, &c., by the General Electric Company's Research Department; and Demonstration of the Physical Properties of Cellactite, by Mr. F. C. Dyche-Teague, B.Sc.

Electrical Power Engineers' Association.

7 p.m. At the Engineers' Club, Coventry-street, London, W. Informal discussion on "Boiler Troubles."

Technical Inspection Association.

7.30 p.m. At the Royal Society of Arts, John-street, London, W.C. Lecture on "The Extrusion of Metals," by Mr. R. Genders, M.B.E.

North-East Coast Institution of Engineers and Shipbuilders.

7.30 p.m. At the Literary and Philosophical Society, Newcastle-on-Tyne. Paper on "Running Costs of Diesel-Engined Ships," by Mr. T. Madsen.

Junior Institution of Engineers.

8 p.m. At Caxton Hall, London, S.W. Lecture on "Curved Beams, Rings and Chain Links," by Prof. E. G. Coker.

Edinburgh Electrical Society.

8 p.m. At the Philosophical Institute, 4, Queen-street, Edinburgh. Paper on "Some Experiments in Electrical Sound Detecting," by Mr. B. A. Pilkington.

MONDAY, Feb. 27th.

Institution of Electrical Engineers.
(North-Eastern Centre.)

7.15 p.m. At Armstrong College, Newcastle-on-Tyne. Discussion on "Starters," introduced by Mr. J. Anderson, and "Some Notes on the Design of Liquid Rheostats," by Mr. W. Wilson.

Royal Society of Arts.

8 p.m. At John-street, London, W.C. Cantor Lecture on "The Mechanical Design of Scientific Instruments," by Prof. A. F. C. Pollard. (Lecture II.)

TUESDAY, Feb. 28th.

Institution of Electrical Engineers.
(North Midland Centre.)

7 p.m. At the Film Trade Exchange Theatre, Leeds. Exhibition of Cinematograph Films, by Dr. C. C. Garrard and Mr. F. Gill, O.B.E.

Junior Institution of Engineers.
(North-Eastern Section.)

7 p.m. At Armstrong College, Newcastle-on-Tyne. Paper on "Drop Stamping and General Forge Work," by Messrs. E. F. Lough and R. N. Richardson.

Institution of Electrical Engineers.
(North-Western Students' Centre.)

7.30 p.m. At Houldsworth Hall, Deansgate, Manchester. Paper on "The Application of X-Rays to the Engineering Industry," by Mr. A. F. Steel.

Illuminating Engineering Society.

8 p.m. At the Royal Society of Arts, John-street, London, W.C. Discussion on "Industrial Lighting: Ideal Requirements (Legislative and Otherwise) and Practical Solutions," opened by Mr. L. Gaster.

WEDNESDAY, March 1st.

Newcomen Society.

5 p.m. At Caxton Hall, London, S.W. Paper on "Timothy Hackworth and the Locomotive," by Mr. R. Young.

Institution of Electrical Engineers.
(Wireless Section.)

6 p.m. At Savoy-place, London, W.C. Paper on "The Thermionic Triode as a Rectifier," by Messrs. E. B. Moullin and L. B. Turner.

Industrial League and Council.

7.30 p.m. At Caxton Hall, London, S.W. Lecture on "The Purpose of Economic Activities," by Mr. H. Cousens.

THURSDAY, March 2nd.

Institution of Electrical Engineers.

6 p.m. At Savoy-place, London, W.C. Discussion on "Starters," with Introductory Papers on "The B.E.S.A. Specifications for Starters," by Mr. C. H. Wordingham; "Electric Motor Starters," by Mr. J. Anderson; and "Some Notes on the Design of Liquid Rheostats," by Mr. W. Wilson.

Liverpool Engineering Society.
(Students' Section.)

7.30 p.m. At the Royal Institution, Colquitt-street, Liverpool. Paper on "Wireless Telegraphy," by Mr. T. E. Daniel.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Bankruptcy Information.

POLLARD, Claud, 12, Corporation-street, Halifax, electrical engineer. Feb. 14. Debtor's petition. First meeting, Feb. 24, 10.15 a.m., and public examination, March 24, 10.30 a.m., County Court House, Prescott-street, Halifax.

TRUELOVE, Harold (trading as H. TRUELOVE & COMPANY), 19, Shepley-street, Stalybridge, co. Chester, electrical engineer. First meeting, March 3, 3 p.m., Official Receiver's Offices, Byrom-street, Manchester. Public examination, March 6, 11.15 a.m., Town Hall, Ashton-under-Lyne.

Company Winding-up Voluntarily.

RUSHMORES (1919) LTD. T. D. Addis, of 26A, Peterborough-road, Parsons Green, London, appointed liquidator. Meeting of creditors at the liquidator's office on Feb. 23 at 4 p.m.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

BARNETT, Barnard, 100, Bethune-road, Stoke Newington, electrician. £18 17s. 11d. Dec. 8.

CASS, M., & COMPANY, 25, Upper Parliament-street, Liverpool, electricians. £13 0s. 3d. Dec. 8.

CUFFE, Mr. F., 200A, Regent-street, Hull, electrician. £27 19s. 4d. Dec. 8.

GREENLING ELECTRIC SUPPLIES, LTD., manufacturers. £10 8s. Dec. 13.

HAINES, J. M., 252, Hackney-road, E., electrical engineer. £29 18s. 1d. Dec. 7.

HOPKINS, Hopkin, Bryneithin-terrace, Morriston, Swansea, electrical engineer. £11 0s. 6d. Dec. 5.

HURLINGHAM ELECTRIC COMPANY, 283, New King's-road, Fulham, S.W., electrical engineers. £23 6s. 11d. Dec. 2.

LOWER, A. & E., 670, Seven Sisters-road, N., electricians. £20 9s. 9d. Dec. 6.

REGAN BENNETT & COMPANY, LTD., R/O, 32, Charing-cross, S.W., electrical engineers. £25 16s. 11d. Dec. 16.

SHAW & COMPANY, 172, Oxford-street, Manchester, electrical contractors. £21 19s. Dec. 6.

SOHO ELECTRICAL WORKS, 125, Islington, Liverpool, electricians. £14 12s. 2d. Dec. 19.

WOUTERS, HERBERT, & COMPANY, 14A, Beaumont-road, West Kensington, electrical engineers. £30 3s. Dec. 1.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

MITCHELL'S ELECTRICAL & WIRELESS, LTD., London, S.E. Registered Feb. 4. £550 debentures; general charge. *Nil. Sept. 13, 1921.

MORGAN EBONITE COMPANY, LTD., Failsworth. Registered Feb. 10, mortgage, to Manchester & Liverpool District Banking Company, Ltd. *Nil. Oct. 27, 1920.

VICTORIA ELECTRICAL (MANCHESTER), LTD. Registered Feb. 7, £7 000 debentures, present issue £6 250; general charge.

Satisfaction.

WINN (Charles) & COMPANY, LTD., Birmingham, manufactures gas and electric fittings. Satisfaction registered Feb. 14, £9 000, part of amount registered Sept. 26, 1918.

Receivership.

APPLEBY CRANE & TRANSPORT COMPANY, LTD. Sir William B. Peat, of 11, Ironmonger-lane, E.C., ceased to act as receiver or manager on Feb. 10, 1922.

Deed of Arrangement.

BARDSLEY, James Nelson, 179, Katherine-street, and 254, Newmarket-road, Ashton-under-Lyne, electrician. Trustee, A. T. Eaves, 15, Fountain-street, Manchester, C.A. (Filed by order on terms.) Liabilities unsecured, £1 287; assets, less secured claims, £385.

Private Meeting.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

RAWCLIFFE, FRANK, & COMPANY, LTD., electrical factors, 8, Nun-street, Newcastle-on-Tyne. A meeting of creditors was held in London last week, when a large number of creditors attended, and the chair was taken by Mr. W. Brittain, the voluntary liquidator of the company. A statement of affairs showing the position as at Jan. 30 last disclosed liabilities to unsecured creditors £14 325 and estimated assets (after allowing for preferential claims) £11 329. There was therefore an estimated deficiency of £2 996, while as regards shareholders the total deficiency was £11 466. The company had been formed in April, 1921, and took over the business successfully carried on for some years by Mr. Rawcliffe, who was now a cash creditor for £3 500. The liquidator said he was instructed on behalf of the directors to submit an offer to the meeting of 10s. in the £, and it was proposed that there should be a scheme for the transfer of the whole of the assets to a new company, and that a debenture should be issued in respect of those assets for an amount necessary to pay the composition referred to by instalments of 2s. 6d. each at three, six, nine and twelve months. The debentures would no doubt bear interest at 5 per cent. or some similar rate. After some discussion it was resolved, on the motion of Mr. Houstoun, representing the Stella Conduits, Ltd., seconded by Mr. C. G. Poppleton, representing other creditors, that the liquidation should be continued with a committee of inspection, consisting of Mr. Maurice (Catchpole & Maurice); Mr. E. A. Ingold, and the representatives of the Stella Conduits, Ltd.; Mr. Joseph, of Messrs. Joseph & Company; and Callenders Cable & Construction Company, Ltd. The following are creditors:—Favell & Company, Newcastle-on-Tyne, £154; B.T.C. Electric Lamp & Accessories, London, £591; Cable Accessories Company, London, £135; Callenders Construction Company, London, £820; Catchpole & Maurice, Ltd., London, £234; British Driver Harris Company, London, £486; Efanden Company, Wolverhampton, £120; Enfield Ediswan Cable Company, London, £148; Joseph & Company, London, £188; Canning, W., & Company, Ltd., Birmingham, £372; Cryselco, Ltd., Bedford, £251; Electric Accessories Company, Leeds, £81; Ingold, Ltd., Shipley, £628; Kent & Company, Burslem, £210; Stella Conduits Company Bilston, £247.

Catalogues, Price Lists, &c.

Leaflet No. 2 676, published by the GENERAL ELECTRIC COMPANY, contains revised catalogue prices of the automatic circuit breakers appearing in Section X 3 of the firm's complete catalogue.

A recent catalogue of THOMAS BROADBENT AND SONS contains a large amount of interesting information regarding the electric capstans made by them. A special point is that the control gear is of the automatic contactor type, which, it is claimed, is absolutely foolproof, besides being of sound and substantial construction. It consists of a time or current limit self-starting rheostat, which embodies no-volt release features.

THE ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI, whose London offices are at 56, Victoria-street, S.W. 1, have just issued a general booklet descriptive of their works and manufactures. This booklet is exceptionally well illustrated, and contains, among other photographs, two aerial views of the works at Marcinelle Villette, near Charleroi, and at Ruysbroeck, near Brussels. Two photographs show respectively the main shop and the cable department in the condition in which they were found at the date of the Armistice and one year after, when the machinery which had been removed by the Germans had been reinstalled. The publication is divided into twelve sections, and covers practically the whole range of electrical manufacture. It is interesting to note that, although the works were situated in that part of Belgium which was occupied by the Germans during the war, since the Armistice it has been possible to re-establish the factory to such an extent that at present about 5 000 people are employed.

The Editorial, Advertisement and Publishing Offices of "THE ELECTRICIAN" are at 8, Bouverie Street, London, E.C. 4. Telegrams: Benbrotric, Fleet, London. Telephone: City 9852 (5 lines).

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CONTENTS.

Notes of the Week.

The Latest (and Last?) Electricity Act.

At a certain place in Mr. Arthur Neal's speech at the annual luncheon of the British Electrical Development Association last week, an almost audible sigh of relief arose from his audience. It was not that the speech was too long and uninteresting, or that the speaker was about to sit down, but that he had announced that the Government would do everything to remove obstacles from the path of the electricity supply industry, and so make clear the way to progress. If we did not know it already, the baleful effect of legislation on the electrical industry was obvious from the remarks of many of the speakers at the Institution Commemoration; and we may, therefore, be forgiven for believing that once that burden is removed the machine will revolve more easily. Unfortunately, that state of things cannot at once be attained. The electricity supply industry is uneasily poised on the top of a barbed wire entanglement, and just one more little act (which we hope will really be the last) is required to bring it down on the right side of the fence.

A Non-Contentious Measure.

We are, therefore, glad to see that a non-contentious measure has so quickly been introduced into the House of Lords, whence we hope it will receive an easy passage through all stages. The measure, which appears to contain all the clauses, especially those relating to charging, which we have recently advocated, will confer on the Commissioners further powers, powers which far from meaning greater autocracy, should really lead to a lubrication and easier running of what is, through nobody's fault, a rather creaking and rusty piece of mechanism. This is a matter of both urgency and importance. Uneasiness and uncertainty about the future are preventing extensions being made by supply undertakings, are resulting in money which would otherwise be used to feed the electrical industry going elsewhere, and are bidding fair to bring about a condition when the public will be demanding electricity and there will be none to give them. The sooner, then, that this measure is passed, and we can all once more settle comfortably to business, the better for everyone.

The North-West Midlands Inquiry.

The scheme for the reorganisation of electricity supply in the North-West Midlands Electricity District which has been under investigation during the present week by the Electricity Commissioners, appears to have been put forward solely in the interests of the municipal undertakers, and they would like the proposed Joint Electricity Authority to be representative of them. There are, however, two power companies in the district, viz., the Midland Electric Corporation for Power Distribution and the Shropshire, Worcestershire and Staffordshire Electric Power Company, and it is proposed to purchase the rights of these so as to make the authority an exclusively municipal one. In addition, railways and tramways, and other large consumers of power would have no representation, as it is thought by the promoters that "only the people who find the money should be represented." Apart from the fact that it seems to be in conflict with the spirit and objects of the Electricity (Supply) Act, we believe this to be a mistaken attitude, for a few representatives of the railways and other power consumers would be of great service in keeping the authority in touch with impending developments, while questions relating to charges for electricity and other matters could also be settled readily by direct negotiation.

Discordant Municipal Councils.

In regard to the scheme itself, there appears to be some conflict of opinion between the municipal authorities. There are fourteen generating stations owned by ten authorised undertakers, and it is suggested that these should be

acquired by the Joint Authority, and three new power stations erected at Rugeley, Stoke and Ironbridge respectively. Walsall objects to the transfer of its station at Birchills, which it considers to be well placed for conversion into a bulk supply station. Newcastle-under-Lyme is also opposed to the transfer of its station, and in the absence of compulsory powers of purchase the Joint Authority will, therefore, find some difficulty in carrying out their programme. We are pleased to notice that the Commissioners intend to do everything possible to extend the use of electricity, for, in the course of a discussion on a clause imposing an obligation to provide a supply of current for collieries and industrial works, Sir JOHN SNELL intimated that it was competent for the Commissioners to impose such an obligation in the event of an authorised undertaking raising unreasonable objections to the giving of a supply.

Power and Traction Prospects.

INDUSTRIAL developments in the area between Stoke and Lichfield are expected to result in heavy power requirements, and an early electrification of some of the local railway lines is also anticipated. The evidence tendered on behalf of the railway companies showed that there is a heavy and a growing passenger and goods traffic, and electrification would be a remunerative policy to adopt. No doubt when the railway amalgamation scheme is complete the subject will be considered, but apart from the traction supply there is likely to be an increased demand for power from the railways in the near future, while there is also an excellent colliery load in prospect. It is, therefore, to be hoped that a suitable scheme will be formulated by the Commissioners, in order that there may be no delay in making the necessary preparations for meeting the demands, immediate and prospective, for electricity in the district.

Telegraphy in the Background.

THOUGH generally filled with admiration at the arrangements made for the commemoration of the Jubilee of the Institution of Electrical Engineers, we may be, perhaps, allowed one small criticism—the preponderating amount of time given to matters connected with electricity supply, and, consequently, the very small amount of time given to telegraphy. This is the more astonishing when we recall that in 1872, the date the Institution was celebrating, electricity supply did not exist—telegraphy was the electrical industry—and, though in the intervening years the supply side has far outgrown the weak-current section, the greater claims of the latter to longevity might well have been more stressed. Telegraphy was, in fact, represented by two speakers only, Sir W. NOBLE and Mr. JUDD, and, though at the present time it goes so evenly on its way, both technically and commercially, as almost to be forgotten in the clash of battle on the supply side, there are incidents in its early days which would not only make good reading, but from which useful lessons can be learnt.

Some Forgotten Pioneers.

THOUGH we have no wish to swim the troubled waters, where this or that invention or this or that piece of work is definitely ascribed to one person, it is rather strange that the whole of the credit for early submarine telegraph progress should have been given by Mr. JUDD to Sir JOHN PENDER. Sir JOHN PENDER, as we have reason to know, was an enterprising and far-sighted business man, who did much for the development of submarine telegraphy, but he was in no sense an engineer; and it would, therefore, have been better in a gathering of engineers to have laid greater stress on the work of KELVIN, BRIGHT and FLEEMING JENKIN, to mention only three names. KELVIN himself and Sir HENRY MANCE, in their respective presidential addresses to the Institution of Electrical Engineers, gave, it may be noted, the credit for the engineering side of the early submarine telegraph work solely to BRIGHT.

The Engineers' Dispute.

IT is regrettable that a grave crisis, which may develop into a national stoppage of work, should have arisen in the engineering industry, and we sincerely hope that every possible avenue to peace will be explored between now and March 11, the date fixed for the beginning of the lock-out. The present dispute, which has arisen out of the interpretation of three clauses of the agreement made in September, 1920, only relates to overtime and the working of night shifts. It would be a disaster, not only for those immediately concerned, but for the country, if the matter were allowed to take its normal course.

Wiser Counsels.

FORTUNATELY, there are indications that wiser counsels will prevail, and that mutual explanations may lead to an understanding. Neither the employers nor the men desire overtime, but there are occasions when it may be necessary to work it, and as the men appear to have conceded this point, the real question is what is "necessary" overtime. The employers maintain that they alone shall decide, but the men claim that they, or their representative, should also be "consulted." Clearly it is right and proper that the employer, who alone bears the risk of loss or profit on a contract, should have the right to decide this important point, though it would be good policy to give an explanation to the men when it is necessary to work extra hours. At present nearly one-fourth of the members of the men's union are out of work, and as it has adopted a conciliatory attitude so far, it is to be hoped that it will be able to make its members take a sane view of the matter, and not push matters to extremes.

The Hull Electricity Undertaking.

THE report of the Special Sub-committee appointed to investigate conditions in Hull Corporation electricity department discloses such an unfortunate state of affairs that we are not surprised at the heavy deficit of £16 000 on the year's working. Some of the trouble appears to be due to a lack of that co-operation which ought to exist between the engineer and the chairman of the Electricity Committee and between the engineer and his chief assistant; and the remainder may be ascribed to the war, and to a want of due appreciation of its consequences. It was almost impossible to carry out adequate repairs between 1914 and 1918, and now they have proved much more costly than was anticipated. The reserve fund was inadequate, and instead of devoting it to repairs, it was employed for purchasing new plant for which borrowing powers could not at the time be obtained. The result is that the undertaking, which has a capital expenditure of about £800 000, is now without a reserve. For many years we have been urging the provision of an adequate reserve by all municipal electricity supply undertakings, and we should like to see the maintenance of a minimum reserve of 5 per cent. of the outstanding capital made compulsory.

Cause of the Trouble.

BUT matters do not end there, for the efficiency of the generating plant is poor, the coal consumption being given as 6·7 lbs. per unit generated. This

is attributed to the absence of economisers on the new water-tube boilers, to inefficient mechanical stokers, and to inadequate chimney shafts. Certain recommendations were made by the engineer in order to improve matters, but as there was a conflict of opinion between him and his chief assistant it has been decided to call in a consulting engineer to advise the Committee. Serious errors were also made in estimating the cost of some new plant and of extending the supply cables to Melton. In addition, it is alleged that the charges for electricity were not increased sufficiently to cover the increasing cost of supply, and, to complete the list, during the period from 1914 to 1919 the number of employees of the undertaking increased from 140 to 220, though it is pointed out that the reduced hours of working would only have necessitated an increase of from twenty-five to thirty men. Under the circumstances we think the Committee are wise in calling in an independent investigator to put the undertaking on a sound financial position, and to restore order out of the present chaos. The Hull undertaking has been fairly successful in the past, and we hope that as soon as the present domestic dispute is settled things will rapidly become normal once more. For continued success an engineer must have the support of the Committee, and he must also have the loyal co-operation of the whole of his staff. In brief, organisation and discipline must be maintained, though in the present case the root of the trouble can be traced to the absence of the engineer at the war.

An Unsuccessful Proposal.

It will be remembered that a Special Conference, representing the various branches of the electrical industries was recently convened to deal with the question of unemployment. They accomplished their task successfully and very amiably, and subsequently it was proposed that the conference, instead of being a temporary body, should be converted into a permanent association under the imposing title of the Conference of Joint Industrial Councils and Other Bodies in the Electrical Industry. This association was to comprise the three Joint Industrial Councils, *viz.*, those dealing with cable-making, contracting, and electrical supply, together with representatives of the British Electrical Development Association, the Electrical Wholesalers' Federation, and the B.E.A.M.A. As the purpose of the Conference was publicly to represent the interests of the whole of the electrical industries, the proposal was naturally taken seriously by the bodies concerned. Now we hear that the electricity supply branch, through the National Council, have refused to be parties to this permanent organisation, explaining that, although they are willing to co-operate on special matters, they do not agree to the formation of a permanent and independent body. This is not surprising, for, though the constitution of the Conference is, of course, adequate for dealing with a special matter like unemployment, it is obviously weak as a fully representative body, since neither of the four associations of the electricity supply industry is directly represented. Seeing that the proposed permanent conference is largely political in aim, it is hardly to be wondered at that the electricity supply industry refuses to delegate such important powers to any one of their own associations.

Two Important Exhibitions.

The immediate effect of exhibitions on trade is rather hard to gauge. For large crowds and the optimism of salesmen, based upon interested inquiries, do not always lead to the orders which alone make the enterprise and money expended worth while. The indirect effect is, however, good. For it cannot be denied that the firm that never exhibits, though it may not lose any definite orders, is failing to take advantage of that psychological aid to increased business which is known as keeping one's name before the public. We are, therefore, glad to learn that the electrical industry is well represented both at the Birmingham Section of the British Industries Fair and at the Ideal Home Exhibition at Olympia. The former of these, which was first held in 1915 for the purpose of enabling British manufacturers to show goods which had not previously been made in the United Kingdom, has since grown to include practically every British industry. It has a direct appeal to trade buyers, and is, in fact, only open to them.

Striving for the Ideal Home.

On the other hand, the Ideal Home Exhibition throws the widest net. Its aim is to show how a house fit not only for heroes, but for ordinary people, can be built, equipped, and run. To approach to within even a long distance of idealism the employment of electricity is necessary, and we are not surprised to find that the uses to which electricity can be put in bringing about the utmost quantity of labour saving and comfort in the home are being adequately displayed. Indirectly, electricity will also play a great part. For lighting schemes and decorative effects, which help so much to display goods and attract attention, would be impossible without its aid. Nevertheless, we ask electrical engineers to approach the exhibition in a spirit of criticism. The display will be adequate, but we fear it will be little more. It is their duty to see that another year it is very much more. Last year an often-heard complaint was: "It is very nice, but it is so expensive." We fear the complaint will be repeated with equal justice this year. That is one of the things which the electrical industry should set about altering by all the means in their power.

Geddes—Vol. III.

To readers of The Electrician the most interesting part of the third and final Geddes report will be that which deals with the Post Office. The conclusions of the committee are that a regular and systematic check should be instituted on the postal services, that the cost of the staffs can be reduced by nearly £400 000 per annum, and that the provisional estimate can be reduced by nearly £2 500 000. Now, Post-Office finance must be approached in a different way from that suitable for other Government Departments. For the Post Office not only spends, but should earn money. As we have so often stated in the case of the municipal electricity supply departments, its aim should be, not to make a profit, but to give the best service possible at the lowest possible cost without a deficit on the year's working. This does not mean stinginess, for a well-paid staff and wise expenditure on material are sound finance, but it does mean a careful check on all outgoings, and guarding against inflated staffs. The appreciable reduction in postal traffic since 1913-14 shows that one of these essentials is not being fulfilled, while the increase of staff in the same time indicates a failure to deal with another. These are certainly matters which should receive close attention, and we are glad to see that Mr. Kellaway hopes to go £10 000 000 better than Sir Eric Geddes. It is, however, to be hoped that he will also be able to remove some of the restrictions upon postal facilities which are such a burden upon business. One thing is as important as the other, for without easy and cheap communications trade cannot flourish.

The Jubilee Commemoration

The Jubilee commemoration of the Institution of Electrical Engineers has primarily resulted in the production of a mass of material which it is impossible to deal with at length in the columns of The Electrician. Had it been necessary for us to do so we should have failed in our duty; but, fortunately, a special edition of the Institution "Journal" is to be published, which will contain not only the speeches made at the various meetings, but also communications from a large number of understudies which the Council, perhaps warned by past experiences, provided. This will enable those interested in electrical history, as everyone should be, to examine the various reminiscences in a way which was not possible at the meetings themselves. We shall look forward to studying this official account. For it will be not only a valuable and interesting document, but a record of opportunities seized and lost, of shifts, of ingenuity, and, not least, of humour. It is a poor heart, unworthy of the adventurer, that cannot see what Meredith called the comic spirit playing over the most anxious of these early experiences, and our early *raconteurs* were obviously not lacking in the possession of this valuable quality. Often enough they needed it.

Personality the Keynote.

It may be said with a good deal of truth that personality was the keynote of the Commemoration. The various speeches were not only accounts of adventures, but were, generally unconsciously, reflections of human nature as exhibited in the engineer. "The nature," says Shakespeare, "is subdu'd to what it works in." And this is equally true of the engineer's nature as of the dyer's. This point is excellently made by Mr. Alan Sullivan in his attempts in the article which we publish elsewhere to discover the ingredients which go to make up the composition of the successful engineer. What he has to say will be studied with blushing interest; we only hope it is not too complimentary. He also recommends that the engineer should endeavour to break down the insulation which exists between him and his fellow-men, by communion with "a large-minded bishop, a manufacturer, a stockbroker, and a dealer in sporting goods." This advice might well be taken for the good of all the parties concerned.

It was inevitable, in proceedings like these, where the personal element was so much to the fore, that the names of famous past and living workers should have come up over and over again in the debates. It was not only inevitable, but just. For progress and the acquisition of knowledge are in the limit the result of human endeavour, and it is therefore fitting that the names of those who made that progress and acquisition possible should be suitably honoured. A Commemoration could have no better aim than this.

Faraday and Heaviside.

Now, if those who attended the meetings will review the proceedings from the human point of view they will discover this result: That the two names most frequently mentioned, and in the highest terms of honour, were first Faraday (which is not surprising) and secondly Heaviside (which is). For there can be no doubt, as Dr. Fleming pointed out, that all glory must be given to the man who not only made the discoveries which have rendered modern electrical engineering possible, but who examined and collated the work of others and put it forward afresh in a form in which it could be used. Both as a scientist and a man, Faraday was an example which none of us to-day would lose by following. The Roman Church lays down a period of years after death before one of its members can be canonised. This is a wise provision. It allows the brightness of the good qualities to be toned down, and mercifully glosses over the black patches. If, at the end of the time, the man seems worthy of that apotheosis, it is felt that the honour is fitly due. So with Faraday; and the Institution were therefore only giving him his due in raising him to the highest place in their Commemoration.

Lightening Obscurity.

Now, in Heaviside's history there are points both of similarity and dissimilarity with that of Faraday. His early work did not receive that attention which it merited, but, unlike Faraday, some share of general recognition is still lacking. Perhaps it is too soon, and, in any event, it is not unnatural that this should be so. The problems with which Heaviside dealt, and the way in which he treated them, are both remote from the intellectual processes of the average electrical engineer. It is recognised in a vague sort of way that he did some very good work, but what and where are equally unknown. A good deal of this obscurity is now cleared up by Dr. Eccles' remarks in proposing the resolution which, on the suggestion of Sir Oliver Lodge, the Council submitted to one of the Commemoration meetings, and now no one who belongs to the Institution need have excuse for doubting Heaviside's place among the electrical immortals. It is now some years since he had conferred upon him the highest honour which it is in the Institution's power to bestow. But that was no more than his due, and the additional honour is but a graceful act.

The Turbine and Electricity Supply.

We were glad to see another of the Institution's short list of honorary members present at the Commemoration. Sir Charles Parsons gave a most interesting and modest account of the development of the steam turbine that bears his name. That development is once again a history of failure, disappointment, and ultimate success. How great its effect on the progress of electricity supply has been is vaguely known to all electrical engineers. To gauge that effect in a more material form it is only necessary to visit a station like Bankside, and compare the space once occupied by the reciprocating sets with that taken up by turbines of a much greater output. When to this saving in space is added a reduced steam consumption and higher thermal efficiency, the advance that has been made possible by Parsons' researches is amply demonstrated.

Inventive Curiosity.

In connection with the Jubilee celebration, only one other name need be mentioned—Ferranti. Dr. Ferranti gave a most interesting account of his early devotion to electricity, and of how that inventive curiosity which he then displayed was turned to practical use later on. With him, we learnt, lay the premature conception of the idea of the large electricity district, an idea unfortunately killed by myopic legislation. It was his, and his devoted assistants', work to face the task of inventing a new industry, of finding material to do things which had never been done before, and they successfully won through.

The Re-birth of the Institution.

We seldom hear Dr. FERRANTI speak without his propounding some idea which is worth consideration. His remarks at the Jubilee Commemoration were no exception. In 1910, he said, when he became President of the Institution, he found it slow, quiet, and ready to die out or proceed in a way that made its future uncertain. He saw what a great good the Institution might be, and how much it could do for electrical science and for those who gave their lives to it. He felt it wanted life, and he tried to infuse life into it. This, we think, is the lesson of the Commemoration. Dr. FERRANTI's energy galvanised the Institution into life when it was becoming moribund, until at the end of fifty years of existence it is running more strongly than ever before. Moreover, it has no lack of talent within its ranks; in fact, Mr. SWINBURNE would have us believe the talent available is greater than it ever was. It is for us all to see that that talent is utilised in a way which will redound to the greatest good of the profession, and assist to the greatest possible extent in the development of the industry.

Rotary Converter Practice.

THE rotary converter is at once the Cinderella and the spoilt child of the electrical industry. For while, like its fairy prototype, it performs a series of useful functions, there are not wanting those who would like to see its employment dispensed with altogether, and who contend that it is more trouble than it is worth. It is true that these attacks are not made directly on the rotary converter. The real point at issue is whether direct-current distribution should not be discarded in favour of the alternating-current system, or, for those who are not prepared to go as far as this, whether the mercury-vapour rectifier could not do as much or more at a lower first cost and with less maintenance than either the rotary converter or the motor generator. If either or both these schools have their way, and they are rapidly gaining recruits, Cinderella will disappear into depths from which rescue by any fairy prince, however enterprising, will be impossible.

History Repeating Itself.

That this should happen would in many ways be a pity. But in the electrical industry we are not unused to seeing much work and money put into inventions and improvements which subsequent developments have rendered entirely nugatory. The direct-current turbo-generator is a case in point. For many years much skill and labour were expended in the design and manufacture of these machines. Experience brought forth improvements and better workmanship, until finally a perfected machine was obtained. Then the direct-current turbo-generator disappeared from mortal view, not because it would not work, but because it was not wanted.

As a spoilt child, the history of the rotary converter is not dissimilar. The early machines, especially those designed for the higher frequencies were far from satisfactory. The use of auxiliary poles, of damping windings, and of other devices, gradually did something to bring about an improvement, which, together with the inherent advantages of the rotary machines, over which we do not wish to gloss, has made it a class of electrical equipment from which but few improvements may be expected. Th s much, however, could be said about the direct-current turbo-generator, and we have seen the sequel. Will history repeat iteslf, and the rotary disappear because its place can be filled in some other way?

Rotaries and the Frequency Problem.

Though Mr. F. P. WHITAKER, who recently read a Paper on " Rotary Converters, with Special Reference to Railway Electrification " before the Institution of Electrical Engineers, neither asks this question nor supplies an answer, yet his contribution is of special interest in view of his saving clause. As is well known, the standard frequency of the future is to be fifty. A rotary converter does not work without difficulties on a traction load with this and higher frequencies. For reasons connected with the commutator a fresh set of difficulties arises when 1 500 V, which is to become the standard traction voltage, is employed, and these difficulties will be increased if the voltage is raised to 3 000 V.

Qualities for Admiration.

Even on 1 500 V the difficulties are sufficiently great to make it hard for us to decide which to admire most, Mr. WHITAKER's continued advocacy of this type of machine in general or the enterprise and care which have been expended in bringing the equipment to its present state of usefulness. Both these qualities are well illustrated by the history, given in the Paper, of the design and operation of three 800 kW 1 500 V d.c. rotary converters supplied to the North-Eastern Railway for operating the Shildon-Newport line. These machines work on 40 periods, and consist of two 400 kW 750 V rotaries connected in series. To allow for the severe short circuit conditions which might reasonably be expected, the machines were built with a completely insulating and fireproof screen between the commutator and the rest of the machine, good clearance was provided between the positive and the negative brush arms, and the operating details of the brush gear were well protected.

Commutation Conditions.

Commutation was satisfactory up to three times the full load, while to reduce the severity of the flash overs, which the illustrations in the Paper show to have been pretty severe, instantaneous trips were fitted on the a.c side. Later a step further was made with a 1 200 kW unit consisting of two 600 kW machines in series in which the diameter of the commutator was practically the same as that of the armature, the brush gear is carefully protected, and in the case of flash over the damage is almost negligible. Other features such as clearances, insulation, and commutator protection, have received special attention. These machines have been in operation for four years, their performance has been excellent, and their cost of maintenance low, while further improvements in the direction of making the machine itself more robust and self-protecting have been carried out.

A Live Subject or a Swan Song?

All these details go to show that rotary converter design and manufacture is on as high a plane as any other product of the electrical industry. Mr. WHITAKER is, therefore, to be congratulated on bringing a very live subject before the Institution, and especially on the clearness with which he has stated his case. For his sake we hope it is no swan song. But we confess we have our doubts. We now speak primarily of the traction field. Are we really going to use high-tension direct current traction on any large scale? If we are, Mr. WHITAKER will be amply justified; but we rather wonder.

It is My Privilege to Introduce . . .

By ALAN SULLIVAN.

I have been listening to pioneers, and searching a technical audience meanwhile, to try and discover whether there are any noticeable attributes that differentiate the man of science from the every-day ruck of humanity. But no externals are visible. He is, I think, rather more quiet. He is apt to be more casual about his dress. He has moments of abstraction more frequently than his fellows. I take it that he puts his back into his play—if he indulges in play to any extent—as much as into his work. I can see him at golf—but not at ping-pong.

His memory is good, sometimes painfully so. Outside of his own peculiar province he does not seem much interested. His political knowledge will probably turn on legislation affecting the industry, and he will recall the names of the men who did the foul deed.

Modesty, Self-Induction and Insulation.

He is, however, modest. This is, no doubt, because he realises how little he actually knows, and how much remains to be done. Temperamentally he varies a good deal, being at some times capable of self-induction, and, at others, unaffected by neighbouring potentials. As to his methods of working, he may be either series or shunt wound. But, whichever it is, he can usually be trusted to carry the load. Some engineers are too highly insulated. You know what is meant by this. Most of them ache at times to discard their covering and expose the bare conductor, but they experience what amounts to nothing less than a dread of personal nakedness, and jog along inside the unprofitable coating. It is, as a matter of fact, quite possible for an engineer to be more sensitive than a debutante—much more than some debutantes.

The Human Hawk—

Getting back to the pioneers. I have been listening—and thinking. One of them, a slight man, lean, with a projecting chin, and still energised in advanced years by the fluid in which he dealt, reminded me of a scientific hawk. With aquiline nose, a sharp, incisive gesture, eyes that still flashed with the romance of his own past, he seemed a sort of human dynamo. More than this, it was evident that he valued his failures as much as he did his unnumbered successes. One got the idea that he found in them a greater incentive. It was easy to visualise him in his prime, dashing here and there, almost emitting sparks, and darting from the short circuit of the impetuous attempt to the smooth pressure of achievement. This man found humour in it all—even in his battles, and he had many. He might be checked, but never defeated. He has too many facets of intelligence ready to be turned in any direction ever to allow him to be quite confounded.

—and the Olympian.

Another pioneer gave the impression of an Olympian, who moved in contemplation amongst the eternal verities. Here was a different composition. He built up systems and indisputable analogies, but not dynamos. His field was the empyrean one of thought. One could picture him collaring some nebulous and half-developed theory, dragging it off to the country, pushing it into a chair across the hearth, and reasoning it into almost conscious existence. He had, too, a placid quality. It struck me that he might talk on one subject while he thought about another, and both with entire success. One cannot divest oneself of what information may be possessed, but this pioneer seemed to have established a hunting-ground of his own, where he found his chief delight, and from which he periodically emerged, urbane and impressive, trailing clouds of mysterious ether from regions remote.

The Constructor and the Tactician.

A third was again different. He suggested work-forges-trip hammers and tilting furnaces. His was the sort who waits till others have spoken, then hits the nail on the head with a single sentence. He was the constructor, the builder, the contractor. It did not appear that he would be much interested in anything that weighed less than a ton. A job might go wrong, and serious mistakes be made (by others), but I take it that he would silently unravel the tangle, then dismiss the culprit in tones of silk.

Again a different make-up. Conscious rather of obstacles than of opportunities—and therefore the complement of his fellows—he seemed the man of tactics; a shrewd man, far-sighted and presumably relentless in pursuit. He would I fancy, lick his lips at a legal difficulty, and turn in distaste from one in dielectics.

They followed each other, these pioneers, with whimsical recollections of old rivalries and battles. They did not say so, but it seemed that to their minds the engineer of to-day has easy going. That is a matter of question. They themselves were, fifty years ago, like children playing on some strange and fascinating shore, picking up a medley of multi-coloured pebbles, and staring wistfully seaward, wondering what lay just over the horizon's rim. Prophecy must have been there, but the prophetic instinct must also have been confused by the multiplicity of new marvels they found on this mysterious strand. "Why not?" must have constantly been on their lips.

A Perfect Exhibition of Detachment.

Another, a man of great achievements, was impersonal to a degree, and had a marked distaste for the usage of the first person singular, holding his own remarkable record, so to speak, at arm's length, till it was hard to associate him with the thing at all. It was a perfect exhibition of detachment. The cultivated voice recounted triumph after triumph, with lingering little touches from which he turned with a manner, which, if not apologetic, seemed at any rate to disclaim any personal credit. That was noticeable all through the meeting. The pioneers left it apparently to others to secure the credit—of both kinds. Then, too, we heard of scientific encounters between Saxon, Gaul, and Teuton. The Saxon held his own, but gave rather more than he got.

The Ageless Electrical Era.

Many of these men looked surprisingly young, considering their period of service. One is prone to accept the electrical era as something ageless, whereas it is the latest fledgling in the scientific incubator. Can it be that electricity—which one is now tempted to call a quality, and not merely energy—infuses its devotees with something of its own baffling and ubiquitous power? It is quite imaginable. Why should not the man who moves in an ionised sphere acquire thereby a species of psychopathic purging that eliminates from his body certain undesirable elements of decay? I noticed the same thing in America. Sprague, Edison, Brush, Thomson, and Bell, they all betray a sort of rejuvenation. If the gland of an anthropoid ape can rehabilitate the human body, in the approved Transatlantic phrase, "What is the matter with electricity?"

Nature's Camouflage.

As to the general run of engineers, it seems that Nature has displayed a good deal of camouflage. They have no distinctive personal insignia, which is, perhaps, fortunate. It would only arouse suspicion. Their brows are not more burdened with thought, nor do they display any particular profundity. Their fingers are apt to be square, and one could not call their shoulders round. They seem self-possessed, and that is often all they possess. They carry themselves in a manner that might be described as undisturbed.

As to monetary success, the rich engineer is a financial anomaly. He is too busy making—or spending—other

people's money to accumulate much for himself. He has an insurance policy, and leaves an estate of £2 748—with practically no liabilities. The latter is due to his wife, who knows that in her case she will never be able to regard liabilities with a light heart. The engineer, if he is a good one, marries young, and leaves to his real managing director everything but his own job. The managing director usually leads a one-handled life, and not infrequently asks why he is not more particular about his clothes, also if there is any reason why he should not make friends with the men whose wives she desires to meet.

Artifex Creator.

The true engineer accepts all this without a murmur, and the acceptance is one of his earthly triumphs. Possibly it is the greatest. He is what the Greeks called their poets—a creator. The thing—the ultimate, perfect thing—is glimmering in his eyes, and he hears a reiterant whisper of " Will it work ? " It is, in consequence, a little difficult to appreciate the true importance of the Ponsonby Smythe's dance on the 22nd.

One does not expect that a common purpose, however aspiring, will eliminate temperamental differences. I think it accentuates them; and if an engineer differs, he is apt—believing that his creed is threatened—to differ seriously. I would be much more comfortable discussing a point with a 'bus driver. The engineer is, too, likely to be a shade contemptuous, and evidences a touch of either pity or contempt for those whose views are divergent from his own. He cannot help this, because he believes that his own knowledge is founded on bed rock.

The Inferior Professions.

His admiration—whenever he harbours an emotion so spontaneous—is largely reserved for those of his own tribe. He considers that other professions—excepting only medicine—are inferior. He is unmoved by the sight of a millionaire, even though the latter be his own employer, and declines to admit that the man who rises to a baronetcy on, let us say, waves of resurgent yeast, can be either an ornament or an asset to his country. And yet he may be both. This, I think, is where many engineers fall short in the humanities of life. Their own job is so serious, so responsible, their failures when they occur are so obvious, their successes are so often to the profit of others, that they raise unconsciously an imaginary wall between themselves and the large, easy-going, and, on the whole, good-natured world. Every engineer should try and have amongst his friends a large-minded bishop, a manufacturer, a stock-broker, and a dealer in sporting goods. This would do much to enlarge his *clientèle*, and soften his mental asperities. He will find that the gentlemen I have mentioned are quite agreeable to the suggestion. They think far more of him than he realises.

Electrical Engineering.*

By J. PALEY YORKE.

Dr. Wall states in his preface that this book is intended to give a survey of the principles of electrical engineering which shall be as complete as is practicable in one volume of moderate size. He makes that clear too on the cover-sheet, but we do feel that the time has come when the title " Electrical Engineering " shall be declared as insufficient. For example, this book and Dr. G. W. O. Howe's book have the same title, but the treatment is quite different. Dr. Wall's book is much more engineering than Dr. Howe's, but on the other hand, Dr. Howe's book is much more technical than Dr. Wall's.

On turning over the pages of the book one's first impression is that it is simply a text-book in magnetism and electricity suitable for a student reading for his final. We wonder where the electrical engineering comes in, except in so far as electrical engineering is essentially based on the phenomena of nature, usually described under the title of magnetism and electricity. But when we settle down to read the book we realise that whilst it is a text-book on magnetism and electricity it is also a text-book which deals especially with those phenomena which are applied to modern electrical engineering practice, and which deals with them far more exhaustively than they are ever dealt with in a pure science book, and more exhaustively than they have been dealt with in any single volume of our acquaintance. We may at once express the opinion that the book is an excellent standard work on the principles of electrical engineering. It is intended for students in universities, and in the advanced classes of technical schools, and practising electrical engineers should find it useful as a reference book.

The work is divided into six main sections, dealing successively with static electricity, magnetism, direct-current electricity, electromagnetism, alternating currents and units.

Electrostatics and Magnetism.

The section on electrostatics covers 98 pages, and will, as is usual, cause the greatest amount of difficulty and the least amount of enthusiasm. But we agree with Dr. Wall when he emphasises its rapidly increasing importance to engineers and we hope that more recognition will be given by students and teachers to this previously much despised " sealing-wax and flannel " branch of the subject. The chapters on potential, capacity and energy of the electric field are particularly good, dealing especially with the capacities of cables of differing types and in differing circumstances: with dielectric strength and with electric stresses in cable dielectrics.

The section on magnetism is very complete, and the information given about magnetic alloys, cobalt, steel &c., and about ion losses appears to be quite up to date. In the direct-current electricity section, there are chapters dealing with first principles, electric resistance, electrolysis and secondary cells, and thermo-electricity. We are almost sorry to see the " Best arrangement of Cells " perpetuated—but this appears to be irresistible. We should like to suggest that in the next reprint some mention of the Benedick effect—the converse of the Thomson effect—should be made in the thermo-electricity chapter, and that credit should be given to C. V. Boys for the main idea of the thermo-galvanometer, even though he used it chiefly for radiation work.

Spartanlike Treatment.

The alternating-current section covers 150 pages, and in addition to the fundamentals has chapters dealing specially with harmonic analysis, magnetic fields due to alternating current, transient electric currents, and the use of complex quantities in a.c. problems.

Special attention has been given to the properties of magnetic shells and to Ampere's theorems of the equivalence of electric circuits and magnetic shells.

Altogether, as we have said, the book is a very complete and excellent work on the principles of electrical engineering. The treatment is certainly Spartan-like in its avoidance of stressing the practical application or importance of any special point. Dr. Wall will say that it is *all* important, and that the student who counts will not require any stimulus by direct reference to the immediate application of every point. We agree that it would be impossible to do this without producing an enormous encyclopedia; but on the other hand the majority of us are of baser clay, and most of us do work better for an occasional glimpse of the promised land, in spite of the lesson of Moses. We feel, for example, that we would have been stimulated quite a lot if Dr. Wall had just given us a peep at an electrostatic voltmeter after we had carefully and conscientiously waded through the theory of the quadrant electrometer. We hope that Dr. Wall will smile if he should read this—even though the smile be sadly indulgent.

We congratulate the publishers on having produced the book so well, and at such a reasonable price.

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THE INSTITUTION JUBILEE COMMEMORATION.

Fifty Years of Audacious Progress—Two Outstanding Pioneers—Many Great Workers—Reminiscences of the Early Days—Honouring Heaviside—The President's Illness.

The Jubilee Commemoration of the Institution of Electrical Engineers, which was founded in 1871 as the Society of Telegraph Engineers, and whose first ordinary general meeting was held on February 28, 1872, took place on Tuesday, Wednesday, and Thursday last week. It was a happy idea to celebrate this fifty years of electrical progress by reviewing the efforts of the early electrical workers and, with the assistance of representative pioneers, who are still living, to give present-day members of the Institution some idea of the difficulties that had to be overcome and the mistakes that were made before that great machine, as we now know it, could be fairly started. Pressure on our space prevents us from dealing, except in an abbreviated form, with the remarks of the speakers, but these will be found in full in a forthcoming special issue of the "Journal" of the Institution. They will form not only an interesting but a useful record, for as the POSTMASTER-GENERAL said at the annual dinner, great as have been the advances in the past fifty years, who can place any limit on the possibilities of electrical science and art.

An Opening Tragedy.

The proceedings opened with a tragedy. For it became known on Tuesday morning that the President had been suddenly stricken down by illness and would be unable to play his full part in the proceedings. Apart from depriving the Jubilee of its principal figure, this was the more distressing as the conception of the commemoration in the historical form was Mr. Highfield's own. He can, therefore, be equally commiserated and congratulated, for the whole function was an entire success.

Quite rightly the name and work of Faraday were the first to be honoured, and quite rightly Prof. Fleming was called upon to carry out this appropriate task. On Tuesday afternoon and again on Wednesday evening he gave a lecture on "Michael Faraday and the Foundations of Electrical Engineering," in his own inimitable style. The lecture was a triumph of delivery and stage management.

Tuesday, Feb. 21.

On Tuesday afternoon the room was not crowded when Mr. A. A. CAMPBELL SWINTON took the chair and briefly opened the proceedings by saying that Prof. Fleming required no introduction as his invention of the thermionic valve had made him known over the whole world.

Michael Faraday.

Prof. FLEMING began by throwing on the screen a photograph of Foley's fine statue of Michael Faraday, which stands in the entrance hall of the Royal Institution, and reminding the audience that Faraday became connected with that institution as the assistant of Sir Humphrey Davy in 1813, when he was twenty-two years old. His earliest research work was chemical in character, but when in 1820 Oersted made the discovery of the magnetic field round a wire conveying an electric current Faraday solved in a very neat manner the experimental problem of making a magnet rotate continuously round a current-carrying wire and so gave us the first electric motor. He was thereby stimulated to endeavour to produce a current by the action of a magnet. After failing in his first efforts in 1824, 1825, and 1828 he at last succeeded on August 31, 1831, in his epoch-making discovery.

The Most Famous Ten Days in History.

He wound on an iron ring two tape-covered copper wires and found (1) that the passage of an electric current through one wire created a brief current in the other wire at the instant of starting or stopping the primary current. Following the clue in a series of experiments made in perhaps the most famous ten days in history, he discovered (2) that when a permanent magnet was approached to or drawn from a helix of wire so that the lines of magnetic force "cut" the convolutions of the coil it created in it an electric current; (3) that when a copper disc was rotated between the poles of a permanent magnet radial electric currents were set flowing in the disc, and could be drawn off by proper contacts. These three great discoveries developed in course of time in the hands of numerous inventors into the induction coil, and magneto-electric machine, and later on into the transformer, alternator and dynamo. Prof. Fleming showed all these facts experimentally to his audience, and also Faraday's experiment of obtaining an electric spark from a magnet and coil of wire. He also exhibited the ring magnet with which Faraday had conducted his early experiments, describing it as an almost sacred relic. The value of Faraday's work, he pointed out, lay not only in its intrinsic importance, but in the way he had collated the researches of still earlier pioneers, peptonising them and clarifying them in a way which made us forgetful of the genius which unravelled and enumerated the most fundamental electrical facts. His most valuable investigations were conducted with no other goal than a disinterested desire for scientific progress, and it was worthy of note that Faraday told us not only of his successes, but of his failures and his lines of thought. An instance of this was the way he developed the idea of self-induction from a chance question made to him by one of his audience after a Royal Institution lecture, the only occasion, he himself said, when a question from such a source had started a useful train of thought.

Faraday's Electrostatic Discoveries.

He then explained and showed experiments to illustrate some of Faraday's discoveries in connection with electrostatics, especially that of the specific inductive capacity of insulators, which, however, had been anticipated sixty-six years previously by Henry Cavendish, but were not published until some years later, when they were discovered by the Duke of Devonshire.

Following this attention was directed to Faraday's great investigation in connection with electrochemistry, and especially his two laws of electrolysis (1) that when a current flows through an electrolytic cell the mass of the ions deposited on the electrodes is proportional to the quantity of electricity which was passed, and (2) that when a number of electrolytic cells are joined in series the masses of ions deposited in each are proportional to their chemical equivalents. Von Helmholtz pointed out in 1881 that these laws of Faraday prove that electricity was atomic in structure.

Electro-Optical Work.

Referring then to Faraday's electro-optic and magnetic work, the audience were shown the great experiment Faraday called the "magnetisation of a ray of light." A ray of plane polarised light was transmitted through a bar of Faraday's heavy glass, a boro-silicate of lead, which was placed between the poles of a powerful electro-magnet. On exciting the magnet it was seen that the plane of polarisation was rotated. Both Kelvin and Maxwell considered that this discovery of Faraday proved that some kind of rotation was taking place along lines of magnetic force. Some of Faraday's leading investigations on magnetism were next described, a view of his large electromagnet being shown on the screen.

Faraday and Wireless.

Prof. Fleming then alluded briefly to Faraday's theoretical views on lines of electric and magnetic force and showed how the translation by Clerk Maxwell of those views into mathematical language led the latter ultimately to enunciate his celebrated theory of the electromagnetic nature of light, and thus paved the way for the discovery of electromagnetic waves and the invention of wireless telegraphy.

Faraday's opinions and researches on a possible connection between gravitation and electricity were then mentioned, and it was pointed out that Einstein's theory also had predicted a connection of this kind, which was confirmed at the total solar eclipse of May 29, 1919, where it was found that a ray of light, which was an electromagnetic wave, was deflected slightly by the mass of the sun.

Faraday the Man.

Eulogising the character of Faraday, Dr. Fleming said that he had made posterity his debtor not only by his achievements, but by his personality. He therefore appealed to the audience to support the research work of the Royal Institution. That institution was without rival in the world for the enormous value of the scientific discoveries which have issued from its laboratories, and the ridiculously small cost at which these results had been attained. Sir James Dewar stated lately that the whole cost of maintenance of the institution during the last 120 years has been little more than £100 000, not a twentieth part of the cost of one battleship. Yet the discoveries of Faraday alone, Professor Fleming concluded, had put untold wealth into the exchequers of nations and laid the firm foundation on which rests to-day the entire work of the

modern electrical engineer. He therefore appealed to the largest and one of the youngest of scientific institutions to help one of the oldest.

A Founder Member on Faraday.

Sir HERBERT JEKYLL, who is one of the founder members of the Society of Telegraph Engineers, in proposing a vote of thanks to Prof. Fleming, said that he had attended as a boy Michael Faraday's Christmas lectures at the Royal Institution. He had been struck by the extraordinary simplicity and kindness of the man himself, and his willingness to answer the questions asked by eager youngsters at the end of the lectures. To those youngsters he had always something to give, even if it was only a little piece of magnetised wire. His essential kindness was also shown when at the end of a dull lecture he had spoken for half an hour on the lessons of the halfpenny and sent away a bored audience in a state of good humour. But great as Faraday was as an inventor, he was equally great as a man, so that not only by his achievements, but by his personality, had he made posterity his debtor.

By the kind permission of the Royal Institution some of Faraday's original apparatus was exhibited in the Lecture Theatre and Common Room, while models of a number of early dynamo-electric machines, and one of the first Parsons steam turbines, which were lent by the Science Museum at South Kensington, were also on view

Wednesday, Feb. 22.

On Wednesday afternoon Dr. W. H. ECCLES, presided over the meeting and expressed regret at the continued absence of the President. If Mr. Highfield had been present he would have treated them from the store of his memory to some introductory address upon the Commemoration, but without having had any opportunity of preparing such an address, and without, indeed, the experience Mr. Highfield possessed, he (Dr. Eccles) did not propose to touch on the subject, but recommended every person present to peruse the programme, which gave some particulars of the Institution's history and objects. He called on Colonel Crompton to give his reminiscences.

Colonel Crompton's Reminiscences.

Colonel R. E. CROMPTON began by referring to the fact that there was at least one older member than himself present, viz., Mr. A. P. Lundberg, aged ninety-one..

Continuing, Colonel Crompton mentioned that he had installed Gramme dynamos and Serrin lamps as early as 1878 at the Stanton Ironworks, obtaining the necessary technical knowledge for the purpose from the telegraph engineers. Some of the ideas were strange, notably the impression that a certain internal resistance was essential to the production of an E.M.F. In 1878, he went to Paris and joined in a discussion on electric lighting, and in 1879 he met Emil Burgin, of Basle, and took up the manufacture of his form of dynamos, which were undoubtedly better from a mechanical standpoint than the Gramme machine. Very soon they were turning out several Burgins a week at Chelmsford, and they always sold several Crompton arc lamps with each dynamo. Then the works were enlarged, and Gisbert Kapp was taken on as manager. Subsequently he met Swan, who was developing his lamp company, with which the Edison interest was ultimately amalgamated. The first regular installation of electric light in a country house was apparently at Berechurch Hall, belonging to Coope the brewer. A number of bell-hangers were turned on to electric wiring and eventually became electrical contractors. The remarks that had been appearing in the papers recently about the first electrically lighted house were all wrong. His own house had been lighted before either those of Sir Wm. Crookes or Lord Randolph Churchill.

Early Magnetic Calculations.

Ideas of calculating magnetic fields were very vague at that time. He (Colonel Crompton) believed that bigger cores of softer iron should be used for armatures and magnets, but Kapp did not agree. In the latter's absence he made a machine with gigantic wrought iron field magnets. On Kapp's return it was tried and proved a success, and the modern dynamo was born. Meantime, Hopkinson had been working on the same problem, and they both exhibited at Kensington.

The burning of the Ring Theatre in Vienna led to the Imperial Continental Gas Company in Vienna taking up electric lighting, and he had joined with Monier, a French engineer, in devising a suitable central station. The Allgemeine was then just starting, and he often met Rathenau and Deutsch in Vienna, with the result that he tried to apply his Continental experiences in lighting parts of London. Want of capital hindered these projects, but eventually the Kensington Court Electric Lighting Company (the first real lighting company) was formed. About the same time, Ferranti and Lord Crawford started distributing alternating current from the Grosvenor Gallery. At the latter many extinctions occurred, but he (Colonel Crompton) had accumulators in reserve at Kensington and they scarcely ever had a failure.

The Dynamicables.

In 1883, a dining society, the Dynamicables, was formed, and practically every man of note joined. (One duly elected member was found, when he died, to be a woman !) At the Dynamicables many interesting problems were discussed. About this time the potentiometer was evolved. Interesting competitions between rival dynamo-makers took place on the test bed at Willans' works at Thames Ditton, yielding valuable data on efficiency, and showing that England at this time was in advance of any nation in this form of machinery. When mains were first laid in the Kensington Court subway, bare copper conductors were stretched over porcelain insulators. Many miles of small subways under the pavements were constructed, and after forty years were still in use. There were, however, troubles in the surface boxes—especially in the neighbourhood of leaky gas mains.

Electricity Supply in Westminster.

Sir ALEXANDER KENNEDY began his remarks by paying a tribute to the assistance given in the early days by Colonel Crompton, who had put his experience at the service of everyone, which was more than most people did. Electricity supply in Westminster began in a small shanty in Dacre Street, another in Chapel Street, and a third in the Stone Yard of the Houses of Parliament, from which a supply was given to the building. This was in 1890. In 1891 the company had a total income of £2 600, and their greatest energies were employed in fighting Ferranti. One of the few notes of the combat that he had found remarked that in Millbank-street 7·75 lb. of coal per kW were being used, which was less than half the best " high tension " result.

Early Interconnection Problems.

The great question in those days was whether two stations could be paralleled. As a mechanical engineer he could not see why not, but electrical engineers were very doubtful about it. Colonel Crompton knew perfectly well that it could be done, but had not done it—apparently because he did not want to. In February, 1891, the great experiment was carried out of connecting the Dacre Street and Stone Yard stations, but nothing happened—to many people's great astonishment. In December, 1891, the conversion of the old two-wire system into the three-wire system was completed. At that time a 112 kW machine cost from £1 700 to £2 300, and there were only two makers in the country who were prepared to tender for 250 kW dynamos.

Vibration and Psychology.

Noise and vibration were great troubles, and gave rise to some amusing incidents. There were loud complaints from residents in Milbank of the vibration and noise from machines which had never been run. A doctor in Brook Street complained of smoke, but when asked to say when he had seen any smoke he replied he had never seen any, but there must be some because there was a chimney. In this district vibration tests were made which gave the extraordinary result that the greatest vibration occurred when the station was shut down, *i.e.*, it was caused entirely by wheeled traffic. A doctor's housemaid stated that whenever she opened the door she could hear the current roaring in the mains underneath the pavement, while another doctor complained that the current supplied caused showers of sparks in the incandescent lamps. He did not realise that his lamps were broken.

On another occasion one of the engine-drivers broke off the stop valve of his engine and said nothing about it. As the lamps were turned off the engine went faster and faster and the voltage went up and up, with the result that Mr. Grimshaw and his assistant spent the next day going round with a basket replacing the lamps.

Dynamos and Early Electric Traction.

Sir OLIVER LODGE gave some of his experiences as an electrical engineer, a *rôle* in which he is rather unfamiliar to readers of THE ELECTRICIAN. In early days they discriminated between the dynamo-electric machine which had electromagnets and the magneto-electric machine which had not. The term " dynamo " was first adopted by Lord Kelvin in a Paper which he read before the British Association. Lord Kelvin was extraordinarily immune from electric shock. On the occasion when he, Fitzgerald and Sir Oliver were inspecting the first electric railway between Portrush and Bushmills, on which the working pressure was 500V., Fitzgerald and Sir Oliver suffered from shock, while a cow was killed. Lord Kelvin, however, could feel nothing at all and asked them what they were jumping about for. It was only after he had gravely placed his hand on the rail that he said after a pause: " I think I do feel a something," reminding one irresistibly of the cheese and the charwoman in " Three Men in a Boat."

Sir Oliver also gave his recollections of the first battery vehicle which refused to take a bend in the road and went straight across the street into a shop window opposite. The next day it took the bend but caused trouble with a horse-driven milk cart, as the

horse could not understand why it went along without any visible means of propulsion.

Heaviside and "The Electrician."

Resistance units, current units, voltage units, all came in gradually, Sir Oliver continued, but it took a little time to get the idea of self-induction into the minds of early workers, especially those in the telegraph service. Sir William Preece was very much annoyed with Oliver Heaviside for emphasising the importance of induction in cables, and it was certain that the work of Heaviside had not received even now its due share of recognition. For while Lord Kelvin gave the theory of cables, and made the first cables possible, he did not attempt to take self-induction into account. Heaviside did, and showed that whereas resistance and capacity together were a bugbear and distorted the signals so that they travelled at different rates and had different frequencies, and therefore speech through a long cable was impossible and ordinary signals were liable to be greatly confused, the effect of self-induction would be just the opposite. It would neutralise the effect of capacity, and by loading the cable by introducing self-induction on purpose the damage done by capacity and resistance would be reduced. Everyone knew now that loaded cables were used for telephonic purposes, but a great deal more could be done by using self-induction in cables to increase the speed.

Fitting Recognition of a Great Work.

Concluding, Sir Oliver remarked that Mr. Heaviside was still living in Devonshire in very bad health and he understood in poor circumstances. At this anniversary of electrical engineers it would not, therefore, be improper to suggest that a message be sent to him expressing the Institution's recognition of the mathematical work—the very brilliant mathematical work—which he had done, and which appeared for many years in The Electrician and in his book. His work was far in advance of his time, but it had borne practical fruit in the hands of practical men. Mr. Heaviside himself was not a practical man, but a theoretical genius of a very extraordinary type.

Mr. Campbell Swinton said that during the last week or two the Institution had been in touch with Mr. Oliver Heaviside, with a view to doing him some honour. They were not yet in a position to say what he would like or what he would accept, but the point would be raised later. The question of sending a greeting to him from one of these Commemoration Meetings would be considered.

A Broad View of Electricity.

Mr. Garcke commented on the remarkable fact that, notwithstanding the millions of pounds expended on applications of electricity, we still knew little of its essential nature. It was conjectured that all matter was electricity, and the Institution, true to its broader policy, provided opportunities for the discussion of these philosophical speculations. Electricity was not invented by man. It never was "in its infancy." But its application had been gradually developed. It was difficult, therefore, to see why it had been treated in such a narrow parochial manner. Electric supply was usually dated from the Electric Lighting Act of 1882, but this Act was based on the earlier Tramways Act (1870), and to understand this we must go back about 100 years.

The Tramways Act.

After the Napoleonic wars the prevailing distress necessitated the stimulation of industries and the progress of invention. The extension of public utilities was encouraged, and simultaneously an impetus was given to local government. Hence horse tramways were controlled by the Tramways Act, which had unexpected consequences. It contemplated municipal ownership, but not the operation of tramways by municipalities. The latter extension occurred afterwards. But in connection with electricity supply the precedent was followed. Thus the pernicious Act of 1882 was conceived. Politicians were stupid in their legislation, but were the scientists wise in their outlook? The basic trouble of electricity supply arose from having to open streets to lay conductors, which necessitated a bargain with the community. Had we been able to think more in terms of electromagnetic waves and less in terms of conductors subsequent developments might have been different.

The Story of Electrical Legislation.

The Act of 1882 was not amended until 1888, and then only imperfectly, and the Light Railways Act, which might have been helpful, was interpreted in the terms of the Tramway Act. The story of electrical legislation had been often told. Perhaps the best general description was that conveyed in Mr. Campbell Swinton's address to the Royal Institution in 1912. The future depended on the breadth of view we were able to apply to our interests. Structures developed were often unequal to the functions undertaken. International arrangements were needed for the stabilisation of currencies, the rehabilitation of confidence and credit, for better distribution of raw materials and for intensive production. Apart from such international arrangements, the supreme need of the nation was for better and more sympathetic all-round co-ordination. How could electricity help in the work of rehabilitation? The Ministry of Reconstuction two years ago gave us a lead, remarking that the public mind had been prepared for a large development of electricity supply which would conserve coal and human resources. Power and transport were fundamental agencies of modern economic life. Adequate and cheap power supply, widely distributed throughout the country, would open up possibilities comparable with those of the industrial revolution of a century ago.

"The" Electric Light.

Mr. Sydney Evershed stated that forty years ago his work lay outside the electrical field, but as a spectator he was even then impressed by the vision of the strange new world of electricity developing in the seventies and eighties. He proposed to select from a crowd of memories three disconnected incidents.

In those days people always spoke of "the" electric light in the singular, because they seldom saw more than one arc light. One could not light one's house with arc lamps, but everyone talked of the time when electric light would be available in more manageable units. He remembered reading an excited cablegram from America announcing that Edison had solved the problem by the invention of an incandescent platinum filament. According to popular accounts, the great inventor spent months of fruitless effort, never going to bed, until the problem solved itself—by the accidental dropping of a screwdriver or something of that kind. In contrast with this feverish picture, a quiet man in England was working patiently at the invention of the carbon filament lamp. He would never forget his first sight of the Swan lamp, when some leather mills in Godalming were lighted in this way in 1881. More Swan lamps were used in the smaller streets, but the main streets were lighted by arc lamps. The cables were merely laid in the gutter with no protection against the wheels of carts or the hooves of horses. Ultimately, of course, they were put under the pavement, but this was not permissible until the passing of Chamberlain's notorious Electric Lighting Act, with its unfortunate arresting influence on future developments. In the long list of past-presidents of the Institution there was no name more honoured than that of Swan, the father of domestic electric lighting.

Telegraphy and Telephony.

Telegraphy, Mr. Evershed next remarked, had had a long and curious history. It began as a wireless telegraph, an optical system. His first recollections of electric telegraphy were in 1866 when each morning his father used to read out from the newspaper the account of progress of the ship laying the Atlantic cable. It was good to remember that this pioneering work was done almost entirely by our own countrymen.

It was in 1876, the year of the Centenary Exhibition at Philadelphia, that he first heard of Graham Bell's telephone. A year later he saw a drawing of the apparatus and marvelled at its simplicity, and at once set to work to make one for himself. A young lady eleven years old acted as girl telephone operator. How wonderful it was when her small voice answered him quite distinctly! Since that day much of the glamour has been rubbed off the telephone. Its defects had been attributed to the authorities for mismanaging it, but it would be nearer the truth to say that our telephone service, with all its shortcomings, was a faithful reflection of our national temperament. But the marvel of this invention remained. Was ever so profound an influence on our daily life brought about by such simple means? He could think of no invention made by man that approached it.

Gordon's System of Electricity Supply.

Mr. A. H. Walton, recalling the old discussions on the relative merits of d.c. and a.c. supply, referred to the historic work of J. E. H. Gordon in putting down a single phase a.c. lighting installation at Paddington in 1884. Their only a.c. instruments in those days were the Siemens dynamometer and a Cardew hot wire voltmeter, and calibration was difficult. In fact, it was usual to rely on the judgment of observers as to when a standard lamp was fully incandescent.

Mr. Walton described the generators installed, which were of about 400 kW. at 150 V., running at 180 revs. per min., and giving 42 cycles per sec. The speed, however, was reduced to 146 revs. per min. owing to engine troubles. The machines were direct coupled to compound tandem engines and the field, or rotating part, weighed some 22 tons. It consisted of 56 drum type coils, twenty-eight being mounted on each side of a wrought iron disc built up of boiler plates. The stator consisted of wedge shaped coils wound on a hollow core of wrought iron, twenty-eight coils being used on each circuit of each side of the machine. The hollow

cores enabled internal water-cooling to be used. The weight of each machine was about 45 tons. Three exciters each of about 25 kW were used, their speed being varied according to the load on the alternators. Paralleling alternators was certainly tried, but without much success, the circuits being divided and connected to different machines. A feature of the wiring was the use of Gordon's multiple or "divided main." The voltage drop in feeders to passenger and goods centres was 20 per cent., and to the locomotive centre about 33 per cent. To obtain this drop the section of the divided main was varied by cutting in or out the individual strands of the cable. This method of keeping voltage constant at a given point by altering the section of the feeders seemed worth consideration even in these days.

Early Arc Lamps.

For the lighting of offices and the Great Western Hotel 4 115 incandescent 25 c.p. lamps were used; in the passenger and goods stations and various yards 98 arc lamps each of 3 500 c.p. In addition two arc lamps were installed at the four corners of the Great Western Hotel. Difficulty was experienced in finding a suitable arc lamp, and the mechanism of the original Crompton d.c. lamps was altered, the positions of shunt and series coils being reversed, and two laminated cores substituted for a single one. Lamps were operated two in series with an inductive steadying resistance. Carbons were originally obtained from Vienna, afterwards from Le Carbone, of Paris. Even at that time the incandescent lamps were subjected to elaborate photometric tests before contracts were awarded.

The plant was started up in 1885 and various alterations had to be made in the generators, one event being a complaint by neighbours of excessive vibration, as a result of which Mr. Justice North, who was hearing the case, paid a surprise visit and inspected the plant. There were other difficulties, and the running of plant during the experimental period usually involved 12 to 15 hours per day attendance on the part of the staff. The old and historic plant has now been replaced, but it would always retain a place in the pioneering of electric lighting in this country.

Submarine Telegraphy—1869-1919.

Mr. Walter Judd then reviewed progress in submarine telegraphy from 1869-1919—fifty years during which he had been intimately connected with the subject. In March, 1869, the only ocean cables were three, across the Atlantic, but later in the year communication was established with Egypt, in 1870 with India, Malaya and Japan, in 1871 with Cochin China, Hong Kong and Australia; in 1876 with New Zealand; in 1879 with South Africa. With these enterprises the name of Pender would always be identified. Other countries also entered the field. The Pacific Ocean had been spanned from North to South, and from East to West, and there were now 305 000 miles (71 000 Government owned) as compared with a possible 10 000 in 1869. This included all submarine cables, the great bulk of which were manufactured in this country.

Cables to-day were of the same general type as in 1866. But developments, recommended by Heaviside, had increased the ratio of copper to gutta-percha from 300 (copper) to 400 (gutta-percha) in 1866 to 700 (copper) to 360 (gutta-percha)—the highest known to-day. In shallow tropical waters cables were attacked by boring worms, a difficulty overcome by lapping the cable with thin brass tape. The inclusion of inductances in deep-sea cables had been considered. It had been also suggested that if a consistent constant and weatherproof insulator with a dielectric resistance of a few hundred thousand ohms instead of many thousands of megohms could be found, a cable with small retardation and distortion without excessive attenuation could be secured. Apparently neither method had yet been used, but finality had doubtless not yet been attained.

The Work of Kelvin.

Lord Kelvin, in 1865, solved the problem of operating cables when laid. His mirror galvanometer was for some years in general use, until displaced by the siphon recorder. Both instruments were substantially unaltered to-day. Modern apparatus for operating cables had, however, lost its pristine simplicity. The first great change was the introduction of duplex, but after laying an artificial line having the closest reproduction of the electrical constants of the cable, the art of obtaining balance on a long cable still depended greatly on the skill of the operator.

After referring to progress in relays and magnifiers, Mr. Judd remarked that there was a tendency to revert to the Morse code instead of the cable code hitherto universal on long cables by adapting the Gulstad principle to more sensitive apparatus.

Finally, Mr. Judd declared that only those present at the first landing of a cable connecting new areas of the globe could realise the excitement and pleasure produced. The social effects of such connections in lessening feeling of distance and isolation had been very marked. Submarine telegraphs played a most important part in the war, and great credit was due to those who faithfully carried on this essential work.

On Wednesday evening Prof. J. A. Fleming again delivered his lecture on "Michael Faraday and the Foundations of Electrical Engineering," an account of which is given above.

Thursday, Feb. 23rd.

On Thursday afternoon the reminiscences of the elder brethren of the electrical industry were continued, but before these began Mr. C. C. Paterson, who was in the chair, called on Dr. W. H. Eccles to move a resolution.

A Tribute to Heaviside.

Dr. W. H. Eccles said that Sir Oliver Lodge had suggested, at the meeting on the previous day, that a message should be sent to Mr. Oliver Heaviside conveying the appreciation of the electrical engineering profession of the important theoretical work that he had done. After an informal discussion the Council agreed with Sir Oliver's suggestion. Continuing, Dr. Eccles said that Mr. Oliver Heaviside's work consisted in introducing Maxwell's theory to a public who were not schooled in Maxwell's methods, by the vehicle of a vector algebra which was simpler than the orthodox mathematical methods of Cambridge. Unfortunately, orthodox mathematicians found Heaviside's methods more difficult than their own and poured cold water upon them. This lack of recognition was assisted by the neglect the work received in our engineering colleges. On the Continent matters were different. Lorenz had at once adopted Heaviside's methods, and now even pure mathematicians were employing them.

Telegraphy and Wireless.

It might in fact be said that both on the mathematical and physical sides Heaviside was forty years ahead of his time. The phenomena of submarine cable telegraphy were badly understood, and his suggestion that self-induction might be incorporated in cables in lumps so that conversation could be effected without distortion over a three or four times greater distance than when such methods were not employed had now been proved amply justified. It was only right to point out that Heaviside gave his information to the world at large without any attempt to make money out of it. In wireless telegraphy, too, he had done pioneer work. There had been much scoffing at the suggestion that wireless communication between, say, England and Canada was possible, it being thought that the mountain of water 150 miles high that lay between the two countries would be an effective obstacle. It had now been shown that the upper atmosphere was permanently ionised and was as good a conductor as water. He (Dr. Eccles) had termed this section of the atmosphere the Heaviside layer as some recognition of its discoverer's labour. He therefore moved:

> That the members of the Institution of Electrical Engineers assembled at the Commemoration Meetings being held to celebrate the fiftieth anniversary of the first meeting of the Society of Telegraph Engineers (now the Institution of Electrical Engineers), with their thoughts directed to all those who in earlier days laid the foundation of the science and industry which the Institution represents, desire to send a message of greeting and remembrance to Mr. Oliver Heaviside, F.R.S., Honorary Member of the Institution.
>
> In the course of the meetings they have been again reminded of and have recognised the great importance of the classic work achieved by Mr. O. Heaviside, and published by him in his papers and writings from 1887 onwards, and especially of his discovery of the importance of inductance in circuits for the transmission of telegraphic and telephonic signals without distortion, and of him as the originator of the methods now being universally applied for this purpose; and in no less measure of his investigations and discoveries relative to the propagation of electro magnetic waves in space, the results of which are now being utilised in wireless or space telegraphy and telephony.
>
> They are convinced that, as now so in the future, the name of Heaviside will be one of the names which will rank among those of the great founders of the science of applied electricity.

Mr. Llewellyn Atkinson, who seconded the resolution, said that he remembered Heaviside's Papers when they were published in The Electrician in 1887. Maxwell had said that every advance in pure mathematics had resulted from attempts to solve practical problems. In attempting to solve successfully certain physical problems the classical methods of mathematics had failed, and Heaviside had spent much time in suggesting a new vector algebra to deal with them. It should be pointed out that even non-mathematicians could learn from his statements of results even though they might not understand his mathematics. It was obvious that Heaviside had not been recognised as he ought to have been.

The resolution was carried with acclamation.

(To be concluded.)

Rotary Converters, with Special Reference to Railway Electrification.*

By F. P. WHITAKER.

Introduction.

The consideration that is being given to railway electrification makes this an opportune time for reviewing the problems of conversion. Success in such involved schemes depends largely on the supply of power at low cost, making it essential for power to be generated with a high load factor. It will thus be advantageous in this country for the frequency of supply to railways to conform to the standard frequency of 50 per sec. wherever possible. Frequencies of 25, 40 and 50 per sec., and a d.c. pressure of 1 500 V are probable. Abroad requirements may demand an operating pressure of 3 000 V (d.c.).

Converting apparatus for railway substations, besides being economical in first cost, maintenance and floor space, should preferably possess the following characteristics : —

High efficiency :

Capacity for carrying large overloads, more especially if situated in outlying substations ; reliability and power to withstand ordinary overloads and short-circuits incidental to railway working :

A d.c. voltage as free as possible from ripples and undulations, so as to avoid interference with telephone and other circuits ; high power factor, preferably unity or leading at loads above three-quarter load ; d.c. voltage be maintained at a reasonably constant value up to heavy overloads :

Plant should be capable of being built for operation on systems of 25 to 50 per sec., whether from local supplies of 6 000 to 10 000 V

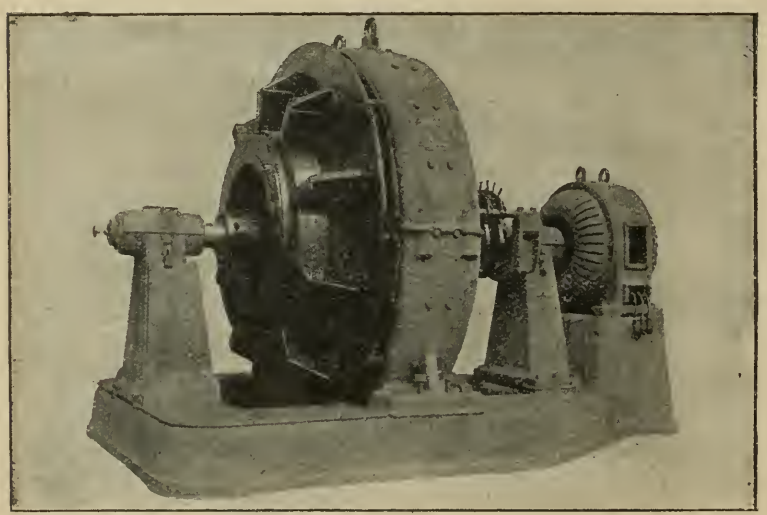


Fig. 1.—View of a 1 200 kW unit. Two 600 kW Machines in Series.

or from extra high-tension feeders at still higher voltages, with practically equal efficiency ; should be suitable for the application of automatic control ; should be simple to operate and capable of being started up and connected to the d.c. bars in a short time.

If regenerative braking is found to be advantageous in a particular district, the equipments must be suitable for inverted operation.

The rotary converter has become the recognised conversion unit on 600 V railway systems operating from 25, 33 and 40 period systems, and the Paper aims at showing how far the modern rotary converter specially developed for the more exacting requirements of 1 500 V d.c. can fulfil these conditions of service even when operating from 50 period systems.

Effect of Frequency and D.C. Voltage.

There is a practical limit to the average voltage that can exist between adjacent commutator segments ; the number of segments will increase with the d.c. voltage to be generated, and likewise the distance between brush-arm centres. Further, for a given distance between brush centres the peripheral speed of the commutator will increase proportionately to the number of periods. Thus the distance between brush-arm centres and, therefore, the peripheral speed of the commutator will increase with the d.c. voltage, and, further, the peripheral speed of the commutator will increase with the number of periods.

For the maximum permissible value of the average voltage per segment, the Author suggests approximately 13 V for the higher-frequency rotary converters, and 15 V for the lower-frequency machines. Peripheral speeds of 6 000 ft. per min. have been adopted and have proved quite satisfactory. Speeds of 8 000 ft. per min. have been used experimentally over prolonged periods with heavy loads with excellent results ; if advantageous, such speeds may become common in the future. If we assume 13 for the maximum permissible value of the average voltage per commutator segment, and 8 000 ft. per minute as a limiting value for the peripheral speed of the commutator,

then $$V = \frac{8\,000 \times 13}{2f} = \frac{50\,000}{f} \text{ approx.}$$

i.e., the maximum d.c. voltage that can be conveniently generated in a rotary converter with a single commutator is approximately :

Periods :	15	25	33	40	50
Pressure :	3 500	2 000	1 500	1 300	1 000

Frequency and Machine Units.

On 25 periods the generation of 1 500 V direct current has been accomplished in single-armature converting units, and such practice can be extended up to approximately 33 periods. Above this frequency it is necessary to connect two 750 V rotary converters in series, or one single-unit motor converter could be used for such duty, as in that case the frequency to be taken in the above formula is that of the armature of the motor converter, and not that of the supply.

In the case of series connection of rotary converters, the capacity of each machine will be half that of the complete unit, and the machine will be supplied from a separate winding on the secondary of the transformer. For complete unit of about 1 200 kW capacity and above, series working is suitable, but below this capacity the individual machines become too small for the satisfactory generation of 1 500 V direct current.

The series connection increases the floor space required per kW, and this may be a limiting condition in some cases, but in other cases it may be advantageous on account of the reduced weights of each part.

The generation of 3 000 V d.c. will generally be associated with a supply frequency of 50, and with relatively long a.c. transmission. For such duty the synchronous motor-generator set is the most serviceable unit. The voltage of 3 000 could be generated on one commutator, but it is more economical to generate such a pressure by connecting two 1 500 V generators in series, each generator operating at about 25 periods per second.

The Effects of 1 500 V D.C. on Converter Design.

The effects of 1 500 V d.c. on the detail design of converters are that the general proportions of both 25 and 50 period converters will not be seriously changed with the increased voltages ; a larger number of conductors of smaller section will have to be accommodated on the armature ; increased space will be required for insulation ; creepage distances will be increased, and the peripheral speed of the commutator will be higher.

These modifications will no doubt lead to slightly larger dimensions for the same rating and speed as compared with, say, 600 V machines, but the general operating characteristics such as commutation, efficiency and power factor will remain unchanged.

A limiting condition, however, in railway working is that of short-circuit. Liability to flash over is to some extent controlled by detailed design, but even when the most conservative figures are used, high-voltage machines will flash over when subjected to short-circuits, if protected by the ordinary type of switchgear. If the load is increased beyond a certain limit, serious sparking results. Also, if large loads be very suddenly applied, the normal balance between a.c. and d.c. armature reaction is upset and this tends to produce sparking.

Under partial or complete short-circuits the machine has momentarily to withstand currents beyond the commutating limit, and the armature reactions are seriously unbalanced. This results in an arc being drawn between the commutator segments and the brush-tips and adjacent metal parts.

Such operation would prove a serious limit to the generation of high-voltage d.c. with the ordinary apparatus, and it would seem necessary to modify the normal design so as to make machines more self-protecting.

* Abstract of a Paper read before the Institution of Electrical Engineers.

The N.E.R. Rotaries.

Manufacturers have approached this matter in various ways. Three 800 kW 1 500 V rotary-converter equipments were originally supplied to the North-Eastern Railway for operation on the Shildon-Newport electrification, from the local supply system at 40 periods. Each unit consisted of two 400 kW, 750 V rotary converters connected in series. It was recognised that the short-circuit conditions, especially in the early days of the electrification, might be severe, and, consequently, the machines were built with a completely insulating and fireproof screen between the commutator and the rest of the machine, so that, in the event of flash-over, the arc would not penetrate into the more delicate parts of the machine.

Fig. 2.—View of Machine under complete short circuit.

Good clearance was provided between the positive and negative brush arms, and the operating details of the brush-gear were well protected.

The commutation was quite satisfactory up to three times full load. Originally the a.c. side of the machines was protected by a time-limit device with a view to clearing all short-circuits on the d.c. side. In practice it was found that these machines would take partial short-circuits up to about five times full load without flashing over, but above that point flashing over would result, and it was found advisable to reduce the severity of the flash by the use of instantaneous trips on the a.c. side of the machine.

Later an opportunity was presented for installing a larger set, viz., a 1 200 kW unit (two 600 kW machines in series) having various novel features. The diameter of the commutator was made practically the same as that of the armature, the armature bars being sweated directly into the commutator. It is impossible for the conducting vapour produced under short-circuit to penetrate inside the armature and cause subsidiary short-circuits. A propeller fan at the back of the commutator directed a strong blast of air axially over the commutator surface. The d.c. brush-gear was completely enclosed inside cast metal brush-holders which are practically immune from damage due to flash-over. Fig. 1 illustrates one of these machines.

Advantages of this construction are: The conducting vapour produced under short-circuit is rapidly swept away by the blast of air, thus reducing the chance of flash-over when the d.c. voltage is restored on the opening of the d.c. circuit breaker. In the case of flash-over the resulting damage is almost negligible. The arc has not been known to restrike. The conducting vapours are blown away from the important parts of the machine, so that subsidiary short-circuits are not produced. The short-circuit is cleared so quickly that in most cases it is cleared by the d.c. circuit breaker, and the machine is left running on the a.c. side.

Special Features of the Design.

The following features were incorporated in the design of these machines: The distance between the centre line of the armature and the base-plate was made as large as possible, so as to give a large clearance between the brush arm and the base-plate and provide for air space all around the commutator. The distance between the commutator and the bearing pedestal was made large, and the pedestal and base-plate were shielded with insulation, to prevent the arc striking to earth. No part of the yoke for the brush brackets projects over the commutator, and this yoke is separated from the commutator and brush brackets by a thick layer of insulating material. The commutator segments are provided with arcing tips to prevent the deterioration which takes place at the ends of the commutator bars during flash-over.

When on test at the works this machine was coupled to a large turbo-alternator, and loaded up to full load on a water box. It was found possible to "dead short circuit" this machine, clear the short circuit on an ordinary circuit breaker, and leave the machine running on full load. Immediately after several short-circuits the machine would carry three times full load with good commutation. Fig. 2 shows the appearance of machine under complete short circuit.

These machines have now been in operation for approximately four years; their performance has been excellent, and the cost of maintenance is very low.

Magnetic Removal of the Arc.

We have recently experimented with a construction for magnetically driving the arc from the commutator surface. This scheme was applied to a 750 kW, 1 500 V compensated generator. When protected with an ordinary type of circuit breaker, it was found possible to short-circuit this generator completely when separately excited on the shunt winding, with or without the compound winding, without the slightest damage to the machine (see Fig. 3).

All the above developments have been in the direction of making the machine itself more robust and self-protecting. The high-speed circuit breaker is an external apparatus to protect the machine. Its successful operation depends on limiting the period of short circuit and derangement of commutating conditions to such a small fraction of a second that very little conducting vapour is produced around the commutator and there is little danger of the arc striking when the pressure is restored by the disconnection of the short-circuit.

In the original article the author presents a diagram illustrating the performance of a 1 500 kW, 1 500 V unit, operating on either 25 or 50 periods. The curves relating to regulation, power factor and efficiency are based on the fulfilment of the following requirements: Full load continuously with less than 40 C. rise; 25 per cent. overload for 2 hrs; 50 per cent. overload for 15 min.; 100 per cent. overload for 3 min.; 200 per cent. overload for 20 sec.

The Importance of High-Power Factor.

Importance is attached to a high-power factor. Provided reactance between the h.t. line and slip rings of the rotary is not too large, the power factor of rotary-converter equipments on the h.t. side can be maintained at unity power factor, even up to three times full load, without appreciable loss in efficiency.

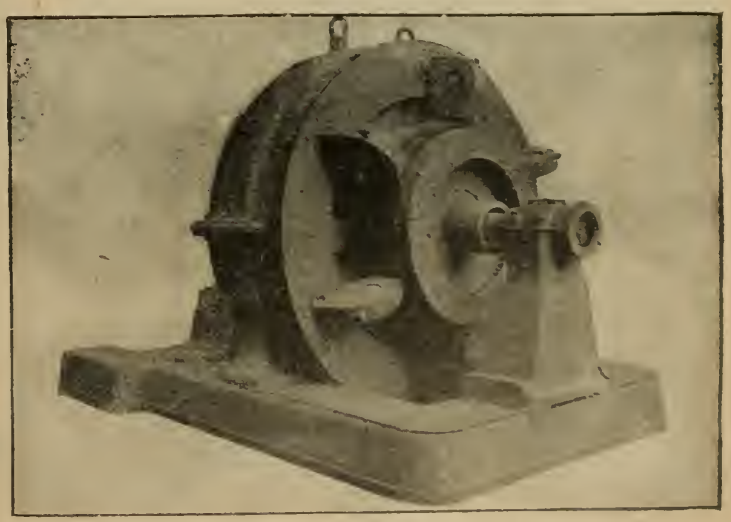


Fig. 3.—A 750 kW 1 500 V Compensated Generator.

The ratio between slip-ring and d.c. voltages on a rotary converter is practically fixed, and can be varied only within small limits, by variation of the field. The d.c. voltage can be controlled independently of the h.t. voltage by inserting reactance between h.t. line and slip rings. The author discusses, in the original Paper, the effect of different values of reactance, illustrating the problems by appropriate vector diagrams.

The author also discusses the origin and effect of these various ripples in detail, illustrating the problem by oscillographic diagrams. The oscillations on the d.c. side may also be broadly classified as

follows: (1) Tooth ripples. (2) Undulations with a frequency of 6 per period. (The oscillations of twelve times normal frequency are usually very small.)

The tooth ripple on rotary converters for traction purposes need not exceed ± per cent. of the d.c. voltage ripple. Providing the supply conforms to a sine wave, undulations of six times normal frequency need not exceed ± 2 per cent. of the mean d.c. voltage on full load, the deviation being slightly greater on overloads. In cases of interference noted the deviations have been considerably greater than the above, and it is not to be expected that any appreciable interference will occur on well-balanced telephone lines with ripples and undulations of this magnitude and frequency.

Wave-Shape of Primary Current.

The departure of the primary current from approximately a sine wave-shape is usually associated with extra loss in transmission or generation. In cases where the supply to converting apparatus is likely to form an appreciable percentage of the output of a generating station, the current wave-shape should approximate to a sine wave. Otherwise increased losses and heating may result in the generating equipment. Further, if the primary network contains overhead transmission, interference with communication circuits may result from the distortion of the current wave.

The wave-shape of the primary current on load and overload on modern equipments will be found to approximate closely to a sine wave.

Automatic Sub-Stations.

The introduction of the automatic substation considerably reduces the cost of attendance, but provision must be made for interest and depreciation on the extra control equipment required. This item increases with the number of equipments per substation, but this is not so with the cost of attendance. Hence the best field for automatic working is the single-unit substation.

In the past, however, on account of the cost of attendance, the tendency has been to group the converting apparatus, so that cases will arise in which automatic working will allow of a wider distribution of the converting plant, with resultant economy either in feeder copper or in copper losses, and consequent improvement in the distribution of voltage on the track.

Models of Ferromagnetic Induction.*

By Sir J. ALFRED EWING, K.C.B., F.R.S.

In giving a detail account of his more recent work in magnetism, the author developed the theory of magnetic induction put forward by him in 1890, and discussed the reasons which have led him to modify the theory in an important particular.

Weber's Conception

The theory was based on Weber's conception that a substance

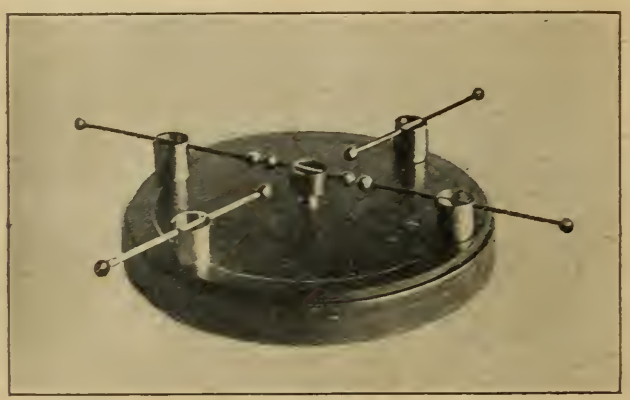


Fig. 1.—Model Showing Action in One Plane.

capable of strong magnetisation, such as iron, owes its magnetic quality to the presence within it of ultimate magnetic particles capable of being turned, and that the process of magnetising consists in compelling these particles to face more or less completely in one

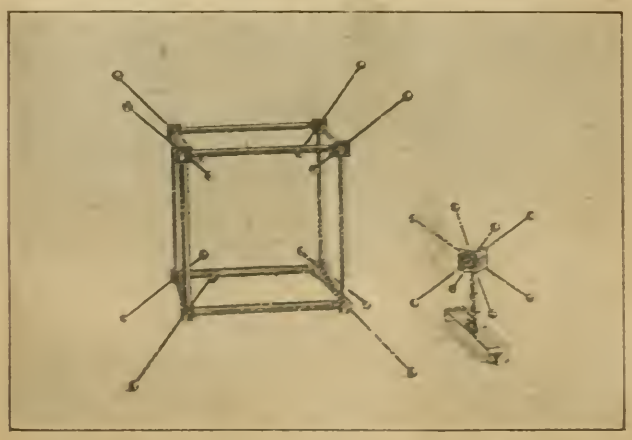


Fig. 2.—Model Showing Action in Three Dimensions.

direction. When all the Weber particles are facing one way, the iron is magnetically saturated. What the author showed in 1890 was that the control under which the Weber particles turned was a magnetic control, and that, in turning, they fell over from one position of stable equilibrium to another, through an unstable phase, thereby producing the phenomena of magnetic hysteresis.

This funadamental feature of the theory is retained, but the author has now abandoned his further idea that the control of the particles was due simply to their mutual magnetic forces acting from atom to atom, because a quantitative examination of the forces produced in that way has convinced him that other forces are also involved. These other forces are those which exist within each individual atom, between the Weber particle and the rest of the atom. We now know the atom to be a very complex whole, comprising many moving electrons. In a substance such as iron, each atom contains a Weber particle, a thing that turns under the influence of an external magnetising force. It is not the atom as a whole that turns, but only a part of it. According to the author's view, there is magnetic control exerted between the part that turns and an outer shell which is held fixed in relation to neighbouring atoms. He now shows that all the characteristics of the magne-

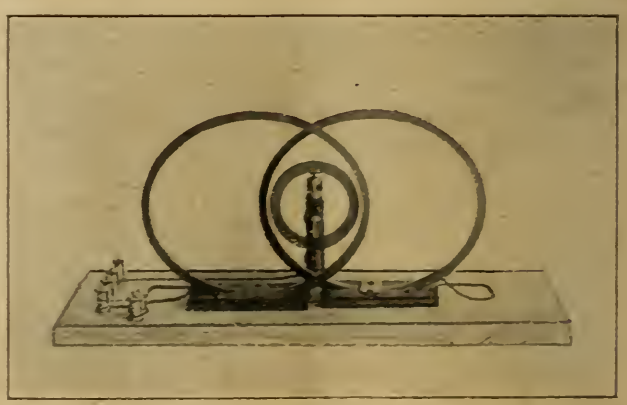


Fig 3.—Model of Rutherford-Bohr Conception.

tising process can be accounted for on this basis, and may be reproduced by means of illustrative models.

Equilibrium of Pivoted Magnets.

The first part of the Paper was a study of the equilibrium of pivoted magnets, undertaken with reference to the author's model of 1890, in which the Weber particles were represented as rows of little magnets controlling one another by their mutual forces only. It was shown that this model fails quantitatively because, when the magnets are placed near enough together to give the correct form to the curve of magnetisation in its several stages, the deflecting force which is required to break up the row is enormously greater than that which suffices to produce strong magnetisation in iron. The stability of the row is far too great. In the new model the stability can be reduced to any desired extent, for it depends on the balance of attracting and repelling forces due to the action of opposite portions of the outer shell of the atom on the Weber particle within.

* Abstract of a Paper read before the Royal Society of Edinburgh.

The New Models Described.

Several forms of the new model are described, some with pivoted magnets to represent the Weber particles, and fixed magnets to represent the controlling portions of the atomic shell. In the simplest model (Fig. 1), which shows the imaginary action in one plane, the Weber particle is a pivoted magnet in the middle of a group of four fixed magnets, all of which have their north poles facing inward. The pivoted magnet has four possible stable positions, pointing towards one or other of the fixed poles. The model of Fig. 2 represents the action in three dimensions. In it the Weber particle is a group of eight magnetic poles, turning as a whole within a group of eight fixed magnets. The arrangement is a cubically symmetrical one appropriate to a metal, such as iron, in the crystals of which the space lattice is known to be the centred cube.

The Rutherford-Bohr Conception.

In another model (Fig. 3) the Rutherford-Bohr conception of an atom with large electron orbits is realised. The orbits are represented by elliptically shaped coils, with the nucleus of the atom at their common focus: one of them is circular and turns under the control of the others, which are fixed. Sir Alfred Ewing went on to show that with these models it is possible to imitate known features in the magnetic behaviour of metals, including effects of stress and temperature. It was pointed out that the new model preserves all the advantages in this respect of his model of 1890, and at the same time escapes the quantitative discrepancy which had made it necessary to amend the former theory.

The Contractors' Coming-of-Age Dinner.

The coming-of-age dinner of the Electrical Contractors' Association, which was founded on Feb. 1, 1901, was held at the Hotel Cecil on Monday, under the presidency of Mr. J. Orringe.

Mr. J. MacGregor, in proposing the toast of the "Allied Associations and Honorary Officials," congratulated the Association on arriving at its majority. At twenty-one everything looked rosy, and there was no doubt that the future was bright for the Association. Such bodies were not trusts nor extortionists, but were formed with a desire to improve trade and to help people who had put money and brains into the industry to accumulate wealth and resist foreign competition. In the past jealousy had cut the trade to pieces, but they were now in a position to maintain the British electrical business and entirely to keep the foreigner out. The various associations in the trade must be brought closer together, and if this were done they might look forward to a brighter future.

The Duty of the Contractor.

The Chairman in reply gave an interesting historical account of the Electrical Contractors' Association, whose formation was due to a suggestion by Mr. Alabaster. He felt the Association was now making headway in the direction most likely to assist the development of the electrical industry. The importance of everyone belonging to a trade association must be stressed, and certainly every electrical contractor should belong to the Contractors' Association, which now had a membership of 750, representing the cream of the contractors in the country. Contractors were free canvassers for the supply side and were in a position to discover outlets from the manufacturers' products by the establishment of sales departments.

Wiring, Standardisation and Hiring.

In responding to the toast of the "Guests" proposed by Mr. T. E. Alger, Mr. C. H. Wordingham said that everything was to be gained by closer union between contractors and the Institution. Many of their body had done yeoman service on institution committees, especially in connection with the Wiring Rules. In formulating these rules he had often wondered what ground should be covered, for at present there was a tendency to write a treatise on wiring rather than to put forward regulations. In this matter they wanted a lead from contractors, and he hoped there would be ample opportunity for discussing the draft rules before they were confirmed. Another question on which he felt very strongly was standardisation. At present there was a multiplicity of patterns of accessories, which was a grave evil, as it increased costs. His experience on the B.E.S.A. had not been encouraging, and the work had been largely abortive because a standard fitting had not been taken up by the manufacturers. Closer work between electricity supply authorities and contractors was essential. In future supply engineers would have more time to devote to commercial development, and this should give very great results. More demonstration of apparatus was wanted in each town, and more should be done in the way of hiring out. He agreed that municipalities should not sell apparatus or wire buildings, but though the 1919 Act gave them power to hire, it gave them no power to sell. This was unjust to the consumer, as he could not hire-purchase. This defect might be overcome by allowing hire-purchase to be effected through the contractor.

Mr. Councillor E. C. Ransome, who also replied to the toast, said that associations such as theirs were for the good not only of the industries concerned, but for the public generally, as they meant standardisation and improved design and quality. In dealing with Government departments they were also useful, as representations from a body carried a vast deal more weight than those from individuals.

Correspondence.

THE INSTITUTION LIGHTING.

To the Editor of THE ELECTRICIAN.

Sir,—All members of our Institution are feeling very proud just now. Our fifty years' celebration with its most interesting features of our 10 000 membership roll and our Royal Charter, certainly entitle us to swell with pride, but, still, let us never be content whilst there are possibilities of improvement.

On this ground, I venture to express the opinion that it is regrettable, now we are again in possession of our Embankment house, that the illumination of the lecture hall is open to severe criticism. When the lighting was originally installed, under the advice of Messrs. Handcock Dykes, conditions were different, the half-watt (inert gasfilled) lamp had not arrived at a commercial stage and the Illuminating Engineering Society, founded by our greatly esteemed past president, Dr. Silvanus Thompson ("the Doctor"), was still unborn. The intense illumination of the white coves and the very dull appearance of the matt surfaced panelling make the hall unpleasant to be in after dark. The illumination of our building, seeing that so many of our members are professionally interested in electric lighting, should be a lesson in good electric illumination, both to members and to visitors. The illumination of the hall of the Society of Arts must be revised when that society rebuilds, as it shortly will, its famous home. The lecture hall of the Royal Institution possesses no dimmers. Let us hope the managers of neither society will come to our lecture hall for inspiration for improvement.

Funds are not lacking for improvement in illumination methods in our really fine home, and I suggest the immediate formation of a small committee of illumination experts, empowered to investigate and charged to make recommendations to our Council in sufficient time for the alterations to be made before next autumn.—I am, &c.

London, W. Justus Eck, M.I.E.E.
Feb. 25.

Beginning and Growth of the E.P.E.A.

At the meeting of the Informal Section of the Institution of Electrical Engineers, on Feb. 13, Mr. F. Pooley was in the chair when Mr. J. H. Parker opened a discussion on "The Evolution of a Staff Trade Union." Mr. Parker kept a large gathering keenly interested while he told at considerable length the story of the beginnings and the growth of the Electrical Power Engineers' Association. He declared this organisation was given impetus by the invidious situation of the engineering staff of the electric supply authorities at a time when the wages of the manual workers were being revised in view of the cost of living. He told of protracted negotiation with the councils and authorities over the wages schedule, and of temporising and evasion by these bodies, who in many cases have yet to honour their agreement.

He protested against misrepresentation of the aims and intentions of the E.P.E.A., which on occasions of acute public interest are often sensationally proclaimed by the lay Press. He declared that the policy of the E.P.E.A. is to secure the welfare of the whole industry, to avoid strikes, and, above all, the lightning strike, and he explained the past action of his organisation in declaring in advance of disputes which might involve their members, a readiness to support the side willing to arbitrate in that dispute. Bearing on this claim of moderation, he read one of the vital rules of the Association, which states that in case of any dispute calling for extreme action, 70 per cent. of the whole membership must agree to the proposed action, and he urged that this was ample safeguard against any impulsiveness.

East of Scotland Electricity District.

The Electricity Commissioners have provisionally determined that the undermentioned area shall be constituted a separate electricity district:—The county of the city of Edinburgh; the county of Midlothian; the county of East Lothian; so much of the county of Linlithgow as is included in the Royal burgh of South Queensferry; the parishes of Abercorn, Dalmeny, Ecclesmachan, Kirkliston (part of) and Uphall; and so much of the county of Peebles as is included in the parishes of Eddleston, Newlands and West Linton.

Objections on account of the inclusion of any area in, or the exclusion of any area from, the district provisionally determined should be addressed to the Secretary, Electricity Commission, Gwydyr House, Whitehall, London, S.W. 1, not later than July 31.

Two experimental houses have been built by Glasgow Corporation at their housing scheme district—Riddrie—where 1 000 dwellings are being erected. The two houses are all electric; there are no coal fires and no gas. The houses are two storey high, and consist of five apartments, with a large scullery. In cost of construction there is a saving of £80 per block, owing to the absence of chimneys and other adjuncts of coal fires and grates. Everything for lighting, heating and cooking is performed by electricity. There is an electric dish-washing boiler, and a clothes-washing machine operated by a motor is also provided, with a standard hot-water cylinder heated by electricity.

British Industries Fair, Birmingham.

The Birmingham section of the British Industries Fair was opened on Monday at Castle Bromwich Aerodrome Buildings, and it will be continued until Friday, March 10. It is, as previously, under the auspices of the Board of Trade, and is conducted by a council of Midland business men, representing the Birmingham Chamber of Commerce and the Birmingham City Council.

The Lord Mayor (Ald. David Davis) presided at luncheon on Monday, making allusion to the extraordinary diversity of Midland industries, which are largely represented in the Birmingham section of the Fair, and to the maintenance by manufacturers of a high quality standard (despite the temptation to accept other classes of business during the prolonged period of trade depression), and expressed the hope that the Fair would give a real impetus to overseas business.

Mr. H. O. Worrall, chairman of the council, who is associated with the leather industries, said there were many evidences in the Midlands that the rock bottom of trade depression had been reached and the upward swing of the pendulum commenced.

Development of Mass Production.

The exhibitors number 500, and there are 60 000 ft. of stands; the entries show a little falling off, but more of the larger firms are represented this year, and, by reason of an enlarged schedule, the Fair is particularly comprehensive. New groups provide for the inclusion of mining, colliery and quarrying machinery and appliances, and also equipment for the needs of agriculture, brewing and distilling. The agricultural group includes displays of agricultural, dairy and horticultural machinery and implements, and poultry equipment. The leading features are the groups devoted to general engineering and to brass foundry and hardware. Very representative, too, are the sections devoted to gas and electrical equipment and accessories.

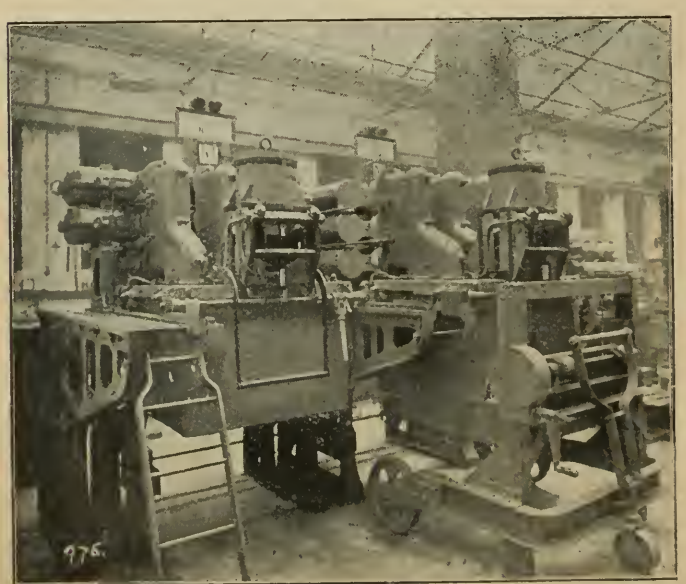
There is much evidence in the Fair of the development in manufacture of mass production methods (making for economy as well as for the standardisation of parts), of a general desire on the part of makers to produce precisely to overseas specifications, and of an increasing application of science to industry.

The Electrical Section.

The display of electrical equipment is unquestionably one of the largest and most interesting in the Fair. There are twenty-four stands devoted very largely to electric light and power fittings, thirteen to electric accessories, and a good deal of space is given to the display of electric fires and (domestic) electric fittings. Some attention, too, is directed to the industrial aspects of electricity, and we observe stands displaying electric arc welding plant, electric furnaces, dynamos, motors, elevators and control gear. Lighting sets and ships' fittings are also attractive features.

Up-to-Date Switchgear.

A. Reyrolle & Company, Ltd., Hebburn-on-Tyne, are exhibiting in Birmingham for the first time (Building B, Stand 201), and have a varied display of switchgear. This has attracted much interest among the general public, small power engineers, and electricity supply engineers, for the types of switchgear range from 5 A wall plugs to the large 20 000 V modern armour-clad high-tension switch-



Reyrolle's Ironclad Mining Switchgear.

gear. Particularly striking is a complete 20 000 V ("A J" type) electrically-driven switchgear, with remote panel control, the whole being in working order, and open to the closest inspection. There is much here to interest the mining engineer. Two excellent exhibits are the mining type of switchgear, which consists of Reyrolle's standard 3 000 V 400 A Class "E" mining pillar gear, and 600 V 200 A Class "F" gear. The illustration is of the former, and from this can quite easily be seen the substantial and sturdy construction, easy manipulation, complete isolation of the switch, and the immunity from any possible shock. This gear contains the common principles of all Reyrolle flame-proof mining gear and complies with the regulations of the Mining Act.

The motor engineer will be interested in the Reyrolle drum starter, while other apparatus shown include patent self-alignment fuses, quick break oil switches, and distribution and telephone dividing boxes. A varied selection of plugs and switches have the same characteristic careful attention to earthing and complete immunity from shocks. The switchgear may be described as water-proof, flame-proof, dust-proof, and vermin-proof, features which ensure complete safety.

Electric Lighting and Heating.

The display of electric lighting and heating equipments is very large, and is especially noteworthy on the decorative side. There are many beautiful designs, both in the metal fittings and also in the materials, be they minerals or textiles, used as shades. Chandeliers and candelabra are of infinite variety, and considerable novelty is to be observed. There are examples of fittings in various period styles, Jacobean in oxidised silver being among the most popular. For large buildings there is a wide choice for both exterior and interior lighting, and the indirect methods of illumination, while a large number of English alabaster bowls are on view. Some of the flambeau are remarkably effective, and are characterised by consummate artistry in design. A restraint in ornament, together with careful balancing and proportioning, form an important part in these charming lighting fittings. On the industrial side the display is of a very representative kind, but comparatively few new features are to be noted.

Domestic Electric Devices.

The Metropolitan-Vickers Company, Ltd., Manchester (Building B, 183 Stand), make a very extensive show of their "Cosmos" electric devices, and in this connection their Radiant fire and lamps are largely featured, as well as fans, for desks or brackets, with 12 in. and 16 in. blades. Flashlight, vacuum, and gasfilled lamps occupy a good deal of space. Other features on this stand are kettles of heavy gauge, spun sheet copper, polished, or with nickel-plated finish on copper, being in each case pure tinned inside. The heating elements consist of a nichrome resistance wound on mica, and are firmly secured to the bottom of the kettle. The "Cosmos" combined grill and toaster, useful for preparing quickly meals on the dining-room table or sideboard, attracts much attention; this appliance is supplied with a two-pin terminal standard connector.

Gent & Company, of Leicester (A Building, Stand 31), show a variety of electric clocks (for industrial and marine purposes), time discipline apparatus, and turrent clocks and chimes. Mining and shaft signals are good features, and in regard to the latter, the "Tangent" system (which is entirely electrical), it may be mentioned that no stepping mechanism is employed, that there is a relay for each signal with a single interrupter, and that the number and nature of the signal shows at the first stroke of the bell. Moreover, any error on the part of the signaller is at once apparent to the engineman, owing to the disagreement between visual and audible signals. The system is operated at the standard signalling pressure of 25 V.

Another exhibit of considerable industrial interest is an idle-machine recorder, on the "pulsynetic" system. The object is to give a record of the time during which a machine has been idle, and so assist the management in keeping the productive machinery fully occupied during working hours. On a machine becoming idle, even for half a minute, a mark is made on a record chart in a column against the number of the machine, and if the idleness is continued, a line is traced for the appropriate idle period. The recorder drum is electrically driven by a "pulsynetic" transmitter.

The London section which was opened on the same date is not of the same importance to electrical engineers as the Birmingham section, but there are attractive exhibits of scientific instruments, glassware, toys, clocks, &c.

(To be concluded.)

Ideal Home Exhibition.

At this exhibition, which is being held at Olympia, London, until the 25th inst., and which was opened by Princess Alice (Countess of Athlone) on Wednesday, there are, in addition to the exhibits connected with the building and furnishing trades, and the beautiful gardens in the Annexe, designed by the Queens of Holland, Spain, Belgium, Norway, and Roumania, Queen Alexandra, Princess Alice, Princess Mary, Lady Patricia Ramsay, and Lady May Cambridge, a large number of stands occupied by makers of electrical appliances, with which we shall deal in subsequent issues.

Frequent conferences upon housing, furnishing, gardening, fruit growing, poultry, &c., are being held during the period of the exhibition, and cinematograph exhibitions are being given daily.

The "Daily Mail" Model Village at Welwyn Garden City, Herts, will also be on view until March 25.

In the Exhibition Catalogue, the names are given of the winners of the "Daily Mail" Labour-Saving House Competition. The prizes are £300, £125, and £75.

Supervising Electricians.

The National Association of Supervising Electricians held their annual meeting on February 14 at the St. Bride's Institute, E.C. 4, when Mr. F. W. Smith, the chairman of the association, presided over a well-attended gathering.

The Chairman, in his address, complimented the members on the improved position of the association, and gave a brief *resumé* of the association's activities. The appointment of a full time general secretary had been fully justified. The finances of the association were sound, new members were continually being enlisted, and the general position was better than it had ever been. Enquiries were being received from all parts of the country, and the formation of district branches was well in hand. The necessity for the association in the electrical industry had been fully demonstrated, and the educational work had been of great benefit to those concerned. It was necessary that they should safeguard the interests of their members and see to it that the workers got an adequate return for their labour. The agreement with the National Federated Electrical Association was a step in the right direction, and prepared the way for greater advancement.

The ballot for the declared vacancies on the Board of Control resulted in the following being elected :—Messrs. F. J. Alldread, C. Burrows, J. F. Chapman, P. N. Hindell, J. Hudson, H. Manning, S. Nicholls, T. E. Pinder, F. W. Smith, A. Tucker, S. Smith, R. W. Whitley T. H. Windibank and C. G. Wright, and Messrs. H. Rooke and J. H. Hall were elected as members' auditors.

The affiliation to the National Federation of Professional, Technical, Administrative and Supervisory Workers is to be further developed. New rules, to cope with the increasing activities of the association, were adopted.

International Scientific Conference.

On the occasion of the seventy-fifth anniversary of its foundation, the Association des Ingénieurs Sortis de l'Ecole de Liége will organise an International Scientific Congress from June 11 to 16 next, to which the engineers and scientists of Belgium and the allied countries will be invited. There will be seven sections, viz., electricity, metallurgy, mining, mechanics, civil engineering, industrial chemistry and geology. In the domain of electricity the questions suggested for treatment and discussion comprise progress in the design of large turbo-alternators, organisation of large power stations and of hydro-electric works, the transmission of electrical energy at voltages over 100 000 V, material used for overhead transmission lines and overground sub-stations at pressures over 100 000 V, local distribution networks, protection of h.t. and e.h.t. lines, manufacture of e.h.t. underground cables, automatic sub-stations, mercury-vapour converters, improvement of power factor of networks, railway electrification (d.c., s. and three-phase, &c.), polyphase motors, electric propulsion of ships, the use of aluminium in electrical work, electricity tariffs, lamp manufacture, electric heating, automatic telephony, wireless telegraphy and telephony, &c.

Prize for Moving Platform.

The Municipal Council of Paris are offering prizes for the best design of mechanism for a moving platform for the conveyance of foot passengers. The suggestions must fit in with existing means of underground communication. The idea is to have a series of platforms moving parallel to one another, each one travelling faster than that next beside it. The first is to have such a speed that a passenger can easily step on to it from the ground or from a fixed platform, and the fastest is to have a speed of 15 kilometres (9½ miles) per hour. The increase of speed between adjacent platforms must not be too great to prevent passengers stepping from one to the other without shock. There are to be three prizes, of the value of 100 000, 50 000, and 30 000 francs respectively. If the authorities eventually decide to install one or other of the systems which receive prizes, then, even if no amicable understanding can be arrived at, the inventor will receive a further sum of 500 000 francs, which the Municipality covenants to pay as forfeit for adopting the design, lacking an agreement. Particulars may be obtained from the Direction des Travaux, 98 Quai de la Rapée, and technical conditions from the Service Technique due Metropolitain, 48, rue de Rivoli, Paris.

Mr. Henry Jackson has resigned his position with the London & North-Western Railway Company on reaching the age limit. Mr. Jackson was telegraph superintendent and electrical engineer for the Lancashire and Yorkshire Railway Company for a period of thirty-two and a half years, and was transferred to the North-Western Company on the amalgamation of the two companies.

Interesting letters have appeared in the "Times" during the week regarding the early experiments of David Hughes. In Saturday's issue Sir Joseph Larmor suggested, in the interests of scientific history, the publication of extracts from the notebooks of Hughes. On Monday a letter from Prof. J. A. Fleming appeared, pointing out that the evidence for which Sir Joseph asked (as to the early experiments of Hughes on electric radiation) already existed in the form of a letter written by David Hughes himself to The Electrician of May 5, 1899 (Vol. XLIII., p. 40).

The Late Mr. Thomas Clark.

We recently announced the death of Mr. Thomas Clark, who was chief electrician of the Telegraph Construction & Maintenance Company until his retirement in 1919. Mr. Clark, whose genial, kindly face was known to so many in all parts of the world, died at Worthing on Jan. 19 last at the age of seventy years, and the deep regret at his death which is felt by his colleagues in the company will no doubt be shared by many of the staff of the various cable companies in stations abroad. He entered the service of the Telegraph Construction Company in June, 1865, as a junior electrician, and served the company for fifty-four years, his first work being on the "Great Eastern" during the laying of the first successful

The Late Mr. Thomas Clark.

Atlantic cable. This was followed by a long course of sea work, in the testing-room, on cable laying and repairing expeditions in the Chiltern, Scanderia, Belgian, Edinburgh, Hawk, Hibernia, Minia. Wm. Cory, Kangaroo, Robert Lowe, Calabria, Seine, Scotia, Anglia, Colonia, and Teleonia.

During his career at sea Mr. Clark is computed to have travelled 660 000 miles, averaging over 14 000 miles a year for forty-seven years, and he was present at the laying of 108 000 miles of cable. He was appointed chief electrician of the Construction Company in 1891, and was in electrical charge of the testing during the laying of over 72 000 miles of submarine cable. His sea work finished in 1912, since when he remained as chief electrician at the company's Greenwich works until he retired in June, 1919. Our illustration is a reproduction of a recent portrait of Mr. Clark.

Power Developments in Nuremberg.

Nuremberg is a good example of how a town can render itself independent of transported fuel supplies, and can become an important industrial centre by means of hydro-electric power. Coal has still to be brought from Westphalia Silesia and Saxony, but about ten or twelve years ago a few leading industrialists and bankers combined with the Town Councils of Nuremberg and Fürth in order to establish two large hydro-electric stations. The capacity of the older station is about 30 000 kW, and there is a network of cables and distributors extending over nearly fifty miles. The station only supplies consumers of at least 60kW, the distribution to smaller customers being undertaken by subsidiary companies or municipal sub-stations. A larger central station was established in 1913, serving the whole of Middle and a large part of Lower Franconia, including nearly 700 towns and villages. Its cables extend over more than 900 square miles and supply electric motors aggregating close on 50 000 H.P. and well over 200 000 electric lamps. In consequence of the cheap and excellent electric service, the industrial growth of Nuremberg and the surrounding country has been rapid, and a number of new industries have been developed. In addition, it has greatly assisted in the increase of rural factories and domestic workshops.

The resignation of Mr. J. A. Robinson, the Salford electrical engineer, is announced. As a consultant he has a good deal of work in hand, and it is understood that this circumstance has influenced his resignation. He has, however, expressed willingness to help the Corporation as consulting engineer—an offer which is of special value in view of the erection of a super-station at Agecroft.

North-West Midlands Electricity District.

The inquiry into the scheme for the reorganisation of electricity supply in this district was commenced on the 21st ult. The chairman of the Electricity Commissioners (Sir John Snell) presided, and the other Commissioners present were Sir Henry Haward, Mr. H. Booth and Mr. W. Lackie.

Mr. Tyldesley Jones, K.C., on behalf of the Conference of Authorised Undertakers, who submitted the scheme, said that there was no opposition to the main principles involved. The conference consisted of the Corporations of Stoke-on-Trent, West Bromwich, Wolverhampton, Shrewsbury and Stafford, and the Midland Electricity Supply Corporation. In regard to the formation of a joint electricity authority, the view of the conference was that the authority should make an application to the Commissioners for the termination of the power companies in the area. However, he did not make the application, and he did not intend to put any evidence before the Commissioners bearing upon that issue, for it was not his duty to introduce anything at that stage which might prejudice them when the application was made. The Conference of Authorised Undertakers took the view that if the proposed joint authority was to be a success it ought to own and work generating stations. There was no power in the Act, however, enabling the authority to acquire compulsorily, and in the absence of compulsory powers acquisition could only be carried out by agreement. Besides the fact that there was no joint authority in existence with which an agreement could be made, there was the difficulty that in addition to the local authorities they had one company in the conference and one outside it, and there were differences as to the methods of financing the undertakings. The conference did not include Walsall Corporation, as it did not agree to the transfer of its generating station. There were fourteen generating stations in the area operated by ten authorised undertakers, and if those stations were to remain the property of the original owners the conference failed to see where the joint authority would come in. The view of his clients was that the joint authority should be representative of the authorised undertakers in the district. They did not want the Commissioners to constitute a body which would consist of representatives of people who had powers that they did not use and merely sat upon. The promoters did not propose to levy a deficiency rate, as they thought any deficiency should be carried forward. It was proposed to erect three new generating stations—at Rugeley, Stoke and Ironbridge respectively. It was suggested that the Rugeley should be the first to be erected, but it might subsequently prove that Ironbridge was the proper site to start with. It was, however, a question for the joint authority to settle. A difference of opinion on the subject had emerged between the conference of undertakers and Walsall Corporation, but he submitted that the question should be postponed for the discussion of the joint body.

The Chairman intimated that before the Commissioners gave their consent to the erection of any station they would require to be placed in possession of all the facts.

Constitution of the Joint Authority.

Walsall Corporation also objected to the proposed allocation of the voting power of undertakers on the joint authority, and they required that, having regard to geographical and other reasons, the area should be divided for the purposes of financial administration. It would be very inconvenient, however, if there were to be two financial autonomous divisional districts. Newcastle-under-Lyme objected principally to the taking over of the generating station and raised the question of compensation, but as there was no compulsory power to make them transfer their station unless the terms satisfied them, Newcastle need have no fear. Cannock would get representation, as they proposed to take their supply of energy from Wolverhampton Corporation. Tettenhall was one of a large body of local authorities who asked for representation, but counsel pointed out that if the Provisional Order sanctioning the extension of Wolverhampton municipal boundaries passed through Parliament, Tettenhall would cease to exist as an independent authority. The scheme, however, left such local authorities the right to buy the undertaking of the power company in their area, which now consisted of distribution mains only.

Promoter's Views.

Ald. Harry Leese, chairman of Stoke-on-Trent Electricity Committee, gave a history of the conferences which led up to the preparation of the scheme. It had been carefully considered and was unanimously adopted. The supply of current under the scheme could be commenced at once. As to representation on the joint authority, he thought that only the people who found the money should be represented. He agreed that if the scheme was a failure the consumer would have to pay.

The Chairman here intimated that he thought it reasonable that a clause under discussion should be extended so as to make it clear that it was competent for the Commissioners to impose an obligation to provide supply in the event of an authorised undertaker raising unreasonable objections to give such a supply.

On Wednesday Sir Harry Haward asked whether the Conference of Authorised Undertakers were absolutely wedded to the proposed constitution of the joint authority with regard to voting powers.

Ald. Leese said he did not think there would be any difficulty in ensuring that the smaller authorised undertakers should be given their proper weight on the authority. The feeling of the conference was very strong that the only people to be represented should be authorised undertakers. As to the terms on which the generating stations would be transferred, he did not believe there would be any serious prospect of disagreement.

Engineering Details.

Mr. John H. Rider, said he had acted as technical adviser to the engineering sub-committee appointed by the Conference of Authorised Undertakers. As a matter of commercial advisability, the whole of the single-phase alternating plant in the district would be shut down, and the two-phase plant now existing would continue for a period to which he could set no limit. He put in some financial statistics which gave the average cost per unit generated (exclusive of management charges) as 0·96d. The figures varied from 3·647d. at Shrewsbury to 0·743d. at Wolverhampton, the latter being the lowest. The total cost for the whole of the proposed district, including distribution, street lighting, management and capital charges, would be 1·552d. The chances were strongly in favour of a continued increasing demand for electrical energy. The total load connected to the six principal generating stations in the district in 1921 was 104 228 kW, which he estimated would increase to 250 000 kW in 1925. To meet that increased demand adequately he thought three new generating stations would be required, and the first one, which should be ready by 1926, should be erected at Rugeley.

Mr. R. Harker (for Walsall Corporation) said that the authority he represented considered that no new generating station would be necessary for some time, and that the growing demand could be met by the extension of the existing Corporation mains.

The Chairman remarked that the Commissioners had considered the matter, and had decided that in the interests of the district they ought to hear the counter-proposals of Walsall Corporation.

Mr. Rider, continuing his evidence, said that Rugeley was the most suitable site for the first power station in the district. It was midway between the northern and southern parts of the district, and as it was necessary to have a river for the cheap generating of electrical power, they would be practically tied to that side of the River Trent. It was proposed that the Rugeley station should be worked at the highest possible load factor, relying upon the plant at the local stations as a stand-by. There was less chance of expansion in the southern than in the northern part of the district. The proposed generating station at Rugeley was intended to provide the greater part of the supply for the south-eastern district, and Stafford and Stoke would obtain their supply from that station.

In cross-examination by Mr. Harker (for Walsall), witness declined to agree that the extension of the Birchills generating station would be as advantageous as Rugeley, as there was only a limited supply of condensing water and the facilities for coal delivery were not so good. If those difficulties could be overcome, Birchills would have the most appropriate site for generating.

Replying to Mr. Tyler (for the railway companies), Mr. Rider said he regarded the inclusion of a representative of the railways upon the joint authority as undesirable. It was better that the joint authority should be in a position to deal with the railway companies as outside bodies.

The Shropshire Power Company.

Mr. Tyldesley Jones, K.C. (for the promoters), said that in his opening statement he said that so far as the Shropshire, Worcestershire & Staffordshire Electric Power Company was concerned, they were sterilised until August, 1923, and that they were therefore not entitled to be represented on the joint authority. It now appeared that the company were providing certain supplies in the southern part of the district, and that constituted the Shropshire company an authorised undertaker, and as such they were entitled to representation. That did not, however, alter the view of the Conference of Authorised Undertakers that an application should be made to the Commissioners in due course for the termination of the rights of the power company in that area.

In answer to Sir Harry Haward, witness expressed the opinion that if the local authorities owning the various generating stations would agree without reservation to put the whole operation of the stations, the system of management and the administration of the staffs in the hands of the joint authority, the actual ownership of the stations would not be desired.

Mr. C. Meades, chairman of Stafford Electricity Committee, said they could install at Stafford 2 000 additional h.p., but that was the maximum, and it was, therefore, obvious that Stafford would need some help. He thought the purpose could best be served by the district being constituted as a whole for electricity supply rather than by the area being divided into two, as proposed by Walsall. There would be a great development in the near future in the district between Stoke-on-Trent and Lichfield.

Mr. Arthur Collins said he estimated that if the proposed scheme came into operation the joint authority would be able to supply the increased quantity of energy required at a cost much less than would be possible under present conditions. The saving in cost to the consumer ought not to be less than £120 000 a year.

Railway Companies' Position.

Mr. Tyler (for the L. & N.W., G.W., Midland, and North Staffordshire Railway Companies) said he was unable to give details as to the likelihood of electrification upon those lines in the near future, but goods and passenger traffic was dense, and electrification would no doubt sooner or later present itself for consideration. In the case of the Potteries Railway the subject was gone into in 1910, but the project was not proceeded with on account of cost. It would, however, be again considered when the railway grouping scheme was completed. The total consumption of electrical energy by the companies amounted to 700 000 units per year, the whole of it for power, nearly the whole being used by the North Staffordshire Railway. If a cheaper supply were available, the demand for current for power, as distinct from traction, would increase

enormously. The railway companies approached the question of electricity supply purely from the commercial aspect; they were out to get their current at the cheapest price. The companies desired, however, to advance certain views on two questions of principle. The first was the obligation upon the joint authority to give a supply, and the second the right of the companies to representation upon that body. There was no precedent for the precise form of constitution proposed for the joint authority, but the companies regarded it as important that there should be somebody on it representative of the consumer. The railways' demand for electricity would be one of the greatest in the district and it would be in the interests of the joint authority that it should be kept aware of developments in that direction by representatives of the railways.

On Friday the case for the promoters closed, and counsel for Newcastle pointed out that the Corporation was not concerned in the question of coal deliveries, as their generating plant was oil driven.

Colliery Requirements.

Mr. H. H. Joy (for Cannock Chase Coalowners' Association) directed the Commissioners' attention to the probability that in the near future electricity would be applied to winding and ventilating of the collieries, and the coalowners felt strongly that when that time came they ought to be satisfied that they had the amplest possible safeguard against the failure of the supply.

Mr. Frank Anslow said he had advised the Cannock Chase Coalowners' Association that, in principle, the scheme was one which should be adopted. The area included fourteen colliery firms or companies owning thirty-five pits, with an output of about 5 000 000 tons of coal per annum. Practically all the collieries were equipped with some electrical plant. Some of the privately owned generating plants had reached such proportions that they should have consideration in the final settlement of the scheme. The demand to meet the present and immediate future requirements of the districts he estimated to be from 10 000 to 11 000 kW. The annual consumption would in the immediate future be from 30 000 000 to 40 000 000 units per annum. Electric winding and ventilation was a matter of development which, in other coalfields, had been shown to follow the provision of a cheap and abundant supply of electric power. It might be assumed, therefore, that with this provision there would be an additional demand of at least 5 000 kW. There would be a net saving in coal of at least 200 000 tons per annum.

The extensions at Birchills would include the erection of two boiler-houses and other buildings, together with the provision of a railway siding. The existing station depended for condensing water upon the canal, and if the extensions were carried out it would mean the admission into the canal of a much larger volume of hot water than at present. The station was designed for an output of 12 000 kW, but the extension would increase it to 20 000 kW. It would not be possible to obtain water at a sufficiently low temperature from the canal for condensing purposes if the extensions were carried out, and it was proposed to erect cooling towers. The total current generated at Birchills when extended would be 109½ million units, and the quantity of water pumped would be 1 200 000 gallons per day.

Mr. H. A. Howie, borough electrical engineer of Walsall, replying to the chairman, said that during last year it was necessary to shut off part of the load at Birchills owing to the temperature of the condensing water becoming too high, and the tramways had to be temporarily stopped. The canal was several inches lower than normal at the time, and a considerable quantity of mud was drawn into the condensers.

On Saturday Mr. E. M. Lacey gave evidence on behalf of Walsall Corporation, and said he believed there was a sufficient supply of water for condensation purposes at the Birchills station. The collieries would be better assured of security of supply under the proposals put forward by Walsall than by those of the conference of authorised undertakers. The linking up of the Walsall generating station with that at Wolverhampton would be a much cheaper and more adequate undertaking than the erection of a new station at Rugeley.

On Tuesday evidence was given by Mr. Lacey as to the capital expenditure involved in the extension of Birchills station and other matters.

Mr. Rider was recalled, and expressed the opinion that Mr. Lacey's estimates were inadequate. Referring to turbo-generators mentioned in Mr. Lacey's evidence as having been quoted for by a foreign firm at £3.7 per kW, he said reliable machinery could not be obtained at such a price in this country. Comparing the proposed new station at Rugeley with the Birchills extension scheme, he said that on the same load factor the cost of coal per unit would be less at Rugeley than at Birchills because at the former they had cold river water for condensing instead of recirculated canal water as at Birchills.

Counsel having addressed the Commissioners, Sir Harry Haward said they were much gratified at the public spirit shown by the authorised undertakers in preparing the scheme and presenting it with so much precision. It was a happy augury for a cheap supply of electricity in the area. The Commissioners would give most careful consideration to the scheme and to the counter-proposals of Walsall Corporation.

Owing to the necessity for reduction in public expenditure, the Department of Overseas Trade announce that as from April 1 the following Imperial Trade correspondents will be recalled :—Brisbane, Dunedin (N.Z.), East London, Durban and Bloemfontein.

E

Improved Street Lighting in Oxford-street.

The Borough of St. Marylebone has always been associated with good street lighting, and Oxford-street in particular has for many years enjoyed the reputation of being one of the best illuminated streets in the metropolis. Whenever new developments in lamp manufacture or illuminating engineering have occurred, Marylebone has taken the fullest advantage of them.

Early in January of this year the lighting in Oxford-street was reconsidered with a view to bringing the installation up to the standard demanded by modern traffic conditions. After careful consideration and experiment, it was decided to replace the existing

Fig. 1.

500 W units by 250 V 1 500 W Osram gasfilled lamps, supplied by the General Electric Company, Ltd., and mounted in new lanterns of octagonal form fitted with diffusing glass panels, designed by Mr. Haydn T. Harrison. This combination yields an illumination remarkable for its uniformity and freedom from glare, as will be seen from the photograph reproduced in Fig. 1.

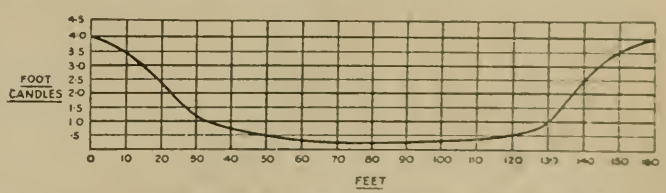


Fig. 2.—Curve showing the Distribution between two Adjacent Standards.

The lanterns are mounted at a height of 25 ft. above street level and at an average distance apart of 160 ft. The average intensity of illumination is 2·1 ft. candles, the maximum value under the lamp being 4·0 ft. candles, and the minimum value between posts being 0·2 ft. candles. Fig. 2 is an illumination curve showing the intensity of light on an horizontal plane 3 ft. above the road surface between two posts.

Social Notes.

The first meeting of the Golf Circle of the Engineers' Club will be held, by the courtesy of the Sandy Lodge Golf Club Committee, at Sandy Lodge on Wednesday March 8. There will be a medal round in the morning and a bogey round after lunch. Lunch will be provided at the clubhouse. The green fee is 6s. for the day, lunch and caddies extra.

About 1 200 persons were present at the Queen's Hall, Langham-place, London, W., on Friday, on the occasion of the nineteenth (the first since 1915) annual smoking concert of the staff of Babcock & Wilcox. A long and enjoyable programme was given. Mr. C. S. Davy (manager of the London office) presided, and among those present were Sir John Dewrance, K.B.E. (chairman of the company) and Sir James Kennal (managing director).

The fourteenth annual dinner of the technical and administrative staff of Cardiff Electricity and Tramways Departments was held last Friday. Councillor S. Jenkins (chairman of the electricity and tramways committee) presided, and was supported by Messrs. C. G. Morley New (city electrical engineer), R. L. Horsfield (city tramways general manager), H. J. David (traffic superintendent), A. Ellis (late engineer and manager of the combined departments), H. Ellis (late chief of Southampton tramways), J. E. Teasdel, W. J. Radley and J. Preston. Councillor Jenkins, in proposing the "City of Cardiff Electricity and Tramways Departments," said the past year had been one of stress, and they had suffered considerably from labour troubles, but they were hoping that there were better things in store this year. Messrs. Morley New and R. L. Horsfield responded. Other toasts followed, after which an excellent musical programme was rendered.

Legal Intelligence.

Electric Furnace Dispute.

Mr. Justice Sankey has been occupied for some days in hearing an action arising out of the sale of an electric steel furnace by the plaintiffs, Electro-Metals, Ltd., to the defendants, the Malleable Steel Castings Company (1909), Ltd., for £3 300. The purchase money was to be paid in three instalments, and plaintiffs now sought to recover one of these sums (£1 100) and a further sum of £139, representing materials supplied in connection with the furnace. Defendants counter-claimed to recover various amounts.

Plaintiffs' case was that they had supplied a number of these furnaces to various Government departments and other concerns, and that they had met with considerable success. The contract for the furnace in question, of 30 cwt. capacity, was made in May, 1918, following interviews between Mr W. Bibby, who at the time was joint managing director of plaintiff company, and Mr. Edward Y. Walsh, managing director of defendant company. An undertaking was given that the furnace would be capable of producing steel to the defendants' satisfaction. The furnace was installed about the middle of 1919, and the first trial run was made on July 29. There were a number of minor mishaps consequent upon broken electrodes and such matters, but they were in course of time rectified. The trials were made under the supervision of the plaintiffs' engineer, Mr. H. Needham, and heats were continued under his direction down to November, 1919, when it was impossible to go on owing to the moulders' strike. Plaintiffs claimed that they had performed the contract and were entitled to the balance of the price. It was also said that defendants' workmen, having been accustomed hitherto only to iron casting, did not possess the necessary experience and skill for steel casting.

Defendants said the furnace never worked to their satisfaction. Plaintiffs had not completed their contract, and the furnace could not be run commercially. Mr. Walsh said he told Mr. Bibby he wanted steel of 40 tons tensile strength to the square inch, with 15 per cent. elongation, and Mr. Bibby said it could be got, and the furnace was the latest thing in steel production. Instead of a current consumption of 800 units to the ton of metal, which defendants had been told would be the figure, the furnace consumed twice that amount. Plaintiffs replied that no guarantee of the tensile strength was ever given, and they denied that defendants' figures regarding electricity consumed were accurate.

In the counterclaim defendants sought to recover in respect of wages paid in working the furnace, metal alleged to have been spoilt, electricity consumed, and the cost that would be entailed in putting the furnace in order.

The hearing was adjourned until a date to be fixed.

Hamilton v. Marconi's Wireless Telegraph Company.

This action was in the list for hearing on Friday last by the Lord Chief Justice and a special jury, but Mr. Douglas Hogg, K.C. (appearing with Mr. Bevan for the Marconi Company) took a preliminary objection, and asked his Lordship to look at the pleadings, from which he would find that plaintiff could not open his case without committing a contempt of court in view of an undertaking which he had given in former Chancery proceedings, that a certain agreement between him and the company should not be published. Counsel quoted authorities in support of his action.

Mr. Hamilton, who appeared in person, contended that the undertaking was obtained by misrepresentation, and that he did not fully understand its purport when he gave it.

The Lord Chief Justice pointed out that he could not get over the fact that the undertaking had been given, and before the case could proceed plaintiff would have to go to the Chancery Division to get the undertaking set aside.

After some argument the case was stayed, with costs against plaintiff.

Personal and Appointments.

Mr. C. G. Lamb has been appointed Reader in Electrical Engineering at Cambridge University.

Mr. W. Burrows, of the British Insulated & Helsby Cable Company, was presented last week with a case of cutlery subscribed for by the office staff, on the occasion of his marriage.

Mr. Frank Wright has been appointed chief electrical engineer to Matthews & Yates, Ltd., in succession to Mr. Wm. Inglis, who now represents Laurence Scott & Company, Ltd., in the Lancashire area.

Mr. James Makin, chief electrical engineer of Bexley, and engineer and general manager of Bexley Council Tramways and Dartford Light Railway Joint Undertaking, has been appointed chief electrical engineer of the City of Hereford.

Following the resignation of Mr. J. W. Hame as electricity engineer and tramways manager, York Electricity Committee have decided to appoint a whole-time engineer for the electricity department, and a whole-time manager (preferably an engineer) for the tramways undertaking. They recommend the appiontment of Mr. E. J. Nichols as City Electrical Engineer, at £650 a year, and that a tramways manager be appointed at £600 a year.

Mr. Ronald Grierson, for twelve and a half years chief electrical and mechanical engineer to Provincial Cinematograph Theatres, Ltd., and its associated companies, has resigned his appointment in order to take an active interest in a new contracting firm, details of which will be available shortly. In the meantime manufacturers of cables, conduit motors, switchgear, fittings, &c., desiring to get into touch with Mr. Grierson, should address correspondence, care of 197, Wardour-street, London, W. 1. 'Phone, Regent 2 226.

Parliamentary Intelligence.

Engineering Trade Dispute.

In a written reply to Commander Bellairs (House of Commons, Feb. 27), Dr. Macnamara said there had been two recent ballots of the members of the Amalgamated Engineering Union in connection with matters that were under discussion in the present dispute. The first was taken on a provisional agreement relating to overtime and nightshift conditions in September, 1920, and resulted in a majority of 43 151 for the agreement. At that time the total membership of the Amalgamated Engineering Union was about 460 000, inclusive of members on superannuation benefit and members of branches overseas. The result of a second ballot, which was taken on the provisional agreement of Nov. 17 and 18, 1921, interpreting the agreement of September, 1920, was a majority of 14 715 against acceptance. The present membership of the union was approximately 409 000. His information did not enable him to state exactly what percentage the majority in each case constituted of the membership of the union eligible to vote, as certain classes, such as members abroad, did not take part in the ballot.

The Proposed Barking Station

In reply to Capt. Martin (House of Commons, Feb. 27), Mr. Neal stated that it was not possible to say when the County of London Electric Supply Company would commence the construction of their generating station at Barking. The Company's Act of 1921 empowered the Electricity Commissioners, when giving their consent to the construction of the station, to prescribe the terms on which the undertaking might be acquired by the proposed joint electricity authority for Greater London. With the object of facilitating the commencement of the work, the Commissioners had communicated the terms to the company, and it was anticipated that formal sanction to proceed with the work would be given shortly.

Private Bills.

Blackburn Corporation Bill passed its first reading in the House of Commons on Friday.

A number of petitioners have lodged petitions against the Black Country Tramways & Light Railways Bill. The majority of these are by local authorities, who object to the proposed lengthening of the concession and to the increase of fares.

Petitions have been lodged by the Caerphilly and Abersychan Urban and Llantrisant Rural Councils, and the Aberdare and Aberaman Consumers' Gas Company and other gas companies in South Wales against the Bill of the South Wales Electrical Power Distribution Company.

Railway Electrification.

The Industrial Group of the House of Commons have appointed a deputation consisting of Sir Allan Smith, Sir William Pearce, Sir Philip Dawson and Mr. P. J. Hannon, to wait upon the Parliamentary Secretary to the Ministry of Transport and invite his assistance in suggesting such amendments in the Railways Act as will enable the London, Brighton and South Coast Railway Co. to proceed with its scheme of electrification without delay.

Select Committee on Telephones.

This committee decided at their meeting last week to call no more evidence. They adjourned for a fortnight, when they will again meet to consider their draft report.

Institution Notes.

A Paper on "High-speed Wireless Telegraphy" was read before the Chelmsford Engineering Society on Feb. 16 by Mr. C. H. Ford, who fully explained the Wheatstone automatic telegraph plant as used to work the wireless sets sending messages at high speed. Mr. Ford then dealt with the more obsolete spark sets as they were used to send high-speed wireless messages, and the signalling keys which interrupted the power supply at 12 000 V. The present type of wireless plant was then explained, in which valve transmitting and receiving stations with directional aerials are used.

At the annual dinner on Friday of the Birmingham Electric Club, Mr. Gilbert C. Vyle (Messrs. Avery's) referred to the difficulties of the industrial position, and stated that the cost of production, which rested at the door of labour, and nowhere else, affected the situation seriously. Mr. H. K. Beale, chairman of Birmingham Electric Supply Committee, stated that in 1895 half a million units of electricity were generated as compared with 137 millions last year. By the time the committee had developed all their schemes, Birmingham would, he thought, be the largest generating authority in the country. Developments were about to take place on the eastern side of the city. With a bigger output it might be possible to reduce charges.

The annual dinner of the North-Western Centre of the Institution of Electrical Engineers will be held at Manchester on Friday, March 24, in the large banqueting hall of the Midland Hotel at 7 p.m. for 7.15 p.m. The President has signified his intention of being present. It is intended to have a short toast list to allow time for a musical programme, and to give members an opportunity to meet one another. Tickets (price 12s. 6d., exclusive of wine) may be obtained from the following Manchester members:—Messrs. W. Walker (chairman), 20, Mount-street; A. S. Barnard (vice-chairman), Monsall Lodge, Prestwich; A. G. Livesay, Lloyd's Bank Buildings, King-street; S. L. Pearce, Corporation Electricity Works, Dickinson-street; C. D. Taite, Lancashire Electric Power Company, 196, Deansgate; A. G. Ellis (hon. secretary), Metropolitan-Vickers Electrical Company, Ltd., Trafford Park; A. L. Green (assistant secretary), 8, Westminster-avenue, Whalley Range, Manchester.

Electricity Supply.

BENTLEY and DONCASTER Councils have agreed to erect on the Victoria-road housing site twenty-four standards, each fitted with electric lamps of 100 c.p. each, at a cost of £9 per lamp per annum.

The deputation recently sent by GLASGOW Corporation to visit British and Continental refuse destructor works have issued a report in which they recommend delay in the erection of plant until the results are known of the experiments which are being made in refuse disposal in Berlin. At Rotterdam the deputation state that the destructor works are capable of dealing with 450 tons of refuse a day, and the whole of the electric current required for operating the tramways is produced by steam generated from the burning of the town's refuse.

Recently several contracts for the supply of ELECTRICITY METERS have been let to CONTINENTAL FIRMS by companies and by municipal electricity supply undertakings. Among those who have placed orders abroad are the Watford and Leeds Electricity Committees. At Leeds considerable feeling has been aroused, but a labour member of the Electricity Committee who was challenged on the question alleges that "there is a ring in this country which is demanding 45s. 6d. per meter, whereas in Germany meters can be bought for 23s. 1d. carriage paid, in Switzerland for 27s. 4d., and in France for 32s. 6d."

Ald. Walker, speaking at Stretford on Monday on the work of the MANCHESTER Electricity Department, said the principal thing in an electricity station was not coal, but water. He gave particulars of how Manchester Corporation had become involved in somewhat costly litigation as a result of using water from the canal at Stuart-street works, which, when turned back again, had become much warmer, so warm, in fact, that the pitch in the canal barges melted and caused damage to the boats. In order to obviate the trouble they had to have recourse to the cooling tower. At Barton they would use the canal also, but not the cooling tower.

A public meeting, attended by nearly 2 000 ratepayers of Wimbledon, was held at the Baths Hall on Monday evening, to discuss the action of the Town Council in summarily dismissing Mr. H. TOMLINSON LEE, chief borough electrical engineer. Alderman H. W. Simpson presided. On the motion of ex-Councillor R. D. Pond, seconded by Mr. A. Webb, a resolution was carried, with only a few dissentients, protesting against the action of the Electricity Committee and the Borough Council in dismissing the electrical engineer without any statement of their reason, and demanding a public inquiry before any further action was taken. It was decided that copies of the resolution should be sent to the Mayor of Wimbledon, the Minister of Health and the Minister of Labour, and the Electrical Power Engineers' Association.

In the report of the special sub-committee on the present condition of the HULL electricity undertaking (referred to in our last issue) it is stated that the main defects of the generating plant are, according to the engineer, Major Bell :—(*a*) Want of economisers to new water-tube boilers; (*b*) mechanical stokers to same not being efficient; (*c*) inadequate shafts or chimneys. He recommended the installation of economisers with future boilers, the employment of a special combustion engineer, and an alteration of the mechanical stokers as soon as possible. The committee also found that plans prepared by Major Bell were not adhered to by Mr. Magoris, who acted in Major Bell's absence. Major Bell and Mr. Magoris differ on the question of suitability of such plans, and these as well as other matters will be referred to a consulting engineer.

New Schemes and Mains Extensions.

PORT TALBOT Town Council have decided to proceed with an application for a Special Order to supply electricity for light, heat and power.

TEIGNMOUTH Electric Lighting Company have received more than the amount required to go to allotment, and are taking steps to proceed with the work of laying the mains.

WATERFORD Public Lighting Committee have recommended the appointment of Mr. Sean McEntee to draw up a report on the proposed electric lighting scheme for the city.

EALING Electricity Committee are considering the possibility of removing the transformer sub-station at the corner of Station-approach, Ealing Broadway, and have instructed Mr. Knight, the borough electrical engineer, to make inquiries regarding a new site.

NAVAN (Ireland) Urban Council have decided to erect electricity works at a cost of £9 970. The water power of the River Boyne will be employed. Electricity for light will be supplied at 9d. a unit and for power at 3d. It is estimated that the income will be £3 415 a year. The Council is to apply for a loan of £12 000.

At last Thursday's meeting of PRESTON Town Council it was stated that the Government had offered to pay 50 per cent. of the interest on money spent on contracts completed up to a certain date at the new generating station. The Electricity Committee considered it was a generous offer, and the Council have accepted it.

BIRMINGHAM Electricity Committee have approved a scheme for extending the supply cables to the outside areas on the east and south side of the city, at a cost of about £100 000. The proposal is to run a h.t. main through Ward End, Stechford, Yardley, Acock's Green, Hall Green, Alcester Lanes End, King's Norton, Cotteridge, Northfield and Selly Oak, to Weoley Park. Pressure will be reduced at transformer stations for local consumption. Good progress is being made with the Nechells power station.

Electric Traction.

For the nine months ending Dec. 31, 1921, HALIFAX Corporation Tramways show a profit of £1 136.

BIRMINGHAM Tramways Committee have extended the hours of the tram and 'bus services from 11 p.m. to 11.30 p.m.

The Ministry of Transport have granted a Provisional Order to DONCASTER Corporation for a loop tramway line above Trafford-street and Factory-lane.

Mr. A. J. Smith, C.A., Glasgow, who was appointed arbiter by the Sheriff in a DISPUTE BETWEEN GREENOCK CORPORATION AND THE TRAMWAYS COMPANY, regarding the rates for electricity, has issued his award, which is favourable to the Corporation. The latter maintained that the company should make a payment of £9 000. The company had paid £5 000, and the award is to the effect that the company's payment shall be over £8 000.

NEWCASTLE tramway men came out on strike on Saturday evening against the proposal to institute a 48-hour week instead of the present 44 hours. At the moment of going to press there seems to be little likelihood of an early resumption of work. The men have rejected an offer by the Tramways Sub-Committee along the lines of increased pay for the additional four hours and "other advantages and improvements in conditions of working." Although the depots have been open for any of the men to resume work on the Committee's condition of a 48-hour week at the old rates, not a single man has presented himself, and the pickets at the various depots have had nothing to do.

The Highways Committee of the LONDON COUNTY COUNCIL have entered into a three-years' agreement under which the company shall continue to operate the lines transferred to the Council in Hammersmith, the Council running one service from Hammersmith to the County boundary and thence along the company's lines to Kew Bridge, or such other point on the company's system as may be agreed. The Council will operate the whole of the service on the company's lines between the County boundary at Merton and Wimbledon, each party retaining the receipts from its own cars. An estimate of capital expenditure (£1 550) for the connection of the tramway tracks of the company with those of the Council, the extension of the overhead wires and standards, and the installation of a change point at Merton terminus has been approved.

Wireless Notes.

The Vazdai Press Agency at Amsterdam began its WIRELESS TELEPHONE NEWS SERVICE for the Dutch Press last week.

The UNITED STATES Senate has passed a resolution, already adopted by the House of Representatives, extending the privileges of the naval wireless service to the Press for five years.

A 500 kW RADIO STATION is being erected at Ruysselede, near Bruges, by the Société Independante Belge de Télégraphie Sans Fils. It will be able to communicate with North and South America and the Congo, and four simultaneous messages can be received. Another big radio station is to be constructed by the Government at Elisabethville, in the Congo.

Business Items, &c.

We are glad to learn that the LORIVAL MANUFACTURING COMPANY (1921), LTD., has secured a substantial contract from the Admiralty for the supply of submarine accumulator containers. Hitherto the supply of these articles has been, more or less, a foreign monopoly.

REAVELL & COMPANY announce that owing to the growth of their business they have moved their London office to larger premises at 47, Victoria-street. Their telephone number, "Victoria 5 935," remains as before. The head office of the business is still at Ranelagh Works, Ipswich.

On Saturday, Feb. 18, a party of members of the Association of Engineers in Charge visited the BENJAMIN ELECTRIC, LTD.'s, works at Tottenham, where the company's manufactures and methods were explained. The party numbered over thirty, and, in addition to an explanatory tour of the works, a short lantern lecture was given on "Industrial Illumination."

Obituary.

We regret to learn that Mr. DRUITT HALPIN, M.I.C.E., M.I.Mech.E., died on Feb. 27, after a long illness. Mr Halpin was a consulting engineer, an authority on boiler-house equipment and refuse destruction, and was for some years managing director of Halpin's Patent Thermal Storage, Ltd.

The death is announced of PROF. J. FISCHER-HINNEN, the well-known Swiss electrical engineer and author of several works and papers on dynamos and motors. Born in Zurich in 1869, he soon developed a liking for physical science and electrical engineering studies. At the age of 19 he joined the staff of the Maschinenfabrik Oerlikon, and, with two short intervals, during which he visited Spain and the Chicago Exhibition, he remained with the company until 1895, being engaged on electric generator and motor design, and on electric railway work. He succeeded the late Prof. E. Arnold as chief designer of the company, but later he spent five years in Paris and three in Prague. In 1905 he returned to the Oerlikon Company as head of their small motor department. In 1914 he became professor of electrotechnics at the Cantonal Institute at Winterthur and director of the Electrotechnical Institute.

Imperial Notes.

Collingwood (Victoria) Council are considering the adoption of electric driving at their colliery instead of steam. The first cost of the change will be nearly £1 000.

Scottsdale (Tasmania) Council are carrying out a water and electric supply scheme. The reservoir has been constructed, and approved by the Minister of Public Works.

The programme of the Parliament of the Union of South Africa includes measures relating to railway construction, weights and measures, the consolidation of company laws, and the production of electricity.

Owing to the cheap supply of power provided by the Southern Canada Power Company, seventeen new industries have been established in the eastern part of Quebec during the past three years with an invested capital of $10 000 000.

A manufacturers' agent in Montreal desires to obtain, on a commission basis, the representation of United Kingdom manufacturers of electrical specialities and shelf hardware of all kinds for Eastern Canada. Particulars from the Department of Overseas Trade. (Reference No. 203.)

Seventy-three miles of the Melbourne Suburban Railways had been converted to electric traction by the middle of January. In addition to these, the Oakleigh and Glen Huntly to Melbourne sections were expected to be opened by about the present time. Up to date about £4 000 000 has been expended on the electrification.

A report is being prepared on a proposal to adopt electric traction on the lines of the Temiskaming & Northern Ontario Railway Commission. The main line is about 252 miles in length, and runs from North Bay to Cochrane. In connection with the scheme an investigation is being made of water-power resources of Northern Ontario.

Bathurst (N.S.W.) Council have received a communication from the Premier of New South Wales to the effect that the question of proceeding with the construction of the power-house to supply electrical energy to railway stations and towns west of Blue Mountains is being carefully considered by the Railway Commissioners, and the site for the power-station has been decided upon.

The site of the Victorian Electricity Commissioners' new power station at Newport (Victoria) has been prepared, and the first turbo-generator is expected by June next. The site of the Morwell power-house is almost ready. This month a start will be made to remove the overburden at Morwell preparatory to producing coal, which should be practicable about the middle of the present year.

By Imperial Preference Order (No. 1), of 1922, the following territories are now included within the definition of the British Empire for the purposes of Sec. 8 of the Finance Act, 1919:—(*a*) The South-West Africa Territory (formerly German South-West Africa); (*b*) the territory of New Guinea (the former German possessions in the Pacific Ocean situated south of the Equator other than German Samoa and Nauru); and (*c*) the territory of Western Samoa (formerly German Samoa).

Owing to a sympathetic strike of the electricity works staff at Johannesburg, in support of the miners, there was no electricity supply on Monday, except at a few places of amusement possessing their own plants. The Strike Committee decided that the Council must not use "scab" coal, and the result is that industries dependent upon the municipal power station are at a standstill and no tramcars are running. The Government will run the lighting services by means of volunteers.

A hydro-electric scheme was prepared four years ago by an engineer of the Ceylon Public Works Department, and "Indian Engineering" understands that such a scheme is likely to be carried out in the near future. The Government is acquiring the Hardenhuish Valley forty miles from Colombo, for the intake reservoir. The Government has favoured the proposal for the generation of electrical energy from the Aberdeen-Laxapanagalla scheme which will combine the flow of two streams into the Hardenhuish Valley, and permit of the generation of 200 000 e.h.p.

European Reconstruction.

As the result of last week's London Conference of the Organising Committee of the Central International Corporation and National Corporations, steps are to be taken to re-establish national corporations in various countries affiliated together (with a central International Corporation in London), for the purpose of assisting, financially and otherwise, the work of European reconstruction. The capital of the National Corporations will be the equivalent of £20 000 000, of which 25 per cent. is to be immediately called up. Government guarantees will be requested where necessary to enable the capital to be raised. The initial capital of the Central International Corporation (£2 000 000) will be provided by subscriptions by the National Corporations of approximately 10 per cent. of their original capital. The following countries have been invited to subscribe 20 per cent. of the total £20 000 000 proposed to be raised, viz., Great Britain, France, Germany, Italy, and Belgium. It is also proposed to ask the United States, Japan, Denmark, Holland, Switzerland, and Czecho-Slovakia to participate, and the Central International Corporation will have power to allow other countries to come in if they so desire.

Foreign Notes.

About 13 000 electricians and metal workers have gone on strike at Mayence.

In order to facilitate the transport of workers in the new mining region of Limbourg, Belgium, a number of light electric railways and tramways are being constructed.

Efforts are being made to improve the Paris tramway system, and the Surface Transport Company is to build 600 new electric tramcars, 300 trailers and 300 motor-omnibuses.

It is officially announced that the Illinois Central Railroad Company will create $50 000 000 7 per cent. preferred stock, which will be convertible with common stock, and the proceeds devoted to electrifying the Chicago lines and the reconstruction of the terminals there.

A decree has been issued by M. Le Trocquer that after Jan. 1 next no gas lighting will be permitted on express trains. After Jan. 1, 1924, electricity must be used for lighting on suburban trains, and by 1925 all trains operating in France must be lighted by electricity.

The supply of electricity in Athens is given by the Société Anonyme Hellénique du Gaz d'Athènes et Autres Villes, a French company. The consumers' voltage is 110 d.c., and only metal filament lamps are used for public lighting. The price of electricity is 20 lepta per unit.

In consequence of the general increase in prices of raw materials and advances in wages and salaries, the Union of Manufacturers of Electric Heating and Cooking Apparatus, of Charlottenburg, Berlin, has authorised substantial increases in the prices of electric irons, cookers, etc.

The manufacture of incandescent electric lamps is now one of the most important industries of Holland, and during the first seven months of 1921 the value of the export of lamps was about £1 000 000. The exports were mainly to France, Great Britain, Spain, Argentina, Belgium, Italy and Sweden.

According to recent reports, there has been a drop in the internal demand for electric cables and wires, motors, meters, and installation material in Germany, but the activity in large steam and hydro-electric plants and for telegraph and telephone apparatus continues unabated. There has been a decreased demand for incandescent lamps for export.

According to the Christiania Press, it is proposed to commence immediately preliminary work on the two electric railways, for which concessions have been granted to A/S "Akersbanerne." The Ostensjo line, which is to cover a distance of 5·2 km., is calculated to cost 720 000kr. per km., while the estimated cost of the Sognsvand line is 700 000kr. per km.

Tenders are being invited for the supply of electric cables in connection with the scheme for the electrification of the Swiss Federal Railways, and foreign tenders will be considered on the present occasion. The scheme will involve the ultimate electrification of a network of 3 000 miles, and the adoption of electric traction on branch lines is also being considered.

According to the Automobile Bureau of the New York Edison Company, the total number of electric passenger automobiles in use in America in 1920 was 16 641. Of these, 4 500 (or 27 per cent. of the total) were in Chicago, and 2 500 (15 per cent.) in Cleveland. The demand for this type of vehicle is said to be on the increase, and the output is soon expected to reach the record of 1918, which was 7 000 cars. Recent reductions in prices have brought the level close to that of 1910.

Bitter comment is made in the "Electrical World" on the paralysis of the United States Patent Office, with the result that patent applications are held up for a year or more. In 1918 the total number of applications was 57 000, but in 1921 it was 109 238. In the same period the examining staff was increased by only 5 per cent., because technical men could not be found to accept the salary scale offered. The result is that there are now arrears of 60 000 applications, and the situation is not likely to improve without legislation. The House of Representatives has passed a relief Bill, but the Senate is holding it up.

The total value of the electrical exports from the United States in December, 1921, was $5 177 276, an increase of nearly $1 000 000 over the preceding month, the total for the year 1921 being nearly $96 000 000, a decrease of over $6 000 000 in value. Prices showed an average drop of 7½ per cent. compared with 1920, but the volume increased slightly. There were substantial increases in the export of dynamos and generators, motors, transformers, insulated wire and cables, carbon filament lamps, meters, and telegraph and telephone apparatus. There was, however, a marked decrease in batteries, carbons, wiring supplies, and in heating and cooking apparatus.

The Société des Agriculteurs de l'Oise are organising an important electrical exhibition, which will be held in June next at Compiègne. The use of electricity is extending rapidly in the north and east of France, not only for lighting, but for industrial power and agricultural purposes. Several co-operative societies have sprung up for the distribution of electrical energy, and in the Oise alone there are six of these in full operaton, and two more are about to be formed. It is anticipated that in a few years quite two-thirds of the communes of the Department will enjoy the advantage of a good supply of electricity. The last date for entering is Feb. 25, and particulars can be obtained from the Commissaire-Général (M. Lefèvre), 7, rue du Palais de Justice, Beauvais.

Companies' Meetings, Reports, &c.

London Electric Supply Corporation.

Mr. R. H. Benson (chairman) presided at the annual meeting of the London Electric Supply Corporation last week.

Referring to the report and accounts (*see* Electrician, Feb. 17), the Chairman said that the company's net revenue increase during 1921 was from £99 487 to £102 286. After putting aside the sinking fund of £16 580 per annum to extinguish their debenure stock, fixed charges, and £20 000 more for reserve and contingencies, the directors recommended 4 per cent. dividend on the ordinary capital, against 2½ per cent. last year, leaving to be carried forward £14 080, against £14 256 brought in. The past year was the year of the coal strike—high cost of fuel, high wages, and higher rates and taxes. When complaint was made that private enterprise blocked the way to cheap power the public should remember, among other factors, the increase of rates—£48 400 in their case in 1921, compared with £11 845 in 1914. If they had stood at the 1914 figure the ordinary shareholder could have received 12 per cent. The increase in rates took 66 per cent. of the return they should have received. Should not local authorities expend their utmost energies in trying to give ratepayers some relief before attempting to take on their shoulders the provision of electricity at the risk of still further increasing the rates? They had received a very gratifying letter from the general manager of the London, Brighton and South Coast Railway testifying to the value of the company's supply during the strike, which enabled the railway to continue its electrical service unrestricted.

Why was it that the vital industry of electrical supply had been treated like a football, continually kicked about and never getting through the goal-posts? He (the chairman) did not suppose Parliament intended to keep the companies, its creatures, poor so that the municipalities might buy them up cheaply in 1931, owing to their credit gradually becoming impaired as that date approached. But that was the way it worked. The company's capital account was overdrawn by £244 089. They needed the money for more plant to meet the annual increase of demand and to cheapen the supply. But until the Parliamentary uncertainty was removed they could not get it. What was needed was an immediate settlement of the London County Council's option of purchase in 1931 and an extension of tenure long enough to make it possible to borrow at a reasonable rate of interest, and repay by a moderate sinking fund spread over so many years as would not penalise present consumers.

From 1888 to 1903 the shareholders' money went in pioneering experiments, by which the public benefited. The first dividend, which was 3 per cent. was in 1904; and the total dividends up to date (including 1921) amounted to 44½ per cent., or an average of 1·3 per cent. per annum. Could anyone say that the shareholders had had too large a share of the price paid by the consumer for light and power? Out of every pound paid to-day by the consumer, labour now received 12s. 3¾d., against 8s. 10d. in 1914; rates and taxes 3s. 5¾d., against 1s. 9d.; and the shareholders 1s. 5¼., against 3s 10½d. in 1914. Obviously costs of production were too high. Cheap power depended on increased output and increased consumption. Between 1903 and 1915 at least fourteen private electrical Bills were deposited in Parliament. Very few passed. The cost of promoting and opposing them must have been at least between £200 000 and £300 000. What was there to show for it? The technical improvements recommended in the Act of 1919, especially bulk supply, were the same as those proposed by companies nearly twenty years ago, and they might have been carried out by this time, and much more cheaply than now. They would have kept the industry well ahead of the demand for power, instead of, as it now was, behindhand.

St. James's and Pall Mall Electric Light.

Presiding at the annual meeting of the St. James's & Pall Mall Electric Light Company, Ltd., on Tuesday, Mr. Walter Leaf (chairman) said the report showed a very profitable year, and the tide of prosperity for the company was on the flow. The last half of 1921 was distinctly better for them than the first, and the figures of the first two months of 1922 continued and emphasised this improvement. The rebuilding of Regent-street promised to their company a large increase in business in the near future; they seemed to be as far as ever from "saturation point." With all the uncertainty and difficulty caused by the coal strike, they did not feel justified in making any reduction of price during the year, but they expected to be in a position shortly to announce concessions in lighting power tariff. The increased capital expenditure under the head of machinery arose from the continued process of conversion of Carnaby-street from a generating to a transforming station. That was now approaching completion, and it would not be long before they would take the whole of their current from Grove-road.

A large scheme of reconstruction and extension to the Central Company had been carried out during the year. The new repair workshop had been completed and fully equipped with machine tools. The main structure of the new boiler house was nearing completion. An additional large cooling tower for 7 500 kW had been completed in time for this winter's load. The first of the two 10 000 kW turbo-generators, to which he referred a year ago, was finished and put to work in the summer, and was running at full output during the last quarter of the year, enabling both the parent companies to close down their old steam plant. The erection of the second 10 000 kW set was completed by the end of the year. The first two B. & W. 50 000 lb. boilers, the delay in the erection of which caused them serious anxiety, were completed in time to enable them to make full use of the first large turbine. The second pair was also considerably delayed, so that they were not in time for the winter load, but they were also approaching completion.

The output from the Grove-road works amounted to 39 857 000 units, an increase of 1 611 000 units, due almost entirely to the extra supply given to the Horseferry-road station of the Westminster Company during the coal strike. The maximum load increased by 6 000 kW to 22 500 kW, covering the whole requirements of the two parent companies, except the Horseferry area. The plant had been run with an improved economy during the year; the gain on the new turbine, which was running only for the last quarter, was estimated at a saving of 2 900 tons of coal, or about £6 000. This they hoped to improve upon very much during the current year, when both turbines would be running. The station was, in fact, now the most efficient of any public supply in the south of England. An agreement had been made with the Chelsea Company for a largely increased supply direct from Grove-road, and it was expected that the supply would be available within the next six months. The cost of the extension made it necessary to seek fresh capital, and in April last an issue was made of £500 000 8 per cent. five-year notes. A claim had been made on them for corporation profits tax. This they were disputing, and they had made no provision for it. In common with other companies, they were taking steps to represent to the Government the injustice of this particular form of taxation. An abstract of accounts appeared in our issue of Feb. 17.

South Metropolitan Electric Light and Power.

The annual meeting of the South Metropolitan Electric Light and Power Company was held on Tuesday, Mr. H. St John Winkworth (the chairman) presiding.

The chairman, in moving the adoption of the report and accounts, said the net revenue amounted to £100 315, against £50 509 in 1916 and £2 150 in 1901. The total horse-power connected at the end of the year was 32 387, against 30,726 in 1920. Compared with 1920, the new services numbered 436, against 539; lamp connections (in 35W equivalents) 44 319, against 56 553; the total consumers and h.p. connected at December 31, 1921, were 8 489 and 32 387 respectively. The number of units sold was 18 697 606 (17 643 122), and the average price obtained from all classes of supply was 2·65d. per unit (2·55d.). The units sold to the larger works and factories were, generally speaking, less than last year owing to the depression in industry. Receipts from sales of current (less rebates) amounted to £206 690 (£186 775). Rentals of meters and apparatus on hire were a little up. Sundry receipts, contract work, &c., were £2 500 down, which was accounted for by a smaller turnover in the showroom and wiring department. The gross receipts from all sources were £216 808, against £199 037 in 1920. There was a decrease of £12 400 net sum. Oil, waste and water, salaries of engineers, wages in generation and distribution were all higher. The expenditure on repairs was £3 660 more, and the plant was now all in good and efficient working order. Rates showed a considerable increase (£4 430). Management expenses were £9 491, against £7 844, the addition being due to the increased business, except in the case of general establishment charges, where the increase was entirely caused by higher postal charges. The total amount of the expenditure was £116 493, compared with £116 216 for the previous year, representing a ratio of cost to gross receipts of 54 per cent., compared with 58 per cent. The amount carried to net revenue account was £100 315 (£82 821), which, with £18 260 brought in and £1 000, the dividend on the company's holding in the West Kent Electric Company, made a total of £119 576 (£96 146). It was proposed to place £24 000 to depreciation (£23 000), £25 000 to reserve (£10,000), pay a 10 per cent. dividend on the ordinary shares (against 8 per cent.), and carry forward £21 497 (£18 260). The capital expenditure for the year, after crediting £500 to electrical instruments, tools and loose plant, and £1 000 to installations account, was £37 882.

Mather & Platt, Ltd.

Mr. L. E. Mather (chairman), addressing the shareholders at the annual meeting of Mather & Platt, Ltd., on Monday, said that the results of 1921 had proved considerably better than any previous year, and that they were able not only to recommend paying the same dividend as last year, but to increase the carry forward by a large amount. This satisfactory state of affairs, in spite of the present depression, was due, in the first place, to a large increase in the volume of turnover, and, secondly, to the profit on the large amount of work in progress brought in from the previous year. No profit on work in progress was taken to the credit of 1920, and it consequently increased the profits of 1921. The percentage of profit on turnover in 1921 actually was slightly less than in the previous year. The increased turnover was made possible by the firm's new extensions with their increased tool capacity, which were completed in time to augment the output considerably. Thus they were able to make deliveries before selling prices had fallen or their stocks had depreciated to any serious extent. Although the profit was much larger than in the previous year, the directors considered that the present time did not justify a larger dividend, and therefore considered it prudent to recommend the same dividend and to increase the carry forward in view of the uncertainties of the future. The capital account of the company was increased by £156 000, due to the payment of the final call, on March 1, 1921, on the new shares issued at par in 1920. The fixed assets at £918 000 showed an increase of £106 000, due to the completion of the extensions at Park Works. War loan and investments in preferred stocks were increased by £10 000 to bring them up to market value at the end of the year. The item stock in trade, which included the work in progress, showed a reduction of £375 000, which showed that they

were not carrying forward to the current year as large a volume of work in hand as they did a year ago, and the value was also reduced by the lower prices now ruling. Sundry debtors, at £535 000, showed a reduction of £200 000, notwithstanding the increased turnover. The bank overdraft of last year had been changed to a considerable balance on the assets side. The item of sundry creditors had been reduced by £250 000.

After paying a tribute to the memory of the late Dr. Edward Hopkinson, the chairman said that last year he was able to report that the company had more men employed in their shops than ever before. The result of this was shown in the results of the year, but for the last few months their company, too, had been feeling the trade depression. Their output per man was decidedly increased over that of the preceding year, and although that was to some extent due to the more settled condition of labour, he considered that the system of payment by results which they adopted wherever possible had contributed also to that result.

The Works Continuation School continued to prove its value. All boys attended the school for eight hours a week from the time they entered the works up to their eighteenth birthday, and he was glad to say that even when suspended for lack of work in the shops they continued to attend school voluntarily. The Research Laboratory, which had now been in existence nearly two years, had justified the expense incurred, and had enabled them to improve the standard of their products and to keep up to date in all departments.

He did not intend to discuss the threatened engineering lock-out, except to say that they regretted it should have been necessary, and earnestly hoped that agreement might still be possible on a principle that all employers considered vital. As regards future prospects at home and abroad, they were obtaining their share of such home contracts as were being placed, but they were not extensive. In France, where they had now established their own French company for sales purposes, business was affected adversely by the rate of exchange, causing their former customers to await improvement, or sometimes even to accept the tempting offers of German firms. Russia was still a closed book, and would remain so until the Government there adopted a sound policy which would attract traders and provide something to exchange other than useless paper. In India they had made good progress. They had also work in their shops from other important countries, such as Italy, Egypt, China, Japan, Brazil, Scandinavia and Canada.

Central London Railway.

Presiding at the annual meeting of the Central London Railway Company last week, Lord Ashfield said that the year 1921 was the first year during which the extension railway from Shepherd's Bush to Ealing had been continuously worked. Under agreement, the G.W.R. Company maintained the railway and stations, and the Central London worked the train service. For working the train service the company received a share of the traffic receipts attributable to the extension railway. This share, however, had barely been sufficient to meet the expenses incurred during the year. The results of working the extension were very disappointing. It was impossible to give exact figures, but the number of passengers using the extension during 1921 was estimated at only 3 200 000, against 9 000 000 passengers using the Ealing group of stations upon the Metropolitan District Railway and travelling to and from the central and western areas of London. This was due to the higher fares charged for journeys on the route, which was necessitated by the fact that the railway from Shepherd's Bush to Ealing Broadway was part of the Great Western Railway, upon which the fares were based upon the pre-war rate of fare increased by 75 per cent. Their company were in negotiation with the Great Western for an adjustment of the fares situation which would enable them to treat all routes from Ealing Broadway into central London alike.

Expectations raised by the revision of fares in Sept., 1920, had not been realised. Experience had shown the general correctness of the level of fares then introduced, but the financial results had fallen somewhat short by reason of the acute depression of trade and industry, which, commencing with the coal strike of last year, still continued. There had been a small additional expenditure during the year, mainly for the completion of the connection with the Ealing Extension. Progress was being continued with the transfer of the power supply from the generating station at Wood-lane to the Lot's-road power house, and further expenditure amounting to £11 900 was contemplated in this connection. The last steam locomotive belonging to the company had been removed from the active list. The number of cars available for passenger service had been reduced by four, and two electric locomotives had also been transferred from the active list to service vehicles. An attempt had been made to deal with the maintenance work, which got into arrear during the war period, and a full programme was now in operation. There had been an increase in train mileage, due to the working for a complete year of the Ealing and Shepherd's Bush extension. There had been a decline in passengers from 50 millions to 43½ millions, or 13 per cent.

The receipts from railway working after the operation of the Common Fund were £661 479, an increase of £83 096 on 1920; expenditure amounted to £468 428 (£16 704), leaving net receipts of £193 051 (£99 800). Miscellaneous receipts amounted to £68 071 (£5 247), making a total net income of £261 122 (£94 553). Adding balance from last year (£15 161) and deducting interest, rentals and other fixed charges (£46 039), appropriation to reserve (£29 000), dividend on preference stock (£21 600), the balance available for dividends on ordinary, preferred and deferred ordinary stocks was £179 644, against £96 984. The interim dividends of 2 per cent. on the ordinary and preferred ordinary stock in August last absorbed £46 925, leaving £132 719 available, out of which the directors proposed to pay final dividends of 2 per cent. on the ordinary stock and of 2 per cent. on the preferred ordinary stock for the year, together with a dividend of 4 per cent. on the deferred ordinary stock for the whole year, making in the case of the ordinary stock and the preferred ordinary stock 4 per cent. for the year, and leaving to be carried forward £59 644. The sum of £29 000 had been placed to reserve, an increase over the previous year of £9 000. The dividends for 1920 were 2¼ per cent. on the ordinary stock, 4 per cent. on the preferred ordinary, and ½ per cent. on the deferred ordinary stock, with £15 161 carried forward.

Metropolitan Railway.

The annual meeting of the Metropolitan Railway Company was held last week, Lord Aberconway presiding.

The Chairman, in moving the adoption of the report and accounts, said the net receipts from railway working were £509 076, against £451 495 in 1920. The interest on the debenture stock and the full dividends on the several preference stocks amounted to the same figure as last year, and after providing for these and transferring £50 000 to the general renewals fund, as they did last year, they had a balance available for dividend on the ordinary stock of £185 202, against £127 020. Out of this balance the board recommended the payment of a dividend on the ordinary stock for the year at the rate of 2¼ per cent. per annum carrying forward the surplus of £17 796. As they paid an interim dividend of 1¼ per cent. per annum for the half-year ended June, this would mean a further payment at the rate of 3¼ per cent. per annum in respect of the second half of the year. They had now over £550 000 set aside for reserve and renewal purposes without taking into account the £206 440 which the Government had recently paid as the first instalment of the amount due in satisfaction of outstanding claims arising out of their control. They had spent during the year just over £400,000 on capital account. Having regard to the way in which land was being developed down the line, and to the prospects they had of a large goods and passenger traffic to and from Wembley Park commencing with next year, and a large passenger traffic to and from the projected exhibition and sports ground, their foresight in adding to their rolling stock and locomotive and power plant had been more than justified. They looked for a still further reduction in their journey times as they got delivery of the new higher-powered electric locomotives. The company's wages bill in 1913 was £295 926; in 1921 it was £924 578, an increase of over 200 per cent. In 1913 their coal cost them £65 000; last year it cost them £223 000. The latter figure was abnormal on account of the strike and its consequences. The number of passengers originating on the line in 1921, apart from season ticket holders, was fewer by about 20 000 000 than in 1920. Compared with 1913, the last normal year when they were working on their own account, the number of passengers originating on the line in 1921 showed an increase of some 10 000 000, and their season ticket traffic had practically doubled itself. So far as fares were concerned, while the increases made did not at present recoup them for the increased working expenses, they thought that they were on a correct economic basis.

The Wembley Park Estate Company had recently sold about 120 acres of their land at Wembley to the authorities of the British Empire Exhibition with a view to that exhibition being held there in 1924. The company would undoubtedly reap very considerable benefit from the exhibition traffic and, as it was the intention to make Wembley the future centre for many of the annual trade and other exhibitions held in London, and also to establish there a sports centre, it was likely to be a source of additional revenue to the company for a long time to come. As a company they were in an infinitely stronger position financially than they had ever been before, and their revenue-earning capacity was greater than it had been hitherto.

The report and accounts were adopted, and the following resolution was passed :—" That this meeting, while willing to bear income tax in common with other H.M. subjects, objects to the payment of an additional income tax or super-tax upon that part of their incomes derived from the profits of railways, or other public utility companies, whose charges are fixed or regulated by statute, and calls upon the Chancellor of the Exchequer and the Government to exempt for all time the companies mentioned in Sec. 52 (2), paragraphs (i.) and (ii.), of the Finance Act, 1920, from corporation profits tax."

S.E. and Chatham Railways.

The annual meeting of the South-Eastern and London, Chatham and Dover Railway Companies was held last Thursday, under the presidency of Mr. H. C. O. Bonsor (the chairman).

The Chairman said that on Aug. 16 last the Government gave them back their railways, after seven years of State control. To put it in the mildest possible form, the damage done to the company as a commercial undertaking was serious. The compensation allotted to the company was £1 031 000. They had had to draw £382 000 of that to make up the revenue of 1920. There was a further sum of something over £1 000 000 to come when the accounts were made up next year. Large economies had taken place all over their system. Wages were lower, both coal and materials were cheaper. The managing committee was ordered under the Railways Act to be a constituent company. It had no shareholders, no capital, and yet it was ordered to be a party to the fusion of the Southern group. The Act was "a most extraordinary production." For the first time in Parliamentary history, he said, commercial businesses were ordered to amalgamate whether they liked it or whether they did not.

Regarding the electrification proposals, Mr. Bonsor said that when

the Working Union Act was passed the principal asset of the Chatham Company was their short distance metropolitan traffic. That asset no longer existed; competition by tram and omnibus had killed it, and their revenue was derived from the area outside the metropolis. That revenue was now threatened by an extension of road competition, and before the war broke out they were preparing plans for the electrification of their system within a twenty-mile radius of London. The war postponed any scheme of that description, and at the end of the war Government control had so diminished railway credit that it was impossible to raise the capital for that most necessary undertaking. The Trades Facilities Act passed last session gave the company the opportunity of asking for the financial assistance of the Government. They were able to show that with seven London central stations they had a splendid position for distributing their passengers in the business areas of London; that besides finding immediate employment for a large number, they would be benefiting the public and increasing development in the counties of Surrey and Kent. Their proposals met with favourable consideration, and their explanation that it was impossible to ask the shareholders under present circumstances to consent to a direct obligation by the issue of capital was also accepted by the Government Committee.

In order to comply with the requirements of the Act it would be necessary that a "private" construction limited company should be formed; its capital would be small, sufficient to cover preliminary expenses; it would not trade for profit; and it would have borrowing powers sufficient to cover the cost of construction. The money borrowed would carry the Government guarantee, both as to principal and interest, and be obtained on the most favourable terms as the work progresses. The works would be the property of the Construction Company, and when complete would be let to the managing committee on lease for twenty-five years at a rent sufficient to repay capital and interest at the expiration of the lease when the works would become the property of the managing committee or its successors. They were satisfied that the electrification would be a considerable and valuable asset to their railways. An agreement with the Government would be necessary, and would be submitted to the shareholders at special meetings to be convened for that purpose.

London Electric Railway Company.

At the annual meeting of the London Electric Railway Company last Thursday, Lord Ashfield (the chairman) said that the year 1921 marked the turning point in expenditure. The reductions in wages obtained during the year were equivalent to a saving of about £240 000 a year for the four railways. And with the reductions still in prospect the total saving in expenditure on this account in 1922 would be about £400 000. Many economies had been inaugurated. A committee of officers had been sitting from week to week reviewing in detail the whole of the company's organisation and methods. A new experimental train with air-worked doors had been put on the Piccadilly section of the company. Alterations to rolling stock were being carried out to provide ten trains of this type, which increased the speed of operation by the additional and wider doors and reduced the number of men required per train. At Kilburn Park station a new type of booking office had been installed, which enabled the sale and check of tickets to be carried out at one point instead of two as previously. The experiment was to be extended to several other stations almost immediately. In the coming year there should be appreciable savings in the cost of materials. The average price paid during 1921 for coal (including the oil used experimentally) worked out at about 52s. 6d. per ton. For the current year to date the cost was less than 32s. 6d. per ton, with a definite promise of a still lower price. The ratio of working expenses to receipts on the railways during 1921 was 70 per cent. There was a lively hope of this being reduced to a more normal proportion, though they could not expect to reach the 50 per cent. of 1913. The company received as its share of the common fund £320 552, against £106 348 in 1920. The debenture capital had been increased by £200 000. The net expenditure on capital account during last year amounted to £66 121. The receipts from railway working, after operation of the common fund, amounted to £2 040 000, an increase of £223 000. Working expenses were £1 369 000, or £19 000 less than in 1920, leaving net receipts of £671 000. The miscellaneous receipts were approximately the same as last year and the total net income was £808 000 an increase of £243 000. The balance brought forward from last year's account (£22 000) made the sum to be dealt with £830 000 approximately. Interest, rentals, and other fixed charges amounted to £296 000 very little more than in 1920. £65 000 was set aside for renewals as against £45 000. The dividend on the preference stock was £127 000, the same as last year. When all these deductions were made there was a balance available for dividend on the ordinary shares of £343 000, an increase of £216 000. An interim dividend of 1½ per cent. had been paid upon the ordinary shares in respect of the first half of the year, and it was now proposed that a further dividend of 1¾ per cent. should be paid, making 3¼ per cent. for the year. This left £40 000 to be carried forward, compared with £22 000 brought in.

Lanarkshire Tramways Company.

At the annual meeting of the Lanarkshire Tramways Company Mr. A. R. Monks (chairman of the company), who presided, stated that the traffic receipts for the year amounted to £226 260, against £228 272 in the previous year. It was anticipated in the early months of the year that there would be a very material increase, but the coal strike and general trade depression which followed had caused their receipts for several months past to be lower than at the corresponding period last year. There was also a small decrease in the sundry revenue, which made a net decrease in the gross revenue for the year of £2 096. They were, however, able to effect substantial reductions in operating expenses, which, at £182 510 for the year, showed a reduction of £9 457 on 1920. There was a reduction of £248 in the cost of electricity, and but for the coal stoppage costs would have been very much lower. Repairs and traffic showed a reduction of £13 883, due, firstly, to the fact that their repairs were not so extensive as in 1920; secondly, to the fall in the cost of materials; and thirdly, to reductions in wages to the staff owing to the continued fall in cost of living. General expenses were £4 770 in excess of the previous year, local rates showed an increase of £700, accidents and other insurances an increase of £3 800, and Insurance Act contributions an increase of £750. A decrease of £2 096 in the revenue and of £9 457 in operating expenses left an increase in gross profit of £7 361. Payments to local authorities and debenture interest were about the same figure as in the previous year. General interest charges at £2 698 showed an increase of £864 but interest charges in connection with the Lanark County Tramways, the purchase of which was completed last May, showed a reduction of £1 595. In the 1920 accounts there was also a debit of £1 809 for income tax, whereas there was no such charge for the past year. The company was therefore left with an increase of £9 909 in the net revenue, which enabled them to transfer £10 000 to reserve for depreciation as compared with £9 000 for 1920, and to pay a dividend of 6½ per cent. per annum for the past half-year, which made with the interim dividend for the first half-year a total distribution for the year of 5¾ per cent. as compared with 5 per cent. for 1920. After allowing for the additional remuneration to the directors there was a balance to carry forward of £2 183, as compared with £1 131 brought in. Track renewals during the year, amounting to £5 977, had been debited to depreciation reserve. Capital expenditure during the past year had been very small, and the reserve for depreciation stood at £186 140, representing 36 per cent. of the total capital expenditure.

City and South London Railway.

In the course of his speech at the annual meeting of the City and South London Railway Company last Thursday, Lord Ashfield, who presided, stated that the revision of fares instituted in September, 1920, had proved to be successful and justified, though owing to the coal strike and the continued and growing depression in trade the expected results were not secured. Conditions had not been favourable for making a start with the reconstruction of their line. The company had joined with the London Electric Railway Company in putting forward an application to the Government under the Trade Facilities Act for a grant of sufficient money to enable the reconstruction to be carried out and the line to be re-equipped with modern rolling stock and of larger size. During the year the traffic had declined by more than 9 300 000, which represented a drop of 23 per cent. These figures hardly represented the full extent of the decline, as if the comparison were taken back to the year 1919 the drop was still more. Looking to the future, he saw no reason why the position of the company should not improve. If the volume of traffic should once more show signs of expansion, there would be a speedy amelioration in its prospects. While the traffic was at the present time regrettably reduced, the working expenses showed signs of at least an equal reduction to the traffic earnings. Receipts from railway working after the operation of the Common Fund amounted to £446 999, an increase of £19 008 over 1920, expenditure was £301 441 (£20 470), leaving net receipts of £145 558 (£39 478). Miscellaneous receipts (net) from rents, interest, &c., amounted to £34 309 (£2 000), making a total net income of £179 867 (£41 478). To this sum was added the balance from last year (£18 820), making £198 687. After deducting interest, rentals and other fixed charges (£45 811), appropriation to reserve (£36 000), dividends on preference stocks (£42 500), the balance available for dividend on consolidated ordinary stock was £73 376, against £32 356 in 1920. The interim dividend paid in August last on the consolidated ordinary stock was 2 per cent. This absorbed £29 600, and left £43 776 available, out of which it was proposed to pay a final dividend for the year 1921 on the consolidated ordinary stock of 1¼ per cent., making 3½ per cent. for the year, leaving to be carried forward £25 276. The dividend on the consolidated ordinary stock for 1920 was 1½ per cent., with £18 820 carried forward. The sum of £36 000 had been placed to reserve, an increase of £11 000.

Metropolitan District Railway.

Lord Ashfield (the chairman) presided at the annual meeting of the Metropolitan District Railway last week. For the year ending Dec. 31 last, the receipts from railway working after the operation of the Common Fund amounted to £1 849 581, and expenditure was £1 351 208, leaving net receipts of £498 373, against £164 041 in 1920. Miscellaneous receipts (net) from rents, interest, &c., amounted to £164 180 (£41 323), making a total net income of £662 553 (£122 713). With balance (£20 537) from last year, the total was £683 090. After deducting interest, rentals and other fixed charges (£326 760), appropriation to reserve (£65 000), dividend on guaranteed and preference stocks (£198 430), a balance of £92 900 (£72 363) was available for dividend on ordinary stock. The interim dividend of 2½ per cent. on the second preference stock absorbed £36 750, leaving £129 650 available, out of which the directors recommended a final dividend of 2½ per cent., making the full 5 per cent. due for the year and leaving £92 900 available for distribution on the ordinary stock. The directors recommended payment of a dividend of 1 per cent. for the year on that stock, leaving £60 550 to be carried forward. The dividend paid on the

second preference stock for the year 1920 was 3 per cent., with £20 537 carried forward, no dividend being declared on the ordinary stock. Having regard to the increased cost of all plant and equipment used in railway working, the directors have carried £65 000 to reserve, an increase over 1920 of £20 000. The net capital expenditure for the year amounted to £772 892.

The Chairman said the Government had rejected a scheme submitted by the company last autumn which would provide employment for a large number of men and secure for London much-needed additional traffic facilities, but they had invited the company to make new proposals under the Trade Facilities Act, which they had already done. Briefly, the scheme put forward was to proceed at once with the construction of the Edgware and Hampstead section of the London Electric Railway, and of a junction line at Camden Town between the City and South London Railway and the Hampstead section of the London Electric Railway; the modernisation and re-equipment of the City and South London Railway to take rolling stock of larger dimensions; and with the construction of a connecting line at Wood-lane between the Central London Railway and the Richmond line of the London and South-Western Railway.

As was feared, the unsettled state of labour and the bad trade conditions adversely affected the revenue of the West Kent Company, which was mainly derived from industrial supplies. This fell off from £60 200 to £50 880, the net revenue being reduced from £13 579 to £10 853. The dividend had, however, been maintained at 10 per cent., and £5 000 had been placed to reserve, as compared with £8 000 for 1920; and £2 440 (£1 740) had been carried forward.

It was difficult to forecast results for the current year. There were indications of improvement, and the position up to the present had been well maintained. The units sold for the month of January showed an increase over last year, while there was a reduction in the amount of coal consumed, and the price was, on the average, lower.

Sunderland District Electric Tramways.

Presiding over the annual meeting of the Sunderland District Electric Tramways, Ltd., on Feb. 23, the chairman (Mr. H. R. Hogg) said the company had not been able to earn sufficient to pay anything to the preference or ordinary shareholders, and since the end of the financial year there had been a further disastrous falling off in the receipts. The gross and net losses averaged £327 and £181 per week respectively for the three months. Part of this might be attributable to the heavy snow, but the chief portion was due to the lack of funds in the district generally. If the company was to pay its expenses, it must reduce them all round, and unless labour costs conformed to the surrounding conditions, it was the lesser evil to shut down than to run the trams on their present basis. They had made the men the best offer circumstances allowed, but as the men had stopped work rather than accept them, there had been no alternative but to close the sheds.

The men had been told for some time that there must be reduced wages. A meeting of employers and employees of the tramway undertakings in the country had been held in London, as it had been urged that all wages should be the same in the industry. Their company had always protested against that, because there must be a great difference between large towns and outlying areas. The conference had agreed on a reduction of 3s. a week on the average, but their company had to go further, and ask for a bigger reduction. They were always ready to put the wages up when they could afford it, but they could not work at all at present except at a heavy loss.

Paisley District Tramways.

At the annual meeting of Paisley District Tramways Company last week, the chairman (Mr. O. H. Smith) said that the result of the year's trading was a profit on working of £34 737. After providing for general interest, income tax, interest and sinking fund on debentures, the usual appropriation to general reserve with interest together amounting to £12 139, and further providing the 5 per cent. dividend and sinking fund on the preference shares, the directors recommended a dividend of 4 per cent. on the ordinary shares, and increasing the amount carried forward from £6 546 to £8 033. The amount added to general reserve for the year was £12 139, to the sinking funds £5 754, and to the carry forward £1 487—in all £19 381. The total reserves held by the company at Dec. 31, 1921, amounted to £194 909. The capital expenditure during the year amounted to £1 721, bringing up the total cost of the undertaking to Dec. 31 to £431 309. During last year they had renewed the track, and done special work at Paisley Cross. A considerable amount was being spent on rolling stock. Since the Armistice repair work had been steadily progressing, and by another year they expected to have overtaken the arrears of this work, and the expenditure should then return to a more or less normal amount.

They had been for some time past in negotiation with the Corporation of Glasgow for the sale to them of the company's undertaking. Should Glasgow decide to offer a price that the company considered fair and reasonable, they hoped to complete an agreement for the sale.

Liverpool Overhead Railway.

The accounts of The Liverpool Overhead Railway Company for the year ended Dec. 31, 1921, show gross revenue receipts (including the amount receivable under the agreement with the Government in respect of the control of railways, for the period Jan. 1 to Aug. 15), to be £199 861, and the working expenses, including appropriation to reserve funds, £191 993, leaving £7 868; from this sum had to be deducted interest on debenture stock (£6 755), leaving £1 112, to which was added £6 818 10s., proportion of the amount receivable under Sec. 11 of the Railways Act, 1921, and £5 577, the balance brought forward from 1920, leaving £13 503 available for dividend. The first instalment of the Compensation payable, under the Railways Act, 1921, to this company amounted to £17 937, and the directors have found it necessary to appropriate £6 818 10s. of this sum to pay the dividend on the preference shares. The directors regret that they could not see their way to declare an interim dividend, but recommend the declaration of a dividend for the year ending Dec. 31, at the rate of 5 per cent. on the preference shares, payable on and after March 3, leaving a balance of £5 577 to be carried forward to next year. The total number of passengers carried during the year was 13 389 857 against 21 020 839 in 1920.

Electrical Distribution of Yorkshire.

The accounts of the Electrical Distribution of Yorkshire, Ltd., for 1921 show a net profit, after payment of interest, of £8 086 against £5 426 in 1920. The sum of £1 571 was brought forward, making a total of £9 655 19s. 7d. (£6 578 17s. 11d.). The directors recommend a dividend on the ordinary capital at the rate of 6 per cent. (tax free) for 1921 (of which 3 per cent. was paid in August), which will absorb £4 722. The sum of £2 000 has been added to the reserve fund (increasing this fund to £10 000), and £2 934 remains to be carried forward. The works have been fully maintained out of revenue. The demands in the districts served by the company for lighting, heating, and power continue to grow, and during the year substantial extensions of mains have been made to meet these demands. The Minister of Transport has made an order authorising the company to proceed with the supply of electricity in the districts of Selby, Stanley, Featherstone, Garforth, Horbury, Otley, Penistone and Rawdon, and the Order now awaits confirmation by Parliament. During the year applications have been received for 13 234 ordinary shares of £1 each, bringing up the issued share capital to £83 234. At extraordinary general meetings held on Feb. 22 and March 15 last year, a special resolution was passed and confirmed increasing the nominal capital of the company from £100 000 to £150 000.

Costa Rica Electric Light and Traction.

The accounts of the Costa Rica Electric Light & Traction Company for the year ended June 30, 1921, show the net earnings in Costa Rica, after charging all expenses incurred, to be £25 727, as compared with £24 519 in 1920. The net profit for the year of £3 709, against £12 691 8s., of last year, wipes out last year's deficit of £330 and leaves a surplus of £3 379, of which the directors propose to write off the balance of £745 standing to the debit of "discount and commission on debentures," and carry forward the remainder. The gold premium has averaged 214 per cent. (or C15·70 per £) during the year, as against 160 per cent. (C13·00 per £) last year, and 112 per cent. (or C10·60 per £, the normal equivalent of the gold "Colon") in the year (1913-14) before the war. At the last-mentioned rate the net profit in Costa Rica for the year under review, which amounts to C403 916·78 (an increase of C95 168 on that of year ending June, 1920) would have been £38 105, as against £25 727, the difference between the current and normal exchange representing a loss of £12 378. All buildings, machinery, plant, &c., have been kept in good working order. The first two deferred warrant issues, amounting, with interest accrued, to £5 417, were paid on March 1 and July 1 last respectively.

Tyneside Tramways & Tramroads.

At the annual meeting of the Tyneside Tramways & Tramroads Company, the Chairman (Dr. J. T. Merz) said that during the past six months, and during the whole of 1921 things had been very difficult. In the first three months of the year the takings had gone up: after that came the coal trade stoppage; and traffic receipts had gone down very considerably. They had, for the whole of the year, been 6 per cent. less than in 1920. The car miles run were about 7 per cent. less, but the passengers carried were 15 per cent. less. They had taken out of reserve for permanent way repairs and rolling stock over £6 000, but they had placed in reserve, out of the profits of the year, £2 700. He regretted that the ordinary dividend would be the smallest paid since 1912. As to the prospects of the company, he thought that, on the whole, there was a slight indication of improvement. They could not be certain that that improvement would continue, but if they went on as they were doing now, they should have a better year than last year.

Lancashire United Tramways.

The Lancashire United Tramways' report for 1921 shows a profit, less working expenses, cost of generating electrical energy sold, general charges (including direction, management, etc.), and rent of leased lines, of £28 217. Receipts show a decrease of £14 881, and expenditure an increase of £7 754. Interest and dividends from operating company, plus motor coach and sundry receipts, was £69 761. Deducting motor coach and other expenses and interest on prior lien debenture stock, there remains a balance out of which interest at 2½ per cent., less tax, will be paid on the second mortgage debenture stock for the year, leaving £1 126 for depreciation. The balance on the working of the operating company, after payment of interest and dividend, was £10 248. Depreciation and renewal account (after writing off £5 000 for depreciation on motor coaches and omnibuses) and amounts carried forward in combined companies now amount to £183 642.

Rushden and District Electric Supply Company.

In the annual report of the Rushden and District Electric Supply Company the directors state that, in spite of the depression in trade during the past year, the output of electricity has been practically the same as during the previous year. Lighting and heating connections have increased by the equivalent of 2 131 32-W lamps, making a total of 9 483. Motors have increased from 761 H.P. to 776½, of which 292 are let out on hire. The maximum load on the plant was 440 kW, and the number of units sold was 580 615. Distributing mains have been laid to the extent of 728 yards, making a total of 6 miles 600 yards. The sum of £2 000 has been added to the depreciation fund (out of which £100 has been allocated to motors), and the balance of the preliminary expenses (£500) has been written off. The directors propose a final dividend of 4½ per cent., making with the interim dividend of 3 per cent. already paid, 7½ per cent. for the year, compared with 6½ per cent. for the previous year. This will amount to £1 125, and there will remain £805 10s. to be carried forward.

London and South-Western Railway.

In the course of his remarks to the shareholders at the annual meeting of the London and South-Western Railway Company, last week, the Chairman, Brigadier-General H. W. Drummond, stated that although the alterations at Waterloo Station were now nearing completion, it was not improbable that in another ten years' time it might be necessary to make further extensions, as even now the station was barely equal to the enormous increase of traffic brought about by the electrification of the suburban lines. In regard to fares, the board would be only too willing to make reductions at the earliest opportunity. Referring to the congested state of the line between Clapham Junction and Waterloo and on the Waterloo and City Railway, he stated that it would be a matter of only a few weeks before the new rolling stock was placed on the line.

Llandudno & Colwyn Bay Electric Railway.

The profit for the year to Nov. 30, 1921, of the Llandudno & Colwyn Bay Electric Railway, after providing for operation and administration costs and for interest on debenture stock and loans, amounts to £6 194 10s., to which is added £2 548 brought forward from 1920, making a total available balance of £8 743. Out of this sum £2 040 has been appropriated for redemption of debenture stock, leaving £6 703, which the directors recommend should be applied as follows :—£2 500 to reserve for repairs and renewals, £2 783 in payment of a dividend of 4 per cent., less income tax, requiring £5 283, leaving to be carried forward £1 420. In accordance with the practice adopted for several years, the sinking fund instalment due on Jan. 1 has been charged against the revenue for the year, and no further provision has been made for depreciation of the system. The total of the fund now amounts to £18 793.

W. T. Henley's Telegraph Works.

The report and accounts of W. T. Henley's Telegraph Works Company, Ltd., for the year 1921 show a profit of £263 079, from which £38 339 has to be deducted for directors' and auditors' fees, debenture interest, and amount written off for depreciation on buildings, machinery, &c., leaving £224 740. To this sum has to be added the amount brought forward from 1920 (£183 538) and the reserve against Government loans and trustee securities written back £7 559 10s., making a total of £415 837. After deducting income tax (£26 214), transfer to reserve (£22 879), dividend on preference shares to Dec. 31, 1921 (£9 000), and interim dividend on ordinary shares (£32 500), there remains an available balance of £325 244. The directors recommend a final dividend on the ordinary shares of 2s. per share, less income tax, making 3s. for the year. This will require £65 000, leaving £260 244 to be carried forward to next year.

Northampton Electric Light & Power.

The Northampton Electric Light & Power Company's report for 1920 shows a net revenue, before paying debenture interest, of £38 142. A sum of £19 681 has been added to depreciation, out of which £1 681 has been allocated to motors, £7 000 to reserve and £2 000 to battery suspense fund. It has been decided to form an employees' benevolent fund, and £500 has been put aside for this. The directors propose a balance dividend on the ordinary shares at the rate of 5½ per cent., making, with the interim dividend 9 per cent. for the year, compared with 8 per cent. for the previous year. There will be £4 564 to be carried forward, against £1 500 brought in.

Toronto Railway.

The gross earnings of the Toronto Railway to Aug. 31 last, being the end of the franchise, were $5 130 431, and operating charges, maintenance, &c.; totalled $4 782 490, leaving $347 941. After providing for various charges, including bond interest ($113 625), war and provincial taxes ($38 890), percentage on earnings to city ($1 004 894), general taxes ($121 999), a deficit of $997 299 is carried forward. The report states that the proposed sale to the Hydro-Electric Commission of Ontario of power and radial railway interests of the company has been unanimously approved by the shareholders. An agreement may be completed within a few weeks, when it will require to be submitted to trustees for bondholders in London for ratification.

London & North-Western Railway Company.

At the annual meeting of the London & North-Western Railway Company, last week, the Chairman (the Hon. Charles Napier Lawrence) said that with regard to capital expenditure, they had spent during the year £1 703 000, of which £912 600 was in respect of steamers, £521 000 in connection with the electrification of the Euston to Watford line, and the balance for sundry works. He was glad to be able to say that, for some time past, the company's financial position had been appreciably improving, and it had never stood higher than it stood at the present moment.

The National Boiler & General Insurance Company has declared a dividend of 20s. per share.

Consolidated Gas, Electric Light & Power Company of Baltimore announce the regular quarterly dividend of $2 per share on the preferred and common stock.

The issue last week by the Yorkshire Electric Power Company of £558 360 in 111 672 six per cent. cumulative preference shares of £5 each, fully paid, at £4 per share, was immediately oversubscribed.

The Chelsea Electric Supply Company announce a dividend at the rate of 7 per cent. per annum for the half year, making 6 per cent. for the year ended Dec. 31 last. The sum of £415 is carried forward.

Belfast Corporation are this week issuing £1 000 000 5½ per cent. redeemable stock at 96. This loan is to provide the capital expenditure necessary to complete the new electricity station, the first portion of the reconstruction of the tramways track, &c.

Vickers, Ltd. have declared final dividends for the half-year ended Dec. 31 of 2½ per cent. on the preferred 5 per cent. stock (less tax); 2½ per cent. on the 5 per cent. preference shares (less tax); and 2½ per cent. on the cumulative preference shares (free of tax).

The Metropolitan Electric Supply Company recommend a final dividend of 5s. per share, which, with the interim dividend of 2s. already paid, makes a total of 7s. per share, or 7 per cent., for the year 1921. The amount set aside for depreciation and reserve is £94 892 and the carry forward £3 609.

After appropriating to depreciation and reserve accounts sums amounting to £15 100, the directors of the Brompton and Kensington Electricity Supply Company propose to pay a final dividend on the ordinary shares at the rate of 15 per cent. per annum, making 12 per cent. for the year, less tax, carrying forward £3 732.

Traction & Power Securities Company recommend a final dividend for 1921 at the rate of 4s. 6d. per share, free of tax, making 8s. per share, free of tax. The net revenue was £35 578 plus £12 722 brought forward, making £48 300. The sum of £14 136, subject to corporation tax, is carried forward.

The annual meeting of the Lanarkshire & Ayrshire Railway Company was held in Glasgow last week, Mr. H. E. Gordon, chairman, presiding. The report for the year ending Dec. 31 last was adopted, and it was decided to pay a dividend of 2 per cent. for the year, inclusive of the interim dividend paid in September last.

The report of Notting Hill Electric Lighting Company for 1921 shows available profit of £41 866, less depreciation, renewal and reserve fund £3 000, special reserve £3 000, income tax £6 469, and excess profits duty £1 118. A dividend is recommended on the ordinary shares at the rate of 8s. per share, free of tax, leaving £3 920 to be carried forward.

The traffic receipts of the London United Tramways for 1921 totalled £575 837. Adding advertising and sundry receipts, the gross revenue was £584 030, an increase over 1920 of £51 238. Working expenses were £473 573, a decrease of £9 024. The balance on working was £110 456, an increase of £60 312. After charging debenture stock and loan interest, there is a surplus of £59 474 as reduction of deficiency of £70 882 brought forward.

The net revenue of the Oxford Electric Company for 1921, including £108 brought forward, was £15 466 (against £11 779 in 1920, when £186 was brought forward). After providing debenture interest, &c., the balance available is £11 357. It is proposed to pay a dividend for the year on the ordinary shares of 5 per cent. (of which 2½ per cent. has been distributed), to place £3 588 (against £457) to reserve and renewal of plant, and to carry forward £20.

Addressing the shareholders at the annual meeting of the North London Railway Company, last week, the Chairman, the Hon. A. H. Holland-Hibbert, said that they had a valuable concern; the line was in a thoroughly efficient state, electrification had tempted back many of their lost passengers, and they had been building up their reserves until to-day they were on a decidedly satisfactory financial basis.

The 1921 revenue of the Mersey Railway Company available for payment of interest amounts to £53 890, and is sufficient to meet the full interest on the various classes of debenture stock, with a balance of £207 carried forward. The total passengers carried, exclusive of season ticket holders, was 11 046 955, against 12 637 352 in 1920. There has been no dividend on the preference or ordinary stock for many years, but the position has been greatly improved by the introduction of electric traction.

The report of the British Mannesmann Tube Company for year ended June 30, 1921, states that the amount of the twentieth drawing of first mortgage debentures was £4 000. Profit, including excess profits duty adjustment, after deducting works charges and depreciation, was £101 948, plus interest and dividends, royalties, rents, &c., £10 537, and the balance brought in, £76 318, less general administration expenses, £49 656, making £139 147. The directors recommend a dividend of 4 per cent., free of income-tax, carrying forward £55 914.

New Companies.

A. P. T. Ltd.

A. P. T. Ltd. (179 633). Private company. Registered Feb. 11. Capital, £3 000 in £1 shares (750 "A" and 2 250 "B"). To adopt an agreement with A. F. de Fraine, S. J. Clark and G. A. L. Sartoris, trading as "de Fraine & Clark," of 23, Old Queen-street, Westminster, to acquire all or any of the inventions and patents referred to therein in respect of the variable hydraulic transmission system and improvements in the said inventions, and to carry on the business of mechanical, general and electrical engineers, &c. Subscribers (each with one share): C. A. Browning and C. T. Twort. Registered office: 5, Fenchurch-street, E.C.

Auto-Electrical Services, Ltd.

Auto-Electrical Services, Ltd. (179 760). Private company. Registered Feb. 17. Capital, £2 500 in £1 shares. To take over an agreement made between C. A. Vandervell and Co., and R. V. Steward to acquire a process of manufacturing dry batteries, and to carry on business as manufacturers, sellers or agents for the sale of dry batteries and accumulators, manufacturers of electrical appliances, etc. Permanent directors: N. F. Steward, and R. V. Steward, with power to appoint other directors. Secretary, C. Brassington. Registered office: 14, Lichfield-street, Wolverhampton.

Brasse, Ltd.

Brasse, Ltd. (179 842). Private company. Registered Feb. 21. Capital, £10 000 in £1 shares. To acquire the business carried on by E. P. Brasse, and to carry on business as electrical cable and surgical instrument manufacturers, electrical engineers, metal workers, &c. First directors: E. P. Brasse and E. W. Brasse. Qualification (except original directors), 100 shares. Registered office: Calvert Works, South Tottenham, N.

Foundation Company, Ltd.

Foundation Company, Ltd. (179 870). Private company. Nominal capital, £250 000 in £1 shares (150 000 8 per cent. cumulative preference and 100 000 ordinary). To acquire (upon the terms of an agreement with the Foundation Company, of New York) the goodwill and rights referred to therein; to acquire, build, work, or control in any part of the world railways, tramways, hydraulic, electric, engineering and improvement works, and to carry on the business of electrical, mechanical, hydraulic and general engineers and contractors, &c. Subscribers (each with one share):—F. D. Billett and W. J. Hill. Registered office: Windsor House, Kingsway, W.C.

Kay Models, Ltd.

Kay Models, Ltd. (179 774). Private company. Registered Feb. 17. Capital, £5 000 in £1 shares (3 000 preference and 2 000 ordinary). Mechanical, electrical, agricultural, constructional and modelling engineers, etc. Permanent directors: A. Goodlett, J. K. Goodlett, A. K. Goodlett, and H. H. Bowyer. Qualification, £50. Registered office: 65, Park-road North, Acton, W. 3.

Kaye & Company (Huddersfield), Ltd.

Kaye & Company (Huddersfield), Ltd. (179 644). Private company. Registered Feb. 11. Capital, £10 000 in £1 shares. To take over the business of ironfounders carried on by J. Firth and J. E. Lunn, as "Kaye & Company," at Crosland Moor, Huddersfield, and elsewhere, and to carry on the business of ironfounders, mechanical and electrical engineers, &c. First directors: J. Firth, J. E. Lunn, R. Carrick, and H. Cotton (all permanent, subject to each holding 500 ordinary shares). Solicitors: Hall, Walker & Norton, Huddersfield.

H. S. Kemp & Company, Ltd.

H. S. Kemp & Company, Ltd. (179 718). Private company. Registered Feb. 15. Capital, £1 200 in £1 shares. Electrical engineers, manufacturers of electric lamps and fittings, &c. First directors: W. F. Bond (or such other person as shall be nominated by Belco, Ltd., of Windsor House, Kingsway, W.C.); E. A. Boxall, H. S. Kemp, and A. E. Cage. Registered office: 25, Stephen-street, Tottenham Court-road, W.C.1.

Metallisation, Ltd.

Metallisation, Ltd. (179 721). Private company. Registered Feb. 15. Capital, £75 000 in £1 shares. To acquire any inventions relating to the coating of surfaces with metal, and/or applying deposits of metal or metallic compounds to surfaces; and to adopt agreements (1) with W. J. Thompson and (2) and (3) with E. T. White. Subscribers: C. Tilt, Wembley Dene; C. P. N. Raikes. First directors: W. J. Thompson (chairman), E. T. White (managing director), and G. Dennison. Solicitors: Francis & Johnson, 19, Great Winchester-street, E.C.

James Moores & Co. (Sundries) Ltd.

James Moores & Co. (Sundries) Ltd. (179 790). Private company. Registered Feb. 18. Capital £5 000 in £1 shares. To acquire the business carried on by J. Moores at 14 Ridgefield, John Dalton-street, Manchester, as "James Moores & Company," and to carry on the business of manufacturers of, dealers in, and/or agents for electric lamps, accessories, cables, wires, flexibles and glassware for electrical, gas, lighting and other purposes, engineering sundries, &c. First directors: J. Moores, Dr. R. H. King, J. Higginbotham and P. Moores. Registered office: 14, Ridgefield, John Dalton-street, Manchester.

National Signs, Ltd.

National Signs, Ltd. (179 824). Private company. Registered Feb. 20. Capital, £42 000 in £1 shares. To acquire the business of National Signs, Ltd. (in liquidation), to adopt an agreement with the said old company and W. H. Worrall (their liquidator), and to carry on the business of electrical and illuminated sign manufacturers, glass process workers, manufacturers of and dealers in advertising and other signs and novelties, &c. Subscribers (each with one share): W. H. Worrall, H. H. Scott (chairman) and G. M. Scott. Registered office: Factory-lane, High-road, Tottenham, N.

Pace Engines, Ltd.

Pace Engines, Ltd. (179 792). Private company. Registered Feb. 18. Capital, £10 000 in £1 shares. To adopt an agreement with T Andrews and to carry on the business of engineers, electricians, makers of internal combustion and other engines, &c. First directors: T. Andrews and H. Singleton. Registered office: 20, Buckingham-street, Strand, W.C. 2.

Reynard Electrical Company, Ltd.

Reynard Electrical Company, Ltd. (179 910). Private company. Registered Feb. 23. Capital, £500 in £1 shares. Manufacturers, importers, and exporters of, agents for, and dealers in, lamps, brackets, shades, connections, switches, ceiling roses, plugs, cable conduit motors and all electrical apparatus and accessories. First directors: J. Cowan (chairman) and W. J. R. Fox. Registered office: Dickinson-street, Manchester.

Sheepbridge Stokes Centrifugal Castings Company, Ltd.

Sheepbridge Stokes Centrifugal Castings Company, Ltd. Private company. Nominal capital, £50 000 in £1 shares (7 500 "A" and 42 500 ordinary). Manufacturers of and dealers in machinery, castings, motors, tools and hardware, iron and steel converters, mechanical and electrical engineers, &c., and to adopt an agreement with the Stokes Castings, Ltd. First directors: W. B. M. Jackson (chairman), J. T. Goodwin, and F. W. Stokes (nominee of Stokes Castings, Ltd.). Secretary: T. E. Haslam. Registered office: The works of the Sheepbridge Coal & Iron Company, Ltd., Chesterfield, Derbyshire. File number is 179 750.

The Electrical Trades' Directory.

The fortieth edition of "The Electrician" Electrical Trades' Directory and Handbook, the well-known Blue Book, is now available. The new issue, which has undergone careful revision, has grown in size by about fifty pages; about 1 000 more firms and names have been included in the Alphabetical Section, and corresponding additions have been made to the Classified Trades portion. In the alphabetical section will be found the name, trade or professional description and address of practically everyone engaged in or connected with the important and rapidly expanding Electrical and Allied Trades, while under the headings in the Classified Trades there are very full and representative lists of persons and firms engaged in the manufacture, supply or erection of electrical plant and apparatus. The Colonial and Foreign sections have also undergone similar expansion and revision.

The Handbook Section contains much valuable technical, commercial and legal information relating to the electrical industry, but space will only permit of the enumeration of some of the more important features. There are a number of electro-technical tables and data, particulars of resistance materials, electric supply cables, wire gauges, aluminium data, illumination notes, &c. Particulars are also given of the work of the British Engineering Standards Association and of the International Electrical Commission, the Imperial ohm, ampere and volt, the Standardisation Rules of the British Electrical and Allied Trades Association, details of the import duties leviable on electrical machinery in the British Dominions and Colonies and in foreign countries, &c.

The Telegraph and Telephones Section contains the International Telegraph Convention, particulars of the work of the International Telegraph Bureau, the International Service Regulations, statistics of the submarine cables and landlines of the world, telegraph tariffs, the world's cable-laying fleet, the International Radio-Telegraph Convention, British Wireless Telegraph Regulations, International Call Signals, technical details of Anglo-Continental telephone cables, and a digest of the law relating to telegraphs and telephones.

Particulars are included of the constitution and officers of all British, Colonial, and Foreign Engineering, Scientific and Industrial Societies, the names of the professors and teachers of engineering and scientific subjects in universities, university colleges and technical schools, the chief officials of the engineering and technical sections of the British, Colonial and Foreign Government Departments, the Rules of the Institution of Electrical Engineers relating to electric wiring and the electrical equipment of ships, &c.

A special feature of the Handbook Section of the Directory is the full Digest of the Law of Electricity Supply and Electric Traction, and the present issue includes all the latest Regulations, Orders and requirements of the Electricity Commissioners and of the Ministry of Transport relating to electric supply powers and the operation of electric tramways. The Regulations as to the use of electricity in Mines and Factories are also given.

The Directory and Handbook has now reached its fortieth year, and with each succeeding issue its utility, influence and circulation have grown. For many years the Blue Book has been the recognised work of reference for the whole of the electrical industry, and it is felt that the improvements effected in the present edition will ensure for it an even warmer welcome than that accorded to previous issues, and that it will continue to be indispensable to the supply engineer, to the consulting, contracting and manufacturing electrical engineer, as well as to suppliers of and dealers in electrical plant and apparatus. It is published at 25s. net by Messrs. Benn Brothers, Ltd., 6 and 8, Bouverie-street, Fleet-street, London, E.C.4.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Bankruptcy Information.

LIDDELL, Robert Henry, under the style of LIDDELL & McINNES, at 4, The Crescent, Carlisle, electrical engineer. Receiving order, Feb. 21. Debtor's petition.

WILLIAMS, Aneurin Tudor, and BEVAN, William John, trading as THE ELECTRICAL & GENERAL ENGINEERING COMPANY, at 49, Commercial-street, Aberdare, electrical engineers. Receiving order, Feb. 21. Creditor's petition.

Notice of Intended Dividend.

BENNETT, William, Back Sitwell-street, Derby, electrical contractor. Last day for receiving proofs, March 17. Trustee, E. W. Humphreys, 4, Castle-place, Nottingham.

Company Winding-up Voluntarily.

WAKELINS, LTD. P. J. Goodchild, 16, Tokenhouse-yard, Lothbury, London, E.C. 2, appointed liquidator. Meeting of creditors at 7, Tottenham-street, Tottenham Court-road, London, W. 1, on Wednesday, March 8, at 12 noon.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

BRADBEER, John Edward, 2c, England's-lane, Belsize Park, electrical engineer, and BARRETT, Edward, 97, Malden-road, Kentish Town, furniture dealer. £20 16s. 1d. Dec. 8.

BRADBEER, Mr. W., 2A, England's-lane, Hampstead, electrical engineer. £11 10s. 10d. Dec. 22.

CALDWELL, WILLIAM, & SONS, Victoria-road, Hale, electrical engineers. £11 13s. 1d. Dec. 21.

CLYNE & DEAKIN, 84, Tilton-road, Small Heath, electrical manufacturers. £22 10s. 5d., Dec. 7; and £22 6s. 9d., Dec. 5.

ELECTRO MOTOR REPAIR & MAINTENANCE COMPANY, 252, Hackney-road, E. 2., electricians. £14 0s. 1d. Dec. 7.

FORSTER, George, 33, Barkley-road, Beeston, Leeds, and PRINCE, George Edward, 34, Balkan-grove, York-road, Leeds, electricians (late trading as FORSTER & PRINCE). £13 6s. 2d. Dec. 22.

GIBBONS, A. R., 8, The Parade, New Eltham, S.E. 9, electrical engineer, &c. £31 2s. 6d. and £20 15s. 8d. Dec. 19.

HARRIS, Sydney Henry (trading as MANCHESTER MAGNETO REPAIRING COMPANY), 191, Chapel-street, Salford, electrical engineer. £108 3s. 11d. Dec. 20.

LONDON ELECTRICAL ENGINEERING COMPANY, 2, Finsbury-avenue, E.C. 2. £66 15s. 8d., Dec. 16; and £33 17s. 4d., Dec. 5.

MACAULEY, Mr. R. A., 48, Ashton New-road, Beswick, Manchester, electrical contractor. £27 15s. 11d. Dec. 21.

MORETON & LUSH, 10, Tower-chambers, Church-street, Cardiff, electrical engineers. £21 12s. 8d. Dec. 8.

TUFFNELL, MONTAGUE H., & COMPANY, Brighton Railway Chambers, Clapham Junction, S.W., electrical manufacturers. £21 15s. 9d. Dec. 21.

Bankruptcy Proceedings.

BENNETT, Charles Godolphin, engineer and agent, 66, Mark-lane, London, E.C. The public examination of this debtor was held at the London Bankruptcy Court last week, when a statement of his affairs was submitted, showing liabilities £2 133 and an estimated deficiency of £1 174. The debtor stated that in March, 1916, he was approached by another person with a view to his taking an interest in an electrical business, the particular line being the manufacture of electric switch holders. He provided £2 000, which was used in experimenting and in part payment of fifty gross of switch holders which he ordered to be manufactured. In order to complete payment for them he approached his brother, who had previously financed him, but owing to losses incurred in Russia he was unable to help him. The orders for the switch holders were placed by him (debtor) personally, and there was now owing £620 to various firms who supplied them. The Official Receiver: Why should you become interested in this venture? You are not an electrical engineer. The debtor: No; but I know more about it than a good many electrical engineers. (Laughter.) The debtor added that his creditors had accepted his offer of a composition of 7s. 6d. in the £. The examination was concluded.

SCOTT, Thomas, and CAMPBELL, James (trading as T. SCOTT & COMPANY), 42, Handyside's-arcade, Percy-street, Newcastle-on-Tyne, wholesale electrical suppliers. The first meeting of creditors of the above was held last week at Newcastle-on-Tyne. Debtors commenced business in March, 1920, Campbell managing the business, while Scott, who was in a situation, assisted with the book-keeping. The statement of affairs showed liabilities of £1 179, assets were estimated to realise £402, or a deficiency of £777. In August last a writ for £66 was served on debtor and paid; in December executions for £73. £20, and £10 were levied and paid. A further execution levied on Jan. 27 last was the immediate cause of failure. The creditors decided to appoint Mr. Wm. Brittain, of 15, Pilgrim-street, Newcastle-on-Tyne, as trustee, with a committee of inspection. At the public examination, also held last week, debtor Campbell said he was in the army between September, 1914, and June, 1919, when he returned to his situation as an electrical engineer until March, 1920. He was then joined by Scott, and they traded at their present address as wholesale electrical suppliers. They had £100 capital, and borrowed £160 from friends, of which £10 had been repaid. They became aware of their position about July, 1921, but continued trading in the hope that business would improve. Proper books of account had been kept. The examination was adjourned to be closed. The following are creditors: B.T.T. Electric Lamp Company, London, £55; Campbell, J. W., Gateshead, £50; City Electric Company, London, £192; Fullers United Electric Works, Ltd., Chadwell Heath, £39; Foster Engineering Company, Wimbledon, £28; General Electric Company, Newcastle-on-Tyne, £49; Gledson, J., & Company, Newcastle-on-Tyne, £255; Jeary Electric Company, Ltd., London, £16; Lee, A., & Company, Newcastle-on-Tyne, £24; North of England Engineering and Electrical Manufacturing Company, Newcastle-on-Tyne, £13; Metropolitan-Vickers Electric Company, Ltd., Manchester, £24; Stella Lamp Company, Ltd., London, £38.

SLAUGHTER, Mihill Loraine, 91, Victoria-street, S.W. This debtor attended at the London Bankruptcy Court last week for public examination, on a statement of affairs showing gross liabilities £12 683 (unsecured £10 893) and assets valued at £2 210. The debtor said that in March, 1920, a company was registered as M. L. Slaughter & Company, Ltd., to acquire and carry on certain agencies belonging to him. In August, 1921, the company bought from the Astral Intensifier, Ltd., the exclusive British rights for five years relating to the manufacture of an intensifier or reflector for electric lamps, of which the Astral Company held the patents. His company agreed to manufacture and sell 250 000 intensifiers per annum and to pay a royalty of fourpence on each one to the Astral Company. Later on his company appointed Overseas Contracts, Ltd., to be their selling agents for the whole of Great Britain, provided that they sold 300 000 intensifiers per annum. The retail price was fixed at 3s., and they manufactured the intensifier at 1s., out of which they had to pay the royalty, and sold it to the Overseas Contracts, Ltd., for 2s. If this contract had been carried through, the company's profit would have reached £10 000 a year, but the Overseas Contracts, Ltd., failed to complete it, and went into voluntary liquidation in April last. Owing to that failure his company also went into liquidation, and that in turn brought him down, as he had incurred heavy liabilities on behalf of the company. The examination was ordered to be concluded.

Private Meeting.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

GOODALL ELECTRIC, LTD. (in voluntary liquidation), convened by notice. At the statutory meeting of creditors held recently at Liverpool, the voluntary liquidation was confirmed, with Mr. A. G. Turner as liquidator. The company was formed in 1920 to take over the Standard Electric Company, under which style T. J. Stapley, W. J. Mills and T. G. Jones traded from an address in South Castle-street, Liverpool. This firm being in difficulties over a country house contract towards the end of 1919 asked S. Chetter & Son to complete the contract on their behalf, and so became indebted to the latter firm to the extent of £123. The Standard Electric Company prevailed upon S. Chetter & Son to purchase necessary plant, tools and raw materials, which were intended to be taken by the Goodall Electric, Ltd., for producing "splitters" of various numbers of ways, invented by Mr. Stapley, Chetters to be reimbursed out of sales and profits. Premises were acquired, and when the first case of "splitters" were completed the company submitted samples to the Electric Brasswares, Ltd., who concluded an agreement whereby they were to take up the output of the Goodall Electric, Ltd. The failure of the Goodall Electric Ltd., is solely attributed to the repudiation of the contract on the part of Brasswares, Ltd. Mr. Chetter made an offer to various creditors of a composition of 2s. 6d. in the £ on the amount of their debt. Two firms refused to accept the offer made to them and one commenced proceedings. The liquidator's statement of affairs shows liabilities £1 116 and assets estimated to realise £101.

Tenders Invited and Accepted.

UNITED KINGDOM.

GREAT NORTHERN COMPANY (IRELAND). March 8.—Six months' supply of (14) electrical fittings, lamps, &c.; (15) electric cable and wire. Particulars from the Secretary, J. B. Stephens, Amiens-street Station, Dublin.

NUNEATON CO-OPERATIVE SOCIETY. March 8.—Electric lighting of Stockingford and Whittleford branches. Specifications from the General Manager, Abbey-street, Nuneaton.

RATHMINES AND RATHGAR URBAN COUNCIL. March 11.—Electric lamps, meters, oils, engine-room stores, &c., for the Electricity Department.

EDINBURGH CORPORATION. March 14.—Manufacture and supply of 130 tons of steel tramway rails. Specification, &c., from the Tramways Manager, 2, St. James-square, Edinburgh.

SHOREDITCH GUARDIANS. March 15.—Six months' supply of electrical goods. Particulars from the Clerk, Mr. J. C. Clay, Clerk's Office, 213, Kingsland-road, E. 2

BLACKPOOL ELECTRICITY COMMITTEE. March 16.—One natural draught-cooling tower for a duty of 300 000 gallons per hour. Particulars from the Borough Electrical Engineer and Tramways General Manager, Mr. C. Furness.

CARDIFF CORPORATION. March 17.—40 000 lb. water-tube boiler, with mechanical stokers and accessories. Particulars from the Electrical Engineer, Central Offices, The Hayes, Cardiff.

RHONDDA URBAN COUNCIL. April 3.—House-service a.c. meters, cable, joint boxes, cut-outs, &c., for one year. Specification, &c., from the Engineer, Electricity Works, Porth, Glam.

LEEDS.—H.M. COMMISSIONERS OF WORKS. April 12.—Electrical engineering labour-in-daywork in the Leeds district. Particulars from the Contracts Branch, H.M. Office of Works, King Charles-street, London, S.W. 1.

CANADA.

CANADIAN FIRM. IMMEDIATELY.—*Hoist, electrically operated and arranged, to be driven by a 200 H.P., three-phase, 550 V, 485 revs. per min. induction motor, which will be supplied by the company. The drive from the motor will be through a Francke flexible coupling and Wuest-type herringbone gears.

AUSTRALIA.

POSTMASTER-GENERAL'S DEPARTMENT, BRISBANE. April 19.—* Supply and delivery of testing and telegraph instruments, including d.c. ammeters, a.c. bridge condenser coil, condensers, cross-talk meters, detectors, milliammeters, polarised relays, and artificial telephone cable boxes. (Stores Schedule No. 549.)

EAST HAM Corporation have accepted the tenders of Bruce, Peebles & Company for a motor converter, £5 749, and A. Reyrolle & Company, for switchgear, £1 627 10s., plus £116 for additional items if required.

SHOREDITCH (London) Council have accepted the tender of the Stirling Boiler Company for a water-tube boiler of 33 000 lbs. evaporative capacity. Six offers were received, ranging from £10 180 to £14 463.

HULL Corporation Tramways Committee have accepted the tender of Messrs. Scott, of Leeds, for 1 000 tons of steel rails at £12 per ton, plus 12s. 6d. for special treatment. The lowest German tender was £11 15s., with £1 per ton for special treatment.

LONDON County Council have accepted the tender of Clayton and Shuttleworth (lowest tender) for three water-tube boilers, superheaters and economisers, with multiple retort stokers, at £61 392. Seven tenders were received, including stokers, the highest being £84 664, and one tender, exclusive of stokers, was £65 345. Five tenders for stokers and fans only varied from £9 755 to £12 490.

LONDON County Council have also accepted the tender of Walter Scott, Ltd., for 2 600 tons of track rails and fastenings at £28 667, or 4 700 tons, £50 307 5s., subject to negotiations with the company as to the quantity of rails required. The accepted tender was the lowest of those from British manufacturers, the highest being £36 354 14s. and £67 108 9s., for 2 600 and 4 700 tons respectively. The three lowest tenders varying from £26 972 16s. to £28 002 5s. for 2 600 tons and from £48 175 7s. 6d. to £50 065 12s. for 4 700 tons were for rails made on the Continent.

In connection with the big contracts recently obtained by Spencer & Company and Henry Simon, Ltd., for the ERECTION OF ELEVATORS in DURBAN, CAPE TOWN, and elsewhere in South Africa, a number of sub-contracts have already been allocated. The order for oil engines goes to Ruston & Hornsby, for electric motors to the English Electric Company, electric lifts to A. & P. Steven, hopper scales to W. & T. Avery, hydraulic machinery to Fielding & Platt, conveyor and elevator belting to Leyland & Birmingham Rubber Company, capstans to the New Switchgear Construction Company, and driving chains to Hans Renold. The Messrs. Ruston & Hornsby contract is for thirty-eight heavy oil engines (of about 2 500 B.H.P. aggregate) for the South African Railways and Harbours Department, for driving grain elevator machinery and for electric lighting purposes in different parts of the country. The order, which is understood to be for approximately 2 500 B.H.P., was secured after very severe competition.

* *Particulars from the Department of Overseas Trade.*

Arrangements for the Week.

FRIDAY, March 3rd (to-day).

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Lecturette on "Factory Administration," by Mr. E. T. Elbourne.

MONDAY, March 6th.

SOCIETY OF ENGINEERS.

5.30 p.m. At the Geological Society, Burlington House, London, W. Paper on "The Testing of Small Electrical Plant," by Dr. C. V. Drysdale.

INSTITUTION OF ELECTRICAL ENGINEERS.

WESTERN CENTRE.

6.30 p.m. At the Merchant Venturers' Technical College, Bristol. Paper on "Induction Type Synchronous Motors," by Mr. L. H. A. Carr.

INFORMAL MEETING.

7 p.m. At Savoy-place, London W.C. Discussion on "E.H.T. Cable Testing," opened by Mr. E. Ambrose.

ROYAL SOCIETY OF ARTS.

8 p.m. At John-street, London, W.C. Cantor Lecture on "The Mechanical Design of Scientific Instruments," by Prof A. F. C. Pollard. (Lecture III.)

TUESDAY, March 7th.

INSTITUTION OF CIVIL ENGINEERS.

6 p.m. At Great George-street, London, S.W. Paper on "The Improvement of the Port of Valparaiso," by Messrs. A. C. Walsh and W. F. Stanton.

INSTITUTION OF ELECTRICAL ENGINEERS.

EAST MIDLAND SUB-CENTRE.

7 p.m. At the Technical College, Derby. Paper on "The X-Ray Examination of Materials," by Mr. J. F. Driver.

SOUTH MIDLAND STUDENTS' SECTION.

7.30 p.m. At the University, Edgbaston. Paper on "The Measurement of Flux Density in the Air Path of a Magnetic Circuit," by Mr. W. P. Conly, B.Sc.

ROENTGEN SOCIETY

8.15 p.m. At Institution of Electrical Engineers, Savoy-place, London, W.C. Papers on "Comparisons Between the Therapeutic, Photographic and Ionisation Effects of Ultra-Violet and of Beta Radiation," by Messrs. L. H. Clark and B. D. Watters, and "Apparatus for Deep X-Ray Therapy." Mr. E. E. Burnside.

WEDNESDAY, March 8th.

INDUSTRIAL LEAGUE AND COUNCIL.

7.30 p.m. At Caxton Hall, London, S.W. Lecture on "The Personal Factor in Industry," by Miss B. Voysey.

ASSOCIATION OF ENGINEERS *in* CHARGE.

7.30 p.m. At St. Bride's Institute, Bride-lane, London, E.C. Paper on "Thermal Efficiency of Small Power Stations and Methods of Comparison," by Mr. A. H. Seabrook.

ROYAL SOCIETY OF ARTS.

8 p.m. At John-street, London, W.C Paper on "The Proper Functions of Trade Unions," by Mr. W. A. Appleton, C.B.E.

THURSDAY, March 9th.

NATIONAL LIBERAL CLUB. POLITICAL AND ECONOMIC CIRCLE.

8 p.m. At Whitehall Place, London, S.W. Lecture on "The Interests of Consumers," by Mr. J. A. Hobson.

FRIDAY, March 10th.

JUNIOR INSTITUTION OF ENGINEERS.

NORTH-EASTERN SECTION.

7 p.m. At Armstrong College, Newcastle. Special meeting. Paper on "Some Impressions of America, with Special Reference to Engineering Practice," by Dr. J. R. Beard.

INSTITUTION OF ELECTRICAL ENGINEERS.

NORTH-WESTERN CENTRE.

7 p.m. At the College of Technology, Manchester. Exhibition of Cinematograph Films, by Dr. C. C. Garrard and Mr. F. Gill, O.B.E.

SCOTTISH CENTRE. STUDENTS' SECTION.

7.30 p.m. At the Royal Technical College, Glasgow. Annual General Meeting and Paper on "Electricity in Mines," by Mr. J. C. Stewart.

IRISH CENTRE.

8 p.m. At the Royal College of Science, Upper Merrion-street, Dublin. Paper on "Wireless Communications in the Campaign in France," by Prof. R. Stanley.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Paper on "Friction," by Mr. C. H. Plant.

ROYAL INSTITUTION.

9 p.m. At Albemarle-street, London, W. Discourse on "Problems in the Variability of Spectra," by Prof. T. R. Merton, F.R.S.

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CONTENTS.

Notes of the Week.

The Electrical Industry and Exhibitions.

In our last issue we gave some reasons why the electrical industry should be represented, not only at exhibitions which are primarily arranged to foster British trade, but at those which are at once of a wider and more limited appeal, in that they attract the general public and allow comparisons to be made between electrical and other methods of doing the same thing. On both these counts the British Industries Fair at Birmingham, which closes to-day, and the Ideal Home Exhibition at Olympia, which remains open until March 25th, may be written down as successes. At each there is an adequate and generally good display of electrical equipment, and at each there is not wanting opportunity of showing that on the scores of attractiveness, reliability and convenience, electrical methods undoubtedly lead. The design of the equipment has been improved and the quality of manufacture is excellent.

Still Room for Improvement.

But the end is not yet. There is room for improvement. For there still persists the idea that the display and sale of the products of individual firms is better than a thoroughly comprehensive exhibit organised by the electrical industry as a whole. We admit that this idea is not wholly wrong. Competition is the soul of business, and the sight of a rival on a neighbouring stand interviewing visitors and booking orders is like a tonic to one's own efforts. But against this must be set the undoubted fact that, especially at a show like the Ideal Home Exhibition, an embarrassment of choice is a disadvantage. The public, eager but uneducated, when shown such a variety of ways of doing the same thing, is first puzzled and then suspicious. The result is that neither individual firms nor the industry profit as they ought. This failure is assisted by the too lavish equipment of the stands. A natural failing, but a failing nevertheless! The result is that even the electrical engineer, who has sufficient knowledge to pick and choose, becomes bewildered. What we should like to see at the next of these exhibitions is a centrally situated electrical stand distinguished by the slogan, if no one can think of a better one, "Electricity in the Home." Perhaps Mr. Beauchamp will arrange.

A Glaring Evil.

But whether this proposal is adopted or not, there is one weakness which should be improved without delay. The cry now is for a "Brighter London." If some of the methods of illumination (!) adopted at the Ideal Home Exhibition continue to be used brightness will be superfluous; for we shall all be blind. The fault is not, we are sorry to say, confined to the non-electrical stands; and, as we indicate in the criticisms which we publish on another page of this issue, something must be done to alter this. It is not inappropriate, therefore, that the subject of debate at the last Salesmanship Conference was "Salesmanship in Relation to Electric Lighting." The debate was opened by Mr. Haydn Harrison, who made the important point for our purpose that "to ensure that electric light produced a bright and pleasant result, it was necessary to do something more than fix a few electric lamps." The endeavour should be, in his opinion, to obtain the same low intrinsic brilliancy which gladdens the eye when looking at the light source, and yet produces that light which tends to make every occupation a pleasure. To obtain this effect not only were suitable shades necessary, but for economic reasons standardisation to some extent was desirable, decorations should be studied, and cheerfulness aimed at. All these are words of wisdom, which we hope will not fall on stony ground.

Industrial Lighting.

In a Paper read before a recent meeting of the Illuminating Engineering Society, Mr. Gaster gave a useful summary of progress towards definite recommendations on industrial lighting. In this country the framing of such

regulations has been the care of the Departmental (Home Office) Committee, which was formed in 1913, and Great Britain may fairly claim to have taken the lead in this matter. Two reports have been issued, in 1915 and last year, and a statutory provision requiring adequate and general lighting has been recommended. Values of illumination requisite in the interests of safety and convenience in factories were suggested in 1915, while the 1921 report contains provisions for avoiding glare. The United States, being for some years little affected by the war, has pushed ahead of us on this road, and there are already seven States which apply "codes" of industrial lighting more elaborate than the proposals in this country, but based on similar principles, though in the latest code issued by the American Illuminating Engineering Society the rules are extremely simple, and the explanations and educational addenda are very full.

Ideal Requirements and Practical Solutions.

Ideal conditions are naturally not always realisable in practice, and, though conditions enabling work to be done with the same ease and safety as in good daylight might be defined in practice, we must be content to devise regulations which will prevent a serious abuse of industrial lighting, without imposing hardship on the manufacturer. We are completely in accord with Mr. Gaster when he emphasises the principle of "government by consent." Interference by authorities is naturally resented by manufacturers; but in view of the educational work that has been done in illumination they will probably readily acquiesce in recommendations made for their own benefit. We understand that the somewhat complex problem of deciding the values of illumination requisite in different industrial processes is to be attacked in co-operation with representatives of the industries concerned. This is a wise step. Although such procedure will naturally take time, it should result in a more scientific and authoritative statement of the necessary lighting conditions than is at present available. It must be remembered that the mere provision of enough light is not the whole problem. The avoidance of glare, and particularly the problem of securing the right *direction* of light for a particular process and the consideration of the nature of the surface illuminated, are equally important. Mr. Gaster paid a tribute to the sympathetic attitude of the Home Office in this matter. We are inclined to think that official action in technical matters would often be more judicious if authorities were to seek expert advice, as has been done in this instance.

The Engineers' Dispute.

At the time of going to press settlement has not been achieved in the Engineers' dispute, trouble still exists in the shipbuilding industry, and at Sheffield the blacksmiths, assisted by the E.T.U., are running a little show of their own. In the first and most important disagreement neither side wants trouble, but neither side wants to give way, and so inevitably we reached the stage we know so well, "when a calamity can only be prevented if the Prime Minister uses his great influence to bring the parties together." Unfortunately the Prime Minister is ill and that hope therefore seems rather illusory. However, the Ministry of Labour has taken the matter in hand, and we understand that conferences between the parties in the disputes are being arranged.

Official and Unofficial Causes.

The official cause of the trouble, as we mentioned last week, is the refusal of the employers to concede their managerial functions on the question of overtime. Here they are undoubtedly in the right, and as the men are conciliatory it seems a little strange that no settlement has been reached. But behind this lies the much more difficult question of the position of the shop stewards, and it is stated to be the intention of the employers to rid themselves of the system which the presence of these men implies. If this really is the issue it would be best to say so, as only by clearly stating the differences between the parties can settlement be reached and disaster averted.

Rental Wiring at Eastbourne.

Though public electricity supply undertakings are now well established concerns, and are daily adding to the number of their consumers, still only a small percentage of the possible demand has been tapped. Of the middle-class houses, small residential property and workmen's dwellings, it is safe to say that not one per cent. enjoys the advantages of electricity supply, partly because of the tenancy agreements and partly because of the inability of the occupiers to bear the cost of the initial installation. Prior to the war many municipal authorities had devised hire purchase or assisted wiring schemes for dealing with this class of property, but when hostilities broke out in 1914 the restrictions imposed soon brought the good work to a standstill. Subsequently the greatly increased demand for power and the heavy cost of wiring and fittings made further progress impossible. Now the prices of materials are falling, and attention is therefore once more being paid to suitable methods for extending the benefits of electricity supply to this class of the community. This is all to the good, and the best method of attack would, we think, be for supply authorities and local wiring contractors to combine to cultivate it properly. In this connection it is interesting to note an experiment now being made by the Eastbourne Corporation.

Details of the Arrangements.

It is significant that the Corporation have made this departure at the instance of the Labour Party, though all the arrangements for wiring and fittings have been prepared by Mr. J. K. Brydges, the borough electrical engineer. At the outset an applicant who desires his house wired must fill up a form of agreement and get his landlord to sign it. The installation, not less than four, nor more than six points, remains the property of the Corporation, and the wiring rental is sevenpence per point per quarter. We are glad to notice that the Corporation have decided not to establish a wiring department, as private enterprise should be capable of dealing with any orders that may come along. Indeed, there are plenty of contractors at Eastbourne to undertake wiring work. Each applicant will be at liberty to select any local contractor for carrying out the work, and when finished the bill will be paid by the Corporation. It is estimated that a six-light installation, inclusive of plain pendants with lamps and opal shades, will cost £9, and as the rental charge would be 15 per cent. upon this figure, the annual rent will be 27s., or 6s. 9d. per quarter, the equivalent of 1s. 1½d. per lamp point. These figures have been modified, but they seem to us still rather high, and we are afraid that the experiment will not be a great success unless there is more flexibility about the arrangements.

Hire-Purchase Arrangements Desirable.

We believe that a hire-purchase, rather than a pure rental scheme, would be less burdensome and be much more

attractive to householders. Experience has shown that when customers are satisfied with an electric light or power experiment they desire to purchase the hired fittings and apparatus. Though the Electricity (Supply) Act does not contemplate this, we think that, perhaps, the Corporation could come to an understanding on the matter with the local contractors. Anyhow, we shall await with interest the results of the Eastbourne experiment.

Electric Lamp Patent Litigation.

Elsewhere we report an important judgment upholding the validity of the patent frequently referred to as the leading-in wire patent. The owners, the British Thomson-Houston Company, have recently been involved in a good deal of patent litigation, and though they have been successful in both the gasfilled lamp and the present case, a great deal of expense must have been incurred, as such proceedings are very costly. The series of episodes, in fact, form a good illustration of the difficulties which beset the path of the inventor, especially the poor inventor who has made a valuable discovery and is himself unable to develop or protect it. Fortunately, in the present case, the plaintiffs are a wealthy company, able to employ counsel and patent experts, and to take all necessary steps to vindicate their rights.

The Points at Issue.

As is well known, for over 30 years platinum was almost exclusively employed as the leading-in wire in vacuum lamps, as its coefficient of expansion was almost equal to that of glass, and it was also non-oxidising. But owing to the high cost of this metal frequent efforts have been made, more particularly since the nineties, to discover a cheaper substitute with similar properties. Though some of the specifications, alleged to be anticipations of the patent, indicate that the inventors were working on somewhat similar lines, though none of them achieved the desired object. In the plaintiffs' patent, which has become a great commercial success, the leading-in wire consists of a core of a nickel-iron alloy with a coating or sheath of copper, which is oxidising, and whose oxide is easily soluble in the glass used in the operation of sealing. In the specification of the patent the alloy consists of 46 per cent. of nickel and 54 per cent. of iron, but in the infringing lamps there was 29 per cent. of copper, about 28·45 per cent. nickel and 42·5 per cent. iron. In the result the Judge held this to be an infringement and granted the usual relief.

Power Companies as Distributors of Electricity.

It will be remembered that the early Power Acts authorised companies to supply electricity in bulk or for power purposes only, the right to supply for lighting and in retail to ordinary consumers being specifically withheld. To overcome this difficulty, several of the power companies, including the North Metropolitan Electric Power Supply Company, formed subsidiary undertakings which obtained provisional orders in towns and districts and took a supply in bulk from the parent Company. Though a fair amount of success has attended this indirect and complicated procedure, it has been costly from the administrative point of view. The North Metropolitan Company has, therefore, introduced a Bill to simplify the position by taking over the seven supply undertakings authorised by the provisional orders held by the North Metropolitan Electrical Power Distribution Company. The whole of the loan and share capital of the latter concern is held by the Power Company and it also supplies all the energy consumed in the seven districts. As far as we can see, the only objection that can be made to this arrangement is that undertakings established under provisional orders can be purchased by the local authorities, who may not wish to lose this right. But in view of the extensive reorganisation of electricity supply which must take place, and especially if a Joint Electricity Authority be formed, this is not likely to be a very valuable privilege.

The North Metropolitan Power Company's Bill.

There is a good deal of indignantly earnest petitioning to the "Lords Spiritual and Temporal" over another clause in the North Metropolitan Company's Bill. This is Clause 15, in which the company desire to reverse a previous prohibition, and to be allowed to supply in the administrative County of London any electricity they purchase from the London & North-Western or the Metropolitan Railways. How, when, or where they are going to do this is the conundrum over which both the London undertakers and the County Council are exercising themselves. Some of them apparently have a vision of the Metropolitan Railway Company forming a "river of electricity" through London, which will be diverted into the premises of private consumers all along the line by the help of the North Metropolitan Company as an intermediary. Some of them also fear that one of their *confrères* is up to no good, since they refer with alarm to the possibility of the North Metropolitan Company obtaining possession of one of the London company's undertakings and performing thereby all kinds of illicit operations. Altogether, most of the petitioners seem to be fighting in the dark, and we suggest that the North Metropolitan might say exactly what they intend doing. For the only section of the population to whom such disputes give unequivocal joy is the legal fraternity, for whose pleasure the poor consumer has ultimately to pay.

A Startling Discovery.

A startling discovery has recently been made, and, like many great discoveries, it has been independently discovered in two different quarters. At the Annual Dinner of the Institution of the Electrical Engineers, Mr. Llewellyn Atkinson included "The Technical Press" among the guests on that occasion, and further reference to this modest and cloistered body were made at the Commemoration meetings and at the lunch of the British Electrical Development Association. Almost simultaneously Mr. Acfield, in his presidential address to the Institution of Railway Signal Engineers, referred to the Technical Press as an educative force. It is not for us to say whether these encomiums are deserved, all we ask is that the Electrical Press should be recognised as part of the electrical industry, and to say that its one aim is the development of the industry of which it is part.

A Ministry of Communications.

That war baby the Ministry of Communications has turned up again. In his recent speech on the Geddes reports the Chancellor of the Exchequer remarked: "There would be much to be said for uniting the Ministry of Transport with the Post Office and having a Ministry of Communications. I do not know whether that recommends itself to anybody." Frankly it does not recommend itself to us. We cannot think of one reason why it would be an advantage, while we can think of several why it would not. We shall not trouble to detail these, as our readers will easily think of them for themselves, but shall simply express the hope that this idea will receive a speedy burial without further waste of time.

The Electricity Supply Bill.

Though the Electricity Supply Bill which was introduced into the House of Lords last week by Viscount Peel is fundamentally the same as the No. 2 Bill of last year, there are certain material omissions and additions. The more contentious clauses of last year's measure have, of course, been abandoned, while additional provisions have been inserted. The Bill, in its present form, is practically permissive throughout, and no compulsion is to be applied to anyone, either company or local authority.

Financial Arrangements.

Unless important parts of the 1919 Act are to remain dead letters some such Bill as the present is, of course, necessary, in order that Joint Electricity Authorities may perform their functions effectively. These dead letters are mainly financial, and it is now proposed to allow a Joint Authority to borrow money for the purchase of generating stations, main transmission lines and permanent works, or for working capital, and to charge the borrowed money on the undertaking and revenues of the Authority. Stock or other securities may be issued in discharge of the purchase price of a generating station or main transmission line acquired from an authorised undertaker provided the latter agrees; and the usual sinking fund arrangements may be suspended in the case of a loan for new works for a period of five years.

Nothing Revolutionary.

There is nothing revolutionary in all this; in fact, many municipal authorities already possess wider powers. As in last year's Bill, there is a provision enabling authorised undertakers within the district of a Joint Authority, as well as consumers and prospective consumers, who obtain a supply of electricity from it, or the Council of any County or Borough to give financial assistance to the Authority by loans, by subscribing for securities, or guaranteeing the interest on loans; but all Councils (except the London County Council) must first obtain the consent of the Ministry of Health before exercising these powers. This precaution is inserted in the interests of economy and as a safeguard for ratepayers.

New Clauses.

Among the new clauses is one enabling the Commissioners to include in a scheme constituting a Joint Authority a provision that those represented on the Authority shall contribute towards its administrative expenses, which seems only fair. There are three fresh clauses dealing with the apportionment of the expenses of the Electricity Commissioners. These enable a revision of the apportionment to be made where necessary, and interest to be charged, if the sum is not paid within two months. Sums due from a Joint Authority or an authorised undertaker can be recovered by the Commissioners summarily as a civil debt. We also notice a small but important extension of Clause 8 relating to the use of transmission lines by agreement. It is probable that colliery, railway, and private company lines are in contemplation, and as the clause is purely permissive no objection can be raised to it.

An Extended Stand-by Clause.

It is proposed to amend Section 15 of the 1909 Act (the "stand-by" clause) and make the expression "premises having a separate supply" include premises "with a separate supply of electricity, gas, steam or other form of energy applicable for the purposes for which electricity is demanded or received." This will enable the Authority to insist upon such a payment for extending the supply cables as will cover the capital charges on the extension in all cases where there is any independent source of power.

Supply from Railway Power Station.

Important amendments have been made in the clause relating to the supply of electricity from a railway or tramway power station to a Joint Authority or authorised undertaker. No such supply is to be given to authorised distributors in the area of a power company or of a Joint Authority without the consent of the latter. This seems to us to be quite equitable and should remove at least one source of opposition from the Bill. The scheme for the revision of prices and methods of charging are practically the same as those in the No. 2 Bill, though the London County Council are now included in the list of those who may make representations on prices and methods of charging. This clause alone, which makes three years the standard period of revision, would be a most welcome and desirable amendment of the existing law. We hope, therefore, that the Bill, now that it has been shorn of practically everything to which exception could reasonably be taken, will be placed on the Statute Book without further delay, in order that the re-organisation of electricity supply, so essential for industrial progress, may proceed on accelerated lines. It was read a second time in the House of Lords on Tuesday.

Interested Opposition.

That being so, we regret to notice that one of the financial journals has declared against the Bill, in ill-informed articles, from a "well-informed correspondent," full of inaccuracies and exaggerations, and calls for its withdrawal. It quotes the late Lord Moulton, a pronounced gas advocate, in support of its attitude, and attempts to scare the public by putting the cost of the transmission lines alone at £150 000 000! In an excess of fury, such as is usually kept for serious matters like football, it holds up the Bill as an attempt to extort money from the pockets of an unwilling public, oblivious of the fact that the public is anxious to invest in electricity supply and does so whenever it gets a chance. It complains that compulsion is still a feature of the Bill. We cannot agree; but even if it were there are people in the electricity supply industry who need compulsion if there is to be any development at all. These arguments may be good enough for the man in the street, but our readers will know that this fantasy is either an emanation from the brain of a director of a gas company or of someone who is not interested in or is even opposed to the progress of electricity supply. Finally the cloven hoof is displayed. Let the present companies go on. We thought so. Now though the companies have not had a fair field their enterprise has not always been what it might. We prefer the J. E. A. idea. For suffice it to say that there exists a large and a steadily increasing demand for electricity, and that this must be met either by the Joint Authorities (or some similar organisation) or by existing supply undertakers. If the latter have to meet their legal obligations the capital expenditure entailed will be greater by millions of pounds than if the Joint Authorities undertake the work, while the financial and economic results will not be nearly so good. Thus there can be no choice of the method that should be adopted, especially as the Company question is mainly confined to London, and it cannot be seriously contended that a particular difficulty should be a basis for general legislation.

Railways and Electrification.

Now that all the British railway companies have held their annual meetings it is interesting to find that, while the speeches naturally dealt with a variety of topics, including amalgamation problems and the great increase in operating costs since 1913, a special point was made of electrification. This is not surprising; for transport charges are one of the principal obstacles to a real revival of trade, and, though grouping will make possible considerable savings, much further effort is necessary if reduced charges are to be realised in the near future. For it is obvious, from the published statistics, that not only have fares passed the economic limit, and that their reduction would be greatly to the companies' advantage as well as to that of trade and industry of the country, but that some means must be taken to overcome congestion. Electrification is that means, especially from the economic point of view.

Electrification Pays.

It is, therefore, gratifying to record that the group of railways controlled by the Underground Company were able to declare higher dividends. The Metropolitan District Company made a payment of one per cent. on its ordinary shares for the first time for 39 years, and the amount carried forward was £40 013 more than in the previous year. Since the line has been worked electrically steady progress has been made year by year and now it would appear as if the shareholders were at last to reap some reward for their directors' foresight and skilful organisation and their own patience. The North London Railway, too, which was in sore straits before it adopted electric traction, now pays 6 per cent. on its consolidated stock, against 5½ per cent. in 1920, and for the first time since 1903 the holders of the preferential consolidated stock receive their maximum rate. Another instance of the combined good effects of electrification and of a progressive policy is the Metropolitan Company, which is able to declare a higher dividend as the result of greatly increased net revenue. In fact, the past year's record of the Company was the best for 15 years, and the prospects are decidedly good.

A Dismal Contrast.

When we turn to the meetings of purely steam railways such as the South-Eastern and Chatham Railway Companies, we find a marked contrast to this dawn of prosperity. This system, more especially the sections within 30 miles of London, is eminently suitable for electric traction and should have been converted years ago. Financial difficulties, coupled with a conservative policy, prevented this being done; though it is just to say that the directors had adopted an electric traction scheme in 1913, but the outbreak of war prevented any real progress being made. Now the chairman, Mr. Cosmo Bonsor, a little inconsistently, complains that the principal asset of the Chatham Company, their short-distance Metropolitan traffic, no longer exists; and that even the company's revenue from outside the Metropolitan area is threatened by an extension of road competition. Truly, an unfortunate position, but wailing will not improve it.

Electric Traction the Only Remedy.

The only effective way to cope with this trouble is to give a better and cheaper service by the introduction of electric traction, and we are pleased to see that probably the companies may be able, by means of the Trades Facilities Act, to do now what should have been done long ago. In order to comply with the provisions of the Act it is proposed to form a "private" construction company, with a capital sufficient to meet preliminary expenses, but with borrowing powers to cover the cost of construction and electrical equipment. The money borrowed will carry the Government guarantee, both as to principal and interest, and will be obtained on the most favourable terms as the work progresses. When complete the works will be let to the Managing Committee on lease for 25 years at a rent sufficient to repay capital and interest at the expiration of the lease, when the works will become the property of the Managing Committee or its successors.

Where Electrification Should Pay.

We have already given particulars of the company's electrification scheme, and we have no doubt that, if it can be carried out, the results will be as satisfactory as in the case of other electrified lines. For though the company's stations are well placed for the distribution of passengers, it cannot run more steam trains in the busy hours, morning and evening, and the only remedy by which increased accommodation for the public and increased revenue can be obtained is, therefore, electrification. The chairman recognises that a change from steam to electric traction would give faster and more frequent services, and would attract those who, owing to overcrowding and inconvenience, now use other means of transport. It would also assist the development of Outer London and so ease the housing difficulty.

The Progressive Brighton Line.

But matters do not end there. The London, Brighton and South Coast Railway is continuing its policy of extending electric working, though it has withdrawn its Bill for additional financial powers. The Great Eastern is another railway that would greatly benefit by adopting electric traction on its suburban lines, and though its ultra-cautious and conservative chairman, Lord Claud Hamilton, made no pronouncement upon the subject, no doubt the force of circumstances and the increasing competition of motor traffic will soon compel it to adopt this form of traction. Other companies are also considering the possibilities and advantages of electric working, and when the amalgamation schemes are out of the way we shall doubtless witness a considerable increase of activity in this connection.

Underground Extensions.

This is the more necessary, for as Lord Ashfield pointed out at the meetings of the "Underground" Electric Railway Companies, improved and extended transport facilities are essential. In the case of the "Underground" a revised scheme has been prepared at the instance of the Government, and, if advantage can be taken of the provisions of the Trade Facilities Act, no doubt it will be carried out. In the case of the City and South London Railway there is urgent need for modern equipment and enlarged tunnels, as anyone who travels on it knows. Last year the traffic declined by more than 9 300 000 passengers, or 23 per cent. There was also a decrease of over 17 millions in the number of passengers carried on the Metropolitan District, of nearly 32 millions on the London Electric Railways, and of nearly 7 millions on the Central London Electric Railway. No doubt the enlargement of the City and South London tunnels, coupled with through running arrangements at Euston, would have very beneficial effects, but we hope that the directors will also bear in mind that a reduction of fares, whenever this is possible, will have an equally good influence on the traffic and revenue of the company.

The Industrial Future in India.

By J. F. CROWLEY, D.Sc., B.A., M.I.E.E.

(*Concluded from page* 225.)

In the second part of his article, though referring to the Indian textile industry, Dr. Crowley deals more generally with labour organisation and its difficulties in that country. Unrest is an important problem, not the least because the native finds it difficult to separate disputes that arise in connection with purely trade matters from political feeling. A good deal of the trouble that has arisen in these disputes would, Dr. Crowley thinks, be minimised if the men were organised into responsible unions and educated by legitimate methods. Details of the development of welfare work and of technical education in India are given, while the importance of rapidly developing the available power on electrical lines is stressed.

Hand Spinning Uneconomic.

As regards hand spinning, which is being strongly advocated by Indian politicians, and an illustration of which is given in Fig. 6, it is a wholly uneconomic proposition, and one that is more likely to lead eventually to distress than to any improvement in the lot of the people. There is no comparison possible, in quantity or quality, between the output of the hand spinning wheel and the modern spinning frame. It might be pointed out here that the counts spun in Indian mills generally vary between 1's and 30's, while the counts used by the native weavers run very much higher, and consist, in most cases, of yarn imported from this country.

There is a definite market for Lancashire goods, and there is reason to believe that, if Lancashire manufacturers

Fig. 6.—Using the Charka or Spinning Wheel in a Mysore Village.

would devote some little attention to encouraging the handloom industry in India by improving the types of loom employed, &c., they would improve the Indian market for their goods.

It is also true, on the other hand, that Indian mills are, in most cases, contemplating extending in the direction of fine spinning, and in course of time would, no doubt, become competitors in this also.

The following extract from a report of Mr. C. R. Palairet, now Director of Industries to the State of Indore, and dealing with his work in the State of Hyderabad, may be of interest in this connection:—

> In spite of the introduction of large spinning and weaving mills, there is, and there probably always will be, room for weaving under cottage conditions. The work lends itself to cottage working, and the low value attached to labour allows of production on lines profitable enough to workers. The industry provides work in this State (Hyderabad, Deccan) for 61 000 persons. Notwithstanding advances in outside places like Sholapur, little or nothing is known here of the fly-shuttle slay; in Hyderabad some weavers are familiar with it, but are too conservative to use it, and cling to the old form of pit loom. The fly-shuttle loom may not be so flexible as the old looms, but could be used, at least, by 75 per cent. of the weavers, who do not have to do work which the fly shuttle cannot do. If unable to handle solid border cloths, it can, at any rate, increase the output in spun cloths threefold without increase in labour. This is the weaver who needs help. Solid border cloth weavers are in competition with themselves only. There is good reason to think that, if proper assistance were given to improving the systems in use among these native craftsmen, and particularly towards improving and simplifying the loom, a great deal of good could be done, particularly in the country districts, and, incidentally, an opening would be maintained for the fine counts of yarn.

With this comment the writer is in complete agreement, and, in his opinion, it applies to many other parts of India besides Hyderabad.

Labour Organisation.

It was estimated that there were fifty million workers in India in 1916. Of this number, farm servants and field labourers formed 52 per cent., handcraftsmen 35 per cent., transport workers 5 per cent., domestic servants 5½ per cent., and factory employees 2 per cent. The growth in factory employees between 1892 and 1919 will be seen from the following table*:—

	1892	1905	1919
Men	254 000	501 000	928 000
Women	44 000	93 000	177 000
Juveniles	19 000	39 000	67 000
Total	317 000	633 000	1 172 000

The organisation of workers in India is still in a very elementary position. The first Trade Union Congress to be held in India was held at Bombay on Oct. 31, 1920, and was attended by representatives of some forty organisations. An office was established at Bombay, and a committee of forty members was appointed, twenty-four of whom had no definite qualifications to represent labour.

Workers' Committees in State Factories

In the latter part of 1920 the Government of India discussed the advisability of establishing Workers' Committees in State factories, and they subsequently established committees in the Government printing offices jointly representative in equal numbers of workers and managers. It has also been reported† that a joint committee has been established as an experiment at the Tata Mills in Bombay.

The tendency towards organisation does not exist only among workers. A meeting of representatives of employers' organisations from all India was held in December, 1920, in Bombay, at which it was decided to form a federation.

Trades Union Movement.

In January, 1921, it was stated that twenty-seven trade unions existed in Madras. These were, however, unregistered, and had no definite constitution. They were not recognised by the employers on the ground that their constitutions were unsatisfactory, and that they were controlled by people outside the Labour movement, who used that movement to serve political ends. The workers, on the other hand, endeavoured to get the unions recognised as they were, on the grounds that they themselves were incapable of conducting them, or of stating their position properly in a dispute. They held, also, that the worker who was a trade union official might be liable to trade victimisation.

In April, 1921, the Government of the Bombay Presidency established a Labour office, (*a*) to compile statistics, and to publish reports on wages, hours, cost of living, strikes, trade unions, and other labour questions, (*b*) to organise a comprehensive labour intelligence service, (*c*) to

* Labour Overseas, Vol. 1, No. 4. March, 1921.

† "The Times of India," Jan. 5, 1921.

advise Government in connection with the settlement of industrial disputes, and (*d*) to advise in connection with the introduction of new and amendment of new legislation. In May, 1921, the Government promised legislation to legalise trade unions, and undertook to encourage their formation. Finally, to complete the twelve months' survey, it should be noted that a movement was started in

Fig. 7.—Warping, Winding, etc., in the Industrial School, Madura.

Bombay for eight unions to form a Central Labour Board on American lines, while a meeting was also held with a view to providing a constitution for a Bengal Federation of Labour.

Unrest.

There is little doubt that the rapid industrial development of India is being seriously delayed by the unsettled political situation there, the frequency with which industrial troubles arise, and the acuteness of these troubles when they do arise. As regards political issues, matters are changing from day to day, and it would scarcely be wise after a visit of something under a year to offer comments or make suggestions regarding matters so complex.

As regards the industrial side, however, some comment seems to be called for. That the situation is not very satisfactory will be gathered from the fact that not fewer than two and a half million working days were lost in the first quarter of 1921 by 185 000 workpeople through strikes or lockouts, fully half of these being in the Province of Bengal.

Unsatisfactory Working Conditions.

The conditions under which the Indian workman lives and works are by no means as satisfactory as they ought to be. On the other hand, there is little doubt that one of the chief troubles with labour in India is that strikes are likely to arise from causes that have really no connection with the ordinary relationships that should exist between employers and employed.

The writer made the suggestion to several responsible people that it would be a very wise step to encourage the formation of reliable and stable trade unions in each and every industry. Many of the employers of labour are opposed to this idea, but there is reason to think that their attitude in this matter has undergone radical alteration. The advantages that should result from the formation of trade unions on proper lines among the workers would be, in the first place, that they would get educated in legitimate trade union methods, and in the part that arbitration and the absence of violence plays in the legitimate settlement of disputes; and, what is of great importance, they would learn to distinguish between matters that properly arise in connection with their employment and have to be adjusted between their employers and themselves, and matters that should really be kept outside the works altogether.

One of the great difficulties in connection with industrial disputes in India is that many of these disputes arise from causes that have no connection with trade union matters.

Recent Trade Disputes.

In connection with recent trade disputes in Bengal, the Director of Industries made the following remarks*:—

> Partly from their non-domicile in the Province, and partly through lack of education, the workmen of Bengal cannot be said to constitute a class, in the sense of a social group, aware of any corporate personality, and they are unpractised in the organisations that make for the common articulation of common desires. The strike as a means of obtaining concessions was not unknown before 1920, but it had appeared only in isolated cases, and the demands had more commonly been non-economic in character.

This summary of the situation in Bengal is applicable to many other areas in India, and the two points put forward, viz., that workmen at present are inexperienced in organisations that make for the articulation of their desires, and that their demands up to recently have been for things properly outside the scope of a trade dispute, form the basis of the contention that the writer puts forward for the thorough organisation of Indian industries on trade union lines, with all the assistance that could be given from experience in more advanced countries.

As has been pointed out, the Government have now taken cognisance of the necessity for such organisation, and legislation has been definitely promised to legalise trade unions and encourage their formation. A notable factor in connection with present trade disputes in India is that the men, through lack of responsible leaders from among themselves, are generally guided by leaders who have no connection with the industry, and to whom, in many cases, notoriety is not unwelcome. On the other hand, there are some notable exceptions to this, and some of those who have taken a leading part in connection with some of the

Fig. 8.—Dyeing in the Open-air, Madura.

industrial disputes have adopted a sound trade union attitude, and one worthy of general emulation in India.

Violent Methods.

As regards the use of violent methods, the following comments in the article just referred to are pertinent:—

> The bulk of strikes have been accompanied by picketing and solidarity has been achieved in individual concerns by methods of intimidation, which have proved, as always, difficult to combat. It

* "Trade Disputes in Bengal," by Director of Industries, Bengal. "Journal of Industries and Labour," Vol. I., Part 1, Feb. 1921.

has been sufficient generally for those most interested in the strike to place anyone who might be recalcitrant under verbal threats of violence to person or property. Actual violence has not been commonly resorted to.

Violence is by no means always absent, however, from strikes in other parts of India, but there is little doubt that greater control would be exercised if the men were organised into responsible unions and educated in legitimate trade union methods.

The suggestion is made that it would be well worth while inviting out to India responsible and experienced trade union leaders with a view to educating and organising the Indian workers on these lines. It is believed that the course proposed would have a stabilising effect on the relationship between employer and employed, and if, in addition, efforts were made to improve the lot of the worker, particularly in his home life, the benefits to industry generally would be very great.

The Development of Welfare Work.

Much has already been done in this connection in Bombay and in Calcutta, where welfare work—as understood in this country—has now been taken up. The Social Service League in Bombay took the initiative in starting the Currimbhoy Ebrahim Workmen's Institute, and the Tata Sons Workmen's Institute, which are carrying on welfare work for the operatives under the agency of these two firms.

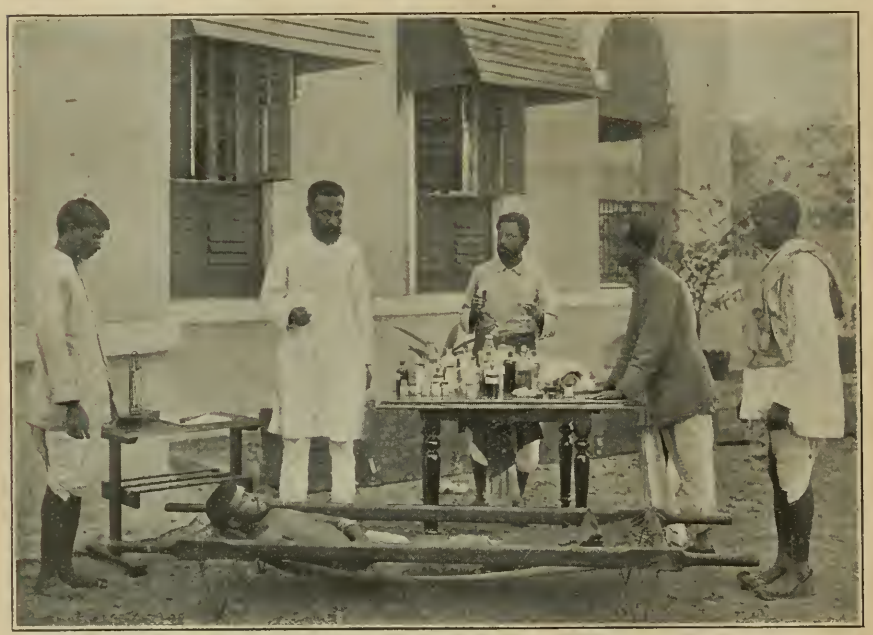

Fig. 9.—Welfare Work in a Calcutta Jute Mill.

Much is also being done in connection with the jute mills in Calcutta, which are really admirably organised concerns, and reflect the greatest credit on those responsible for their control or management.

Fig. 9 shows an illustration of the medical service provided for operatives in a Calcutta jute mill.

As regards maternity benefits and child welfare, India, owing to its special social conditions, was exempted for the time being from compliance with the "draft convention" of the Internationl Labour Conference of the League of Nations. The position of India generally in regard to these matters is not good; in a few cases only is financial assistance given to mothers. The Bombay and Nagpur mills of the Tata Company have established such a system, and also the Sholopur Spinning and Weaving Mills. The whole question is a difficult one, and it is further complicated by the dearth of women doctors.

A notable feature of welfare work, particularly in Bombay, is the establishment of co-operative credit societies, which are formed to enable the worker to be independent of Marwari and Pathan moneylenders, who charge the exorbitant interest on loans of anything from 1 to 4 annas per month per rupee. While it takes some time to educate the workers to new ideas, these societies are already meeting with distinct success.

As regards the work of co-operative societies generally, the following statement* is interesting:—

> The co-operative movement in India made rapid progress in 1919, and its beneficial effects upon the character of the inhabitants are very marked. In the sphere of agriculture . . . much good has been done in helping to reduce debt. . . . In the Madras Presidency, where the movement has advanced considerably, there are at present nearly a quarter of a million members of co-operative societies. . . . The membership of the societies in Bengal rose from 126 000 to 135 000.

Education.

The future of industry depends to a very large extent on the facilities provided for the technical training of the youth of the country. It is not possible, however, in a brief survey of this character, to do anything like justice to the educational position in India.

The Public Works Department provides the greatest number of openings for trained engineers. There are four principal colleges which prepare engineers for this department, viz., Roorkee in the U.P., Madras, Sibpur, and Poona. The training is generally of a civil engineering character, though latterly efforts have been made to develop the teaching of mechanical and electrical engineering. Thus, a Chair of Electrical Engineering was recently founded in Madras. Electrical and mechanical engineering are also taught at the Engineering College, Bangalore, and at an institution which successfully fills a very useful function—the Victoria Technological Institute at Bombay, under the direction of Professor Turner. Higher training in electrical engineering is given at the Indian Institute of Science, Bangalore, established primarily for research under Dr. Fowler and Dr. Alfred Hay, which the writer had an opportunity of visiting. Generally speaking, the training in civil engineering provided in Indian colleges is altogether superior to that provided in mechanical and electrical engineering, largely, no doubt, due to the fact that the principal demand in the public services is for civil engineers. The training in electrical and mechanical engineering is not very satisfactory, and many of the students who wish to take up these courses have at least to complete their education outside the country.

Practical Training.

Education in textile subjects is provided at Serampore, near Calcutta, and in the Victoria Technological Institute at Bombay, and of an elementary character in the trades preparatory schools referred to below.

There are scattered throughout the country in British India, and in Native India, schools of the trades preparatory type, such as the Industrial School at Madura, to which reference has been made.

Universities exist at most of the important centres, as Bombay, Calcutta, Madras, Mysore, &c., and the courses seem to be of a reasonably high standard.

There is apparent throughout India far too great a tendency to regard a degree or a diploma as an end in itself—a marketable label. This attitude naturally lowers the respect in which true education is held, and the respect for knowledge. Notwithstanding this, the Indian student is keen and hardworking, and one found Indian student audiences observant and attentive, and generally differing little from their fellow students in Europe, with whom one would like to see them in closer touch.

* The International Co-operative Bulletin, January, 1921.

As regards the practical side of the training of electrical and mechanical engineering students, it is worthy of note that, owing to the lack of facilities provided by British works, much of this training is given outside the United Kingdom. The result of this is clearly seen on the return of the young engineers to India, when their predilections for material manufactured in the country where they received their training militates very seriously against British trade. This is a matter, however, that could readily be remedied by joint effort between Indian educational authorities and engineering works in this country.

General Impressions.

The writer left India with the feeling that it was a country with a great industrial future, and that while development at the moment was being retarded, partly by unrest and partly by the rate of exchange, great development in the near future was inevitable.

The appointment of Directors of Industry in British India and in native states shows a proper sense of responsibility on the part of Government in these matters. It is noteworthy that the writer found that the directors who had had an engineering or manufacturing training much more successful than those without such training or experience.

It is regrettable that in the application of electricity to industry much of the work carried out is not on the most modern lines, due, no doubt, to the remoteness of the country from the chief engineering centres, and to the absence, in many cases, of highly skilled engineering advice. There is a tendency—on the whole a sound one—more and more to employ Indians in connection with the running of factories and plants, and particularly in all junior positions. As one European of experience in the country put it, " The day of the Chota Sahib in India has ended."

On the other hand there is, and will continue to be, great scope for Europeans in connection with the design and layout of new central power stations, factories, and industrial equipments, and in connection with certain higher technical and administrative appointments, in all of which the longer and greater experience, and the sounder judgment on account of such experience, of Europeans, should be of great value to Indians. Co-operation between the European and Indian on this basis will make for the rapid development of the country, lead to the maintenance of sound feeling and mutual respect between the two peoples, and be of advantage to both.

Reviews.

Absolute Measurements in Electricity and Magnetism. By Andrew Gray, LL.D., F.R.S., M.I.E.E. Second edition. (London: Macmillan & Company, Ltd.) Pp. xix. + 837. Price 42s.

The first edition of Volume I. of this work was printed as long ago as 1888, and the first edition of Volume II. was printed five years ater. Both of these works have played an important part in increasing our knowledge of electricity and consequently in developing the electrical industry. The theorems given clearly explained how it was possible to make very exact electrical measurements. They therefore stimulated further research. The establishment of well-equipped physical laboratories in Europe and America capable of defining and constructing electrical standards has been a great boon to the industry. The consequent easy verification of sub-standards also has been of the greatest value in research work. Prof. Gray's name will always be associated with the early pioneering work in absolute measurements.

To everyone who wants a sound foundation on which to build his theoretical knowledge we can confidently recommend this book. Many of the problems which have to be discussed in electricity need for their solution not only an accurate knowledge of physics, but a thorough knowledge of some of the theorems in higher dynamics. We know no one better equipped with this knowledge than the author. Without it much of the most important work of Kelvin, Maxwell, and Rayleigh cannot be understood. In particular a knowledge of Lagrange's dynamical method is of the greatest value, but the knowledge must be accurate as the method has limitations.

In his preface the author laments the fact that the study of higher dynamics seems to be rapidly dropping out of our University curricula. He comments as follows: " As it is, we have now an army of students and others talking glibly of Einstein and of quantum theory, whose attention to the fundamentals of dynamics and physics has been wofully slight." Many of those who are now trying to understand Einstein's theory would be better employed in trying to understand the more advanced theorems of dynamics.

In bringing this volume up-to-date considerable omissions and additions had to be made. Some of the omissions will be found in the author's treatise on " Magnetism and Electricity," which can be used advantageously as a supplementary volume. Amongst the additions, we note many neat formulæ for the mutual inductance between circular and cylindrical currents. As the radio engineer is always studying problems of this nature, he will find these solutions of immediate practical value. He will also find solutions of the problems of the high-frequency resistance and inductance of cylindrical and strip conductors.

A full description is given of the Gray absolute electrodynamometer and the formula for it is proved. This dynamometer was used by the Bureau of Standards when measuring the electromotive forces of standard cells. The standard historical methods used for the absolute measurement of resistance are described and the limits of accuracy obtainable by the latest methods are given. Chapter XVI. on the comparison of units is of special value. The author points out that the accuracy of R. Shida's result for v, namely, $2{\cdot}955 \times 10^{10}$ cm. per second has been mistakenly called in question. It was a wonderfully accurate result to be obtained by a young Japanese student at Glasgow University forty-one years ago. The mean of the values of v obtained by electrical methods is given as $3{\cdot}0001 \times 10^{10}$ cm. per second. This compares very satisfactorily with the velocity of light, $2{\cdot}9986 \times 10^{10}$ cm. per second, measured experimentally by Perrotin in 1902.

In Chapter XVII. electrostatic measurements are described. We were pleased to notice a description of Snow Harris's electrometer. This was one of the first electrometers ever made, as it dates from about 1834. Few are aware of the high accuracy Snow Harris obtained in his measurements with this instrument. It is well worthy of study. The concluding chapter on the effect of the inductivity of the medium on electric phenomena will be found helpful by students. Beginners always have difficulty in understanding advanced electrostatic theory. The extended use that is now made of high electrical pressures for power transmission makes a knowledge of this theory essential to the engineer. In an Appendix Prof. E. Taylor Jones gives a clear account of a useful working theory of the induction coil.

The standard nomenclature of electricians is practically adopted throughout. This is a great help to the technically trained engineer, as it enables him to understand the theorems much more easily. This work will prove of great value to all electricians who have to leave the beaten track in order to explore the economy and efficiency of new methods. We can congratulate the author on having completed a work which will for many years be a standard book of reference.

ALEXANDER RUSSELL.

A Catalogue of British Scientific and Technical Books. Prepared by a Committee of the British Science Guild. (London: British Science Guild, 6, John-street, Adelphi, W.C. 2.) Pp. xviii. + 376. 10s. net.

To all who have to keep up-to-date in any department of science and learning, this comprehensive catalogue will prove indispensable as a guide to the published volumes that are obtainable on any specific subject. It is at times a sheer impossibility to find a fairly complete list of books on any section of science; this catalogue will help to make the task easier.

The volume contains more than six thousand titles, the classification of which demanded most careful consideration. There are forty-nine main groups, and these are classified into just over 460 sub-classes. For example, Physics and Electrical Engineering are divided into sixteen sub- and twenty sub-headings respectively. Under each sub-heading full details of each book are given—author, full title, size, number of pages, date and number of the last edition, as well as the name of publisher and the present price. Only books that are obtainable through booksellers in the ordinary way are given.

The volume is well printed on a very good tough paper, with a clear type, and the general " get up " is a credit to the printer and the binder; the binding appears to be done for strength, as a work of reference should be.

The Central Office of the INTERNATIONAL ELECTROTECHNICAL COMMISSION informs us that the verbatim report of the Conference on High-Tension Transmission Systems, held in Paris last November, will be published next month in French and in English by the Union des Syndicats de l'Electricité. The price of the report will be 60 fcs. if ordered before April 1, or at least 75 fcs. if ordered after that date. The Union would be glad if those who wish to procure the report would inform M. Tribot Laspierre, general secretary of the Union, Boulevard Malesherbes, 25, Paris, of the number of copies required, specifying whether the copies desired are to be in French or English

THE INSTITUTION JUBILEE COMMEMORATION.

Turbine History—The Boyhood of an Inventor—A Short Way with Legislation—The President on the Commemoration—Early Telephony—The Battle of the Systems.

(*Concluded from page* 257.)

Thursday, February 23.

The Evolution of the Turbine.

After the resolution of congratulation to Mr. Heaviside had been passed, Sir CHARLES PARSONS, who was called upon by the chairman to give his reminiscences, said it was about the year 1884 that he determined to attack the problem of the steam turbine with a very high speed dynamo or alternator directly driven by it. The electrical side involved quite as much work as the turbine, and at that time the data available was very scanty. Little was known quantitatively about hysteresis or eddy current losses, and considerable margins were therefore necessary when designing for periodicities from thirty to fifty times greater than those then in practical use. A speed of 18 000 revs. per min. was chosen, and the estimated output was 10 H.P. To guard against periodicity difficulties a field density one-half that of the Edison machine was aimed at and the E.M.F. was calculated as being directly proportional to the surface speed and the total length of active wire between the ends. The voltage was 100, the length of core 8 in. There were ninety-six conductors of 0·08 in. over the insulation. These were laid on a smooth core composed of thin sheet iron of 0·015 in. thick, which was insulated with paper throughout and threaded on to a hollow steel shaft through which lubricating oil passed for cooling purposes. The end wires were spiralled in two layers and the whole was bound with phosphor bronze wire of 60 tons tensile strength. The commutator had twelve sections with twelve convolutions per section. The current density in the armature at full load was about 9 000 A per sq. in. Thanks to the small radial depth of copper the current was not excessive.

The efficiency of this dynamo was about 80 per cent. and the steam consumption of the plant, about 150 lb. per kWh. This set worked satisfactorily and the only important alterations which had to be made were in the commutator, which was finally constructed of bars in short sections held by dove-tailed steel rings with asbestos insulation which stood up well against the great centrifugal force. The machine worked regularly for some years, and its electrical constants had been re-examined recently and found to agree closely with modern dynamo practice modified to suit the speed of 8 000 revs. per min.

The D.C. Turbo-Generator.

In the four following years about 360 turbines of from 1 kW to 75 kW output were made to similar patterns, these being chiefly used on board ship. From 1885 onwards alterations were made to improve the efficiency of the turbine. The ratio of expansion was increased, the curvature and formation of the blades modified and the velocity of ratio of blade to velocity of steam raised so that in 1888 the consumption of a 32 kW turbine with 90 lb. steam pressure and non-condensing had fallen to 34·5 lb. per kWh.

Early Turbo-Alternators.

The first high-speed alternator driven by a non-condensing turbine was made in 1888. It had a revolving single-phase armature for 75 kW at 4 800 revs. per min. 80 cycles. The armature body was a smooth laminated cylinder and the conductor was wound in a single layer round six longitudinal wooden slabs keyed into the core so as to cover the whole remaining surface, and this after an insulating covering had been applied was bound tightly with piano wire.

It was soon recognised that the efficiency of the turbine could be doubled by using condensers and that the efficiency would increase rapidly with the size at a greater rate than in the reciprocating engine. The first condensing turbo-alternator to be built was for 120 kW in 1891. These machines had a consumption of 27 lb. of steam per kW at 100 lb. steam pressure at 465°F. and 28½ in. vacuum. In 1899 two 1 000 kW turbo-alternators at 4 000 V 1 500 revs. per min. were ordered for Eberfeld. The consumption at full load was 18·25 lb. per kW with steam at 125 lb. and 14°C. of superheat. These were the first turbines to be used in Germany.

Insulation Difficulties.

As sizes and voltages increased it became difficult to secure satisfactory armature insulation and to provide sufficient copper to reduce the heat gradient through the thickness of the insulation. For these reasons since 1903 revolving fields had been adopted. The first revolving field alternator was installed at Neptune Bank, Newcastle-on-Tyne in that year, and was of the salient pole rotor type for 2 000 kW 6 000 V., three-phase, 1 200 revs. per min. 40 cycles. In later years fields of the barrel type had been adopted with the exciting coils sunk in slots and retained in position by dove-tailed keys and the end windings held by caps of bronze or by non-magnetic steel alloy forms which were found to lend themselves more readily to the requirements of the rapidly increasing sizes of alternators which by 1911 had reached 25 000 kW at 750 revs. per min. in the turbo-alternator supplied to the Fisk Street Station of the Commonwealth Edison Company of Chicago. In the construction of these machines the finely stranded type of armature conductor was used which was stranded, insulated and spiralled several times in a conductor length. In this way eddy currents were reduced to a minimum. With the increased outputs at high speeds the cooling by ventilation had become a very important matter, and it had been found that the separately driven fan was in every respect preferable to a fan mounted directly on the rotor, as it more effectually eliminated hot spots. The water cooling of rotors had been satisfactorily carried out, but owing to the increased complication involved it was found better to keep to the usual means of air ventilation.

Ferranti's Boyhood.

Dr. S. Z. DE FERRANTI began by expressing a word of appreciation of the work of Oliver Heaviside, which he described as being of the greatest possible value. Continuing he gave an interesting account of his early mental gropings in the electrical direction. At the time the Institution was holding its first meeting he had not reached the age of eight and took no interest in electrical matters, in spite of the fact that he had slept peacefully when the house he occupied had been struck by lightning. What effect this manifestation might have had on his after work he did not try to estimate, but if his contact with the demonstration had been closer it would have been his last electrical experience. At that time he was exceedingly interested in the steam engine, and Sir Charles Parsons would be amused to know that his first model was a turbine. It was not until he was about eleven years old that he became in any way connected with electricity. In Pepper's "Play Book of Science" he found described an oxy-hydrogen light, and he remembered telling his father that he would like to have an apparatus to make it. When his father said that a much better light was the electric light, he, however, became much more interested in that.

The Magnetic Engine.

Another early idea he had was that of a magnetic engine which should work by the attraction and repulsion of permanent magnets. This involved the insulation of magnetism, and he remembered trying to find out what would insulate magnetism. He conceived brass as being such a material, and an optician in Hatton Garden agreed with him. This was all now quite absurd, but if a permanent magnet working without apparent expenditure of power was conceived it did not seem more ridiculous than obtaining energy from the dissociation of the atom. An early experience of a Siemens dynamo with a two-part commutator gave him more food for thought and he tried to improve the machine, with the result that he evolved one practically identical with that of Paccinotti. The machine worked pretty well, and its sale when he came upon hard times tided him over until he was able to start earning for himself.

Later on he went to University College and had the great advantage of studying under Carey-Foster, Lodge, & Kennedy, but he learned very little from these teachers as he was all the time wanting to get on and do something of a practical nature for himself. In 1881 after two fruitless attempts he succeeded in getting into Siemens' works. Here he was surrounded by dynamos and had the desire of a lifetime satisfied.

Early Arc Lamp Installations.

In those days electric light installations generally consisted of one dynamo supplying one arc lamp. In the City of London there were three systems, that of the Brush Company with a number of sixteen lamps circuits, that of the Maxim Company, which worked in much the same way, and the Siemens installation consisting of a number of masts carrying very big lamps which were each fed from their own dynamos.

What Might Have Been!

Later, Dr. Ferranti continued, he became associated with the Gaulard & Gibbs' high pressure alternating system which in a very short time was supplying 30 000 lamps. He then aimed at lighting the whole of the north side of the Thames, over an area similar to that of the Gas Light & Coke Company, and to secure his position laid mains running from the City in the east to Chelsea in the west, and to the Thames right up to the points adjoining Hamp-

stead. Legislation, however, came along and knocked this scheme on the head.

Here Dr. Ferranti paid a tribute to the devoted men who had worked with him all through the difficult times of starting a high tension electricity supply in London and particularly mentioned Mr. C. P. Sparks, Mr. Vesey Brown, Mr. Arnott, Mr. Colley, Mr Addenbrooke, Mr. R. Wilson, Mr. Partridge, Mr. Wordingham and Mr. Hawtayne. The greatest difficulty in the new work that they undertook at Deptford was not only want of knowledge and experience, but the lack of satisfactory insulating materials. Though they had to build alternators, transformers, switchgear and mains, the only materials available were porcelain and ebonite. Whatever else they needed to complete the system had to be found and adapted, and the gear had to be so designed that they could carry out the results with the only material available. It was hard to think to-day what a handicap that really was, and it was interesting to know that such common things as brown paper and wax candle refuse were used to construct mains which carried 10 000 V and many miles of which after all these years were still giving just as good service as ever.

The Re-flowering of the Institution.

In 1910 Dr. Ferranti continued, he had the great honour of his life, in being elected president of the Institution. He found the Institution somewhat slow and quiet, and inclined to die out or proceed in such a way that he felt its future was uncertain. He saw what a great good the Institution might be and how much it could do for electrical science, and for those who gave their lives to it. He felt that it wanted life and he tried to infuse that life into it. He pleaded, he did everything he could do, he stated his views, but really personally he did nothing, but where he thought he had succeeded was in giving a lead to the presidents who followed him. They really did the work of making the Institution the great society it was to-day.

Early Ship Lighting.

Sir THOMAS CALLENDER said one of his first experiences with electric lighting was when he went to the United States on one of the old Cunard ships which was lighted by oil lamps which had done duty for generations. Coming back he was passenger on the "Cynthia" which if not the first electrically lighted vessel to cross the Atlantic was certainly the first which claimed to have an effective installation. He remembered great crowds of people coming down to the docks to see this wonderful ship, and it was there he first met Mr. J. F. Allbright, associated with Crompton & Company, and in charge of the dynamos. Shortly after that he started his work in connection with electricity. One of the first installations they carried out was the lighting of Buckingham Palace. A great deal of work was also done for the Jablockov Company for Covent Garden and the preliminary lighting of part of the Embankment. Returning from a visit to Russia he came across Jablockov himself in the Customs House, and there began a friendship which lasted for a considerable period.

Main Laying Extraordinary.

The first supply business he undertook in this country was in connection with the Chelsea Electric Supply Company. This was the first real undertaking that had seriously entered into the field of supplying electric light in London on orthodox lines. The difficulties that this company met with were not so much engineering as financial, for even in that rich neighbourhood they could not get any monetary support. In spite of its old-fashioned plant and old-fashioned ways this company was still an independent company waiting, he presumed, to be absorbed in the great scheme which would be brought out for London.

Sir Thomas gave an amusing account of his connection with Mr. Bailey and the Whitehall Court Company when they had run a series of mains about Charing Cross and the Strand without rights, powers, or permission, acting as pirates and pulling up roads. The engineer in charge of the work was discretion itself and he spun yarns which were interesting and fanciful with the result that nobody quite understood what they were doing. It was, of course, necessary to make arrangements with the local governments and obtain certain permissions, but these were given with considerable misgivings. Sir Thomas also described the laying of mains across Waterloo Bridge on a Bank Holiday, a date chosen because the courts were closed, and there was no one to grant an injunction. These mains remained in position for a number of years before the Charing Cross Company regularised their position, and obtained the necessary Provisional Order.

Pioneering Electric Light Work.

Mr. F. BAILEY reviewed Institution history from the year 1883 onwards, remarking on the disappearance of matters relating to the laying and manufacture of submarine cables. He then alluded to the pioneering work of those associated with the Telegraph Construction and Maintenance Company, whom he joined in 1883. This company showed great enterprise in entering the field of electric lighting at a most critical period. An interesting event was the arrangement by the Chairman of the company of a contract for the lighting of the Great Western Railway on the Gordon system. This enterprise had a marked effect on the future of electric lighting.

At this time much difficulty was experienced in dealing with self and mutual induction, matters that were still imperfectly understood. Want of instruments also led to considerable trouble, the Greenwich works of the T. C. & M. Company being compelled to regulate pressure by the aid of a rough photometer in the engine room.

The Paddington engines made by J. and G. Rennie were the last constructed by this firm, and the Willans 3-cylinder engines for driving the exciters at Paddington were the last of this type prior to the introduction of the central valve. The Whitehall station, erected 1887-1888, used the first central valve engine with solid eccentrics on the crank pins.

Some Early Experiences of Mr. Swinburne.

Mr. J. SWINBURNE remarked how strange now appeared the ignorance of forty years ago. There was then an idea that there was some curious problem awaiting solution called "the subdivision of the electric light." Dynamos then were series wound, compound winding unknown and shunt winding a mystery. Each dynamo commonly ran one arc lamp. The problem was how to make it supply a number of small lamps.

Mr. Swinburne recalled a visit to Antwerp and Paris in order to start making Swan lamps. There were no rational text-books, no satisfactory measuring instruments. The best were electro-dynamometers. Voltmeters were obtained eventually, but as the power wasted by the instrument was comparable with that used by a lamp, calculation was necessary to obtain rational results.

Early Carbon Lamps.

The earliest suggestion for carbon filament lamps *in vacuo* was in Belgium in 1836, the subject being a safety lamp for mines. Swan made the first lamp, but Edison realised that lamps must be of high resistance arranged in parallel. Homogeneous cellulose for filaments was due to Weston, who also devised flashing under low pressure. Swan invented squirting. L. S. Powell squirted zinc chloride solution of cotton. C. H. Stearn worked with squirted viscose and with, ultimately, artificial viscose silk—perhaps the first viscose silk ever made.

Mr. Swinburne was inclined to suggest that the giants of old were really pigmies. We had now an industry employing thousands of trained minds and a large number of scientific and business men of exceptional ability. It was therefore exceedingly difficult to rise to the top. But forty years ago things were only at the beginning, and then it was relatively easy to rise.

The Electrical Engineer and Education.

One cause of the different mental equipment of the electrical engineer of to-day was the advance in real education. Matters that were difficult to understand in the early 'eighties were now quite elementary. As an instance Mr. Swinburne recalled the discovery, about 1884, that the product of volts and amperes in an alternating-current circuit was not necessarily the watts. On one occasion, at Brighton, when an alternator was on an inductive circuit, they found the indicator diagram smaller than the apparent watts indicated. "Someone told one of the esteemed past-presidents of this. He regarded his informant severely, but thoughtfully, and said, 'You're a liar.'"

In conclusion, Mr. Swinburne mentioned that the electrical and engineering papers, not to speak of the Institution, did much to remedy the poverty of good text-books. THE ELECTRICIAN and "The Electrical Review" had both done splendid work in this direction.

A Letter From the President.

At Thursday evening's meeting Mr. A. A. CAMPBELL SWINTON presided, and opened the proceedings by reading a letter from the PRESIDENT, expressing his great disappointment at being unable to preside over the Commemoration. He thanked Mr. Swinton, and the other vice-Presidents and his many kind colleagues for the special efforts they had made to take over his job. The Commemoration meetings were devised to serve manifold ends. Just as there was only one really true and just reason for drinking wine—that was because one liked it, it was the first end of these meetings to give pleasure by meeting old friends and hearing them recall past days, with their failures, trials, and at length, successes. In short, the noble pleasure of hero-worship. Again to realise the supreme pleasure of visualising the still growing enterprise that had emerged from fifty years of work—team work carried out often by men who did not at the time realise that they were on the same job, in fact opposing one another in every way, and now finding they were really working to the same end.

The second object of these meetings was to produce a living history of electrical engineering in all its applications, and to preserve this history by producing a special number of the "Journal

containing the contributions, spoken and written. The history of electrical engineering began with Volta's discovery of the primary battery, and Oersted's moving compass needle. Faraday's discoveries provided means of converting mechanical into electrical energy, and to preserve its value, as the development of these primary discoveries proceeded, measurement of quantities and constants became necessary, and from the work of Kelvin, Maxwell, Rayleigh, Joule, Carey-Foster, Wheatstone, Bright, Latimer Clark, and many others from about 1850 to 1870, arose not only the system of electrical units now in international use, but also knowledge leading to the better understanding of heat and its applications.

A Cyclic Advance.

It was interesting to trace the many instances where a notable advance in one device led to advancement in unexpected directions. In 1775, Watt's steam-engine patent was renewed in the same year that Arkwright patented his invention of the cotton-spinning mill. The steam-engine made possible the large mill, and the mill led to the development of the steam engine. The development of the electric generator produced the high-speed steam-engine, and later the work of Parsons in building the steam turbine led to the so-called super-power station of to-day. The alternator and turbine developed side by side, the one depending on the other. There would be no use ashore for the large turbine apart from electricity supply.

Dr. Fleming's Co-operation.

They were truly fortunate when Dr. Fleming threw himself so heartily into the spirit of the Council's Commemoration Scheme. They owed him a great debt. He had made clear the foundations of electrical engineering. The last fifty years of its history was in fact the history of their Institution. It started with a trifling apparatus used with delicate skill, and a growing army of keen men pursued the new idea, ever broadening its application, bringing in their train armies of skilled assistants and craftsmen, who during fifty years had built up the latest enterprise of to-day. The foundations laid by a master mind turned strength and security to kinetic energy. They held the principle of light, which was the principle of growth. That was the precious heritage they must preserve, and it could be preserved only in an atmosphere where freedom of growth was possible. Legislation had hampered their freedom, and he hoped the record of their meetings might serve to spread a wider knowledge of the history of electrical engineering, so that future legislation might be guided by wiser hands.

Thanks to the Press.

Mr. Campbell Swinton, on behalf of the Council thanked Messrs. A. H. Allen, F. H. Masters, E. Slater and A. G. Whyte for the invaluable work they had done in condensing for Press purposes the remarks of the various contributors of the discourses at those meetings. The Council also thanked the daily Press for the large amount of space they had devoted to the meetings.

The Inception of Telephony.

Mr. J. E. Kingsbury remarked that it was something of a coincidence that the year they were celebrating, 1872, saw the origin of Bell's experiments. His own first experience of telephonic speech was in 1878, through the Edison carbon transmitter, which gave more powerful effects than the early magneto form. It was almost impossible to convey to those who had always been familiar with the telephone, the feeling of awe that was excited by first hearing human speech by this means. Public demonstrations of the telephone in those days were always interesting and sometimes exciting. At the first demonstration of Edison's loud-speaking receiver it broke down completely. He (Mr. Kingsbury) admired the coolness with which Edison's nephew took the instrument to pieces and replaced it while an excited crowd of scientists were waiting at the door for admission.

It was really as exchange organisations that the Bell and Edison companies started. Existing telegraph lines were mostly along roads and railways. New methods of carrying increasing numbers of wires had to be developed. Pioneers in England had no statutory powers, and depended on permission from private persons to fix their fittings. The switching system was a new and most difficult thing to evolve.

The Difficulties of Adaptation.

It was less difficult to create something new in itself than to adapt the new to work with the old. Yet this must be done in all telephonic advances, otherwise there would have to be immediate duplication or cessation of service. Let it be recalled that in 1878 the telephone was first used in exchange service. To-day there were about 21 million telephones connected to various exchanges throughout the world. In 1877 Bell aimed at conveying speech "through instruments not more than twenty miles apart." To-day conversation had been accomplished over 5 000 miles. America was spanned from East to West more than seven years ago. Given commercial conditions to justify it, the Continent could be equally well spanned from north to south. Scientifically, an Indo-European telephone was possible, though it might not be a commercial probability. Yet conversation between London and Constantinople was by no means an idle dream.

Telephone Legislation.

In the latter part of his address Mr. Kingsbury dealt with legislation, remarking on the narrow view originally conceived. More regard should have been paid to what the nation might gain by improved communication as a set off against a possibly reduced revenue from telegraphs. The artificial difficulties that impeded early growth have had far reaching consequences. It was useless decrying legislation which was not spontaneous, but represented roughly the public opinion of the moment. So far as the telephone was concerned the period of divided interests was over. There was doubtless leeway to be made up, but much criticism was ill-informed. Broader views were needed all round, and not the least among the critical subscribers.

Early Experiences of Electricity Supply.

Mr. G. W. Partridge mentioned that with the Brush series arc lighting system pressures up to 3 000 V were used, and the fact that so few people were injured could only be explained by the awe with which electricity was regarded. The Earl of Crawford, on his return from the Paris Exhibition, decided, in conjunction with Sir Coutts Lindsay, to install a portable plant in a yard behind the Grosvenor Gallery. The go and return a.c. mains were run side by side to obviate induction effects. Mr. Ferranti afterwards introduced the parallel system of transformers and reconstructed the generating plant. Power was conveyed to the neighbourhood by an overhead system of mains. The London Electric Supply Corporation was formed in 1887, and the Deptford station started soon afterwards. The a.c. system was looked upon with much dislike and suspicion. There were numerous accidents, and ultimately the whole installation was shut down in order that underground mains might be substituted. During the period of shut down (four months) the consumers had no electric light. Meantime the rival d.c. companies were busy connecting up their consumers. Trouble was experienced from interference with the telephone circuits, and newspapers commented upon the "mysterious magnetic storms" which affected the telephones not only in London, but in Paris.

Legislative Difficulties.

Mr. Partridge gave a list of improvements in a.c. work that followed, and remarked that work was very well executed in spite of the limited knowledge of electric phenomena. Under Dr. Ferranti's guidance much ingenuity was shown in overcoming difficulties, and the directors personally found large sums of money to perfect and carry on the work.

Many difficulties were due to legislation, and it had always seemed remarkable that electricity supply should be treated so differently from water, gas, railways and other public service undertakings. Association or actual electrical connection between different companies was forbidden by law, so it was not surprising that each company adopted whatever system it thought best. It was not until the 1908 Act that companies were empowered to assist one another and to supply railways. The troubles during the twenty years prior to this had had a most serious effect on electrical developments. His own company in 1906 risked its capital to install the plant for supply to the Brighton railways, though it had no legal power to undertake this supply.

Considering the extraordinary pioneering work carried out by London supply companies it seemed a great hardship that this country had not benefited more from these efforts. The future was still uncertain, and the industry had still to release itself from the stranglehold perpetrated by the legislative errors of forty years ago.

In the Land of Don Quixote.

Mr. M. Bernard Drake recalled his experience of the installation of electric light in Spain, where he was arrested as a smuggler on the ground that the coil of "rope" he carried contained hidden copper. Eventually he was able to show the first arc lamp in Madrid. On one occasion a shortage of cables was made good by iron hurdles suspended from trees—this was regarded by German engineers at work in the city as an essential part of the Brush system and caused them much puzzling. The next event was a dispute with a Spaniard who wished to take over the working. In order to prevent interference Mr. Drake pocketed a brush, which again led to arrest for theft and a challenge to a duel.

On his return to England Mr. Drake was responsible for the lighting of the railway stations at Bristol and Cardiff. The next step was an appointment as managing engineer of the Electrical Power Storage Company, when the batteries did not last well. Many of the later improvements in batteries such as the use of wood separators, were, however, tried in these early days. The

long life now obtained was due as much to increased knowledge of use as improvements in the plates themselves. Until some entirely new departure was made not very much more could be expected from lead batteries, said Mr. Drake.

Fifty Years of the Electric Telegraph.

Sir William Noble, in his address on the "Electric Telegraph," recalled that several distinct telegraph companies were in operation up till 1870, when they were taken over by the Government. Subsequent developments had been rapid showing that a State monopoly does not necessarily retard advances. Efforts were soon made to attain uniformity in apparatus, and the single needle was displaced by the sounder on all important circuits.

Methods were adopted to improve the carrying capacity of lines. Duplex working, invented by Gintl in 1853, was introduced by the Post Office in 1873; quadruplex working, independently devised by Heaviside in 1873 and Edison in 1874, came into use soon after 1876. Post Office engineers had eliminated many radical defects in all these methods, and had practically evolved a new system.

Another outstanding invention, the Wheatstone automatic system, was likewise developed and improved. Other advances included improvements in methods of repeating signals and refinements in balancing duplex circuits. In 1919 676 Wheatstone automatic sets were in use by the Post Office.

Printing Telegraphy.

The Hughes Printing Telegraph was used in the British Post Office in 1889, and has been much improved. Multiplex telegraphy had revolutionised telegraph practice. In 1886 it was used as a single current system, but two P.O. engineers, J. Chapman and R. Hendrie, enabled it to work double current, and later on S. A. Pollack, also a P.O. engineer, applied diplex, either operators working simultaneously, four in each direction. The adoption of a five-unit code in place of the Morse "dot and dash" enabled multiplex to be used on circuits of much lower line speed; this was substantially the Baudot system developed in France and successfully duplexed in by A. C. Booth in 1905, with most important results. The twelve-channel set working on one circuit between London and Birmingham had carried more than 8 000 messages in a day of twelve working hours. Yet another outstanding achievement was the design of the multiple intercommunication switch by T. F. Purves, adopted in London in 1902, which greatly expedited the transmission of telegrams within the London area.

It had always been the practice of the Post Office, concluded Sir William, to encourage inventors. The Creed, and Murray apparatus illustrate the success of this policy. Important work had been done in recent years in improving primary batteries, and their displacement by secondary cells in large offices. The British Post Office had always been pre-eminent in methods of line-construction, and underground construction had also made rapid progress.

Early Electricity Supply in Brighton.

Mr. A. Wright's communication consisted of an interesting chronological survey of electricity supply in Brighton up to the year 1889. An exhibition of Brush arc lighting was given in 1881, and Robert Hammond was persuaded to leave the plant there for experiment. Finally a few enthusiastic consumers were found who were willing to pay 12s. per week per arc lamp, and permanent supply commenced in 1882, when sixteen lamps were contracted for. In 1883 business increased, and a tariff of 6s. per arc lamp per week and 1s. 6d. for each carbon consumer was fixed. This meterless tariff attracted consumers. In 1884 a method of metering combined arc and incandescent lamps was devised, and by the end of the year the Brighton Electric Light Company was formed. The result of the first year's trading was a 4 per cent. dividend on a capital of £7 240 and the supply to forty customers taking twenty-seven arcs and 874 incandescents. In 1885 a tariff of 1s. to 1s. 4d. per unit, under specified conditions, was adopted. By 1888 the constant current system was replaced by the more elastic a.c. system with transformers.

Early in 1889 Mr. Wright severed his connection with the Brighton Company and joined Mr. Ferranti's staff in London. Early developments at Brighton were fully described by the late Mr. Snell in the twentieth volume of The Electrician in 1887.

The Work of John Hopkinson.

Mr. C. H. Wordingham said that he was articled to Dr. Hopkinson in 1885, but that great man had earlier aroused his interest by the prediction that a.c. machines would work in parallel. This was verified by Prof. Grylls Adams at the South Foreland with some lighthouse machines, on the occasion of some tests of the relative merits of gas, oil, and electric light for lighthouse purposes. Dr. Hopkinson was responsible for several epoch-making Papers, notably that written with his brother on dynamo electric machinery, and that delivered as his inaugural address to the Junior Institution of Engineers (1895), on the principles governing the cost of production and methods of charging for electricity.

The Battle of the Systems.

Mr. Wordingham also assisted Hopkinson in his work on the Manchester and Whitehaven generating stations, schemes which deserved great credit for their boldness. For by the three-wire system he was able to attain nearly all the advantages of the higher pressure which the 200 V lamp afterwards made possible. The Manchester and Whitehaven systems were the first to have the middle wire of a multiple wire network connected solidly to earth. This doubtless caused most of the early troubles with these mains, owing to the maintenance of a pressure of 200 V. between negative and earth, which forced the current through the dielectric. In those days the "battle of the systems" was in full swing. It was hardly credible that the generators at Manchester, the largest of which was of 240 kW capacity, were looked upon as tremendous machines and referred to as "Jumbos."

Meter Difficulties.

Mr. Wordingham also recalled the introduction of meters on the system of the London Electric Supply Corporation. At that time, 1889, Ferranti was the presiding genius. The results of the introduction of meters were remarkable. Some consumers found their consumption reduced to a third while others were troubled by an increase, leading to stormy interviews. Recollection of those days raised doubts of the merits of contract rates per lamp and other panacea for producing revenue. "There is only one true system of charging and Hopkinson is its prophet," said Mr. Wordingham. In conclusion the speaker paid a tribute to Dr. Hopkinson as an educationist. His mind was so clear and everything he did so directly to the point, and he was always equable and reasonable. High as his reputation was much more would be said about him if the full extent of his work and inventive genius were more widely known.

Mr. Atkinson's Summing Up.

Mr. Atkinson said that the President had asked him to say a few words at the close of the meetings by way of summing up. There was no doubt that the meetings had been a great success, that the audience had been carried into another age, but an age so near to our own, that many of those who had worked in it were still taking an active part. It was well that on the fiftieth anniversary of their first meeting they should collect and visualise a little of the past age because he believed that they were now at the beginning of another age, a tremendous era when the use of the atom and its energy would probably replace all the generating appliances they had been considering.

Mr. Atkinson recalled a few of those who were of this age, but also had gone, including Thomas Parker, who he believed was in turn ironmonger, travelling showman, mesmerist, and then electrician, Hughes, whose name had been mentioned in connection with the electric telegraph, and Ayrton, who was a great man in spite of the idiosyncrasy that he claimed every invention under development as a child of his own or Perry's.

The Ignorance of the Early Workers.

During these meetings it had come to him with great clearness how tremendously ignorant the early workers were and what difficulties they had had to overcome. In Crompton, Kennedy, Raworth, and Kapp they had examples of well-trained expert engineers who had had to begin to learn electrical science in the middle of their professional and commercial life. Then there were Hopkinson, Forbes, Oliver Lodge, Silvanus Thompson, men of university training, knowing the mathematical side, but with little of that practical knowledge of engineering which proceeded from actual contact with things. A third type such as Ferranti, Mordey, and Ravenshaw trained themselves and a great many others.

Three Different Languages.

In the electrical world in these days they had three different languages. In a lecture at the Institution of Civil Engineers, Hopkinson had treated the equation of the motion of two parallel connected alternators as an equation of the motion of two moving bodies with a certain force between them. He proved by equations that the motion was suitable, and therefore they would run in parallel; but nobody believed him. When Kapp gave a Paper at the Institution of Electrical Engineers on transformers, George Forbes jumped up and put a few differential equations on the board which he said gave the whole theory of transformers, but he was speaking a language that transformer makers did not understand or believe in. Blakesley showed by graphic vector algebra what took place in alternating current circuits, but it was beyond the practitioners; besides, the alternator did not give the required sine wave. He laid stress on these matters because they explained to his mind many of the difficulties that had arisen. As Col. Crompton had said, those were joyous days. An experimentally discovered fact would always give more pleasure than a deduction from theory.

This concluded a most successful Commemoration.

The Home Idealised.

No doubt many electrical engineers, either in their official or domestic capacities, will visit the IDEAL HOME EXHIBITION which opened at Olympia on Wednesday of last week, and remains open until Saturday, March 25. If up to the present they have not arranged to do so they should change their minds, for there is on view a good deal which is of real electrical interest, of educational value and of suggestion for future action.

The Householders' Aim and Object.

This exhibition, indeed, is not as other exhibitions. Its appeal is general rather than specialised, particularly in these days of housing problems. For everyone has to have a home of some sort, and everyone can, therefore, visit Olympia with advantage and obtain hints how their present methods of living and house equipment may be improved. Incidentally, they may learn a little what to avoid. The present aim and object of every householder, and particularly of every householder's wife, are to discover and install labour-saving appliances which shall reduce to a minimum the work which is of the most tedious kind, because it has ever to be repeated and never leads to any tangible results. From this point of view the exhibition is an education, and the only reasons which prevent our homes being bettered on the lines suggested by various exhibitors are the infinity of choice of method, an innate conservatism and the high prices that must be paid before the goal can be reached.

Solely from the electrical point of view the exhibition does not display anything that is startlingly novel. At one end of the scale there is a wide assortment of small country-house lighting plants, which their manufacturers assure us are better designed and more economical than anything else of the kind on the market, but the cynically-minded have heard that before, and turn away with the reflection that, if the plutocrat wishes to light his house electrically—and, of course, all plutocrats do—he has ample choice of many sorts of equipment which do not really differ very much from each other either in price or efficiency. It is with the middle class that we, as electrical engineers, should be mainly concerned. There lies the demand and there lies our strength.

Help for the Middle Classes.

In the more purely domestic section, i.e., on the stands where heating and cooking apparatus are shown, the same tale holds good. There is little of novelty, but much of interest. For electric cooking and heating apparatus is becoming at once a more engineering job and a piece of apparatus which can be safely entrusted to ordinary domestic hands. This is not a paradox; but an eternal verity. On these stands also there may be found a large variety of approaches towards the same end, though designs differ both in scope and in detail, for while there are some who worship at the shrine of solidity, others believe in the goddess of cheapness. Generally, however, the apparatus on view is much more capable of its work than it was only two years ago, and there is also a pleasing recognition on the manufacturer's part of the fact that price has been in the past a real obstacle to electrical development.

Out-of-Date Illumination Methods.

We first visited the exhibition at a time when it was comparatively empty, and took the opportunity of visualising generally the various exhibits so as to try and discover tendencies. A large majority of the stands are not, of course, officially of electrical interest, but as all of them, except those which are occupied by the gas industry, are electrically lighted, a few remarks on the systems of illumination adopted may not be out of place. Primarily it is interesting to note that the aisles of the exhibition are still lighted by arc lamps of an antiquarian pattern. This, of course, has nothing to do with the exhibition organisers, but must be laid entirely at the doors of those who own Olympia. On most of the stands, as might be expected, gasfilled lamps are prominent, and, though these are generally properly shaded there are a few glaring instances to the contrary, and it is regrettable to notice that electrical firms are among the sinners. What can be said of the man who illuminates (save the mark) his stand with gasfilled lamps protected by no shades whatsoever, and so arranged that anyone approaching down a neighbouring aisle receives the light from the unshaded filaments like a whip-lash across his face? Almost worse, if that is possible, is the man who "protects" his gasfilled lamps by plain shades as exiguous as a ballet dancer's skirt, and who places these lamps so low that they are really an interference with those who wish to see what he is exhibiting and with those who rent neighbouring stands.

Illumination as it should be.

These criticisms are necessarily severe, but we do not thereby wish to detract from the excellent lighting schemes which are to be found on a number of the stands, mostly the electrical ones. Interesting, as being novel, is the free use made of neon lamps for sign purposes, and the schemes in which these lamps are employed are often very well worked out. There are bowl fittings innumerable, most of them excellent from the illumination point of view, and many of them of high artistry in both design and execution. In some cases, however, the illumination of the more decorative stands occupied by furnishing and other similar firms is too low, and is therefore hardly calculated to show the exhibits up in the way they should be shown up. This is a matter which, in these modern days, the furnishing trades might take up with advantage for good illumination is most necessary for the adequate display of their goods.

Royal Gardens and Daylight Illumination.

Excellent use has, we are glad to see, been made of modern illumination methods in the ten gardens which have been designed by various Royal ladies. These gardens, which occupy the annexe, are illuminated by a special lighting scheme consisting of Mazda gasfilled lamps and CHANCE BROTHERS' colour-matching glass.

The installation was designed by the BRITISH THOMSON-HOUSTON Co.'s illuminating engineers to illuminate the model gardens in such a way as to obtain a permanent sunlight effect, and to preserve the natural colours of the flowers. These objects have been successfully achieved, and it may be claimed with justice that the installation represents an important advance in the production of artificial daylight on a large scale.

The equipment consists of 60 concentrating type Mazdalux reflectors, fitted with Chance's sunlight glass rectifying screens, and each reflector contains a 1 000 W Mazda gasfilled lamp. These units are suspended at a height of 20 ft., so that the bottoms of the reflectors project just below the azure blue muslin-ceiling, which forms the "sky" of the annexe.

Turning to the more purely electrical exhibits this year as the exhibition organisers have discarded the use of model houses which were so prominent a feature of the exhibition two years ago, many electrical firms have been prevented from showing their domestic apparatus in a wholesale fashion. Nevertheless the same end has generally been arrived at in different ways.

Nine Years' Specialisation.

A firm who have been specialising for no less than nine years in the manufacture of electric fires and cooking appliances are BELLING AND COMPANY. The latest outcome of all this concentrated work is a 2 kW fire which we illustrate herewith (Fig. 1).

This consists of a small dog grate with electric fire bars well to the front, the top of the fire being cleverly shaped and coloured to represent glowing embers. But this is a delusion, for the top is really illuminated by suitable lamps in the body of the fire, the light being thrown upwards and downwards by aluminium reflectors. The effect is cheerful, more psychology! In this fire Belling's

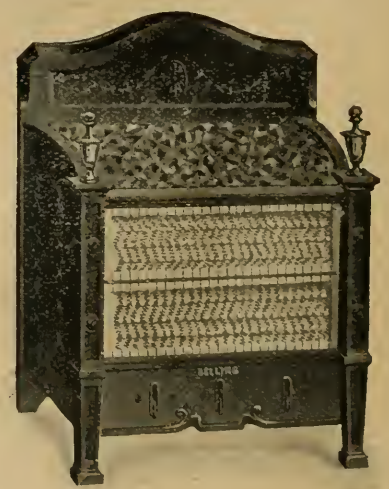

FIG. 1.—THE BELLING "IMITATION COAL" FIRE.

new multi-parabolic bar is employed. This consists of the usual base of vitreous material, which is given a fixed curvature and the face of which consists of a large number of wells of parabolic shape, in which the wire is seated at the correct focus. This arrangement, it is claimed, is very efficient, as the curved formation results in the heat being well distributed throughout the room.

Switches for the Lazy.

As will be noted from the illustration, three switches are provided, one for the lamps and two for controlling the heater. These, which are so arranged that they can be worked by the foot, are of

the MK pattern, giving a free and positive make and break. They are so designed that no lateral motion of the switch handle is possible even if the foot be placed not quite centrally upon the handle, or if the handle be kicked rather than pressed. In construction these switches, which are of the double-bladed knife type, are very robust, and mica has been largely relied upon for insulation. We are interested to learn that Belling & Co. are adopting this switch as standard throughout their fires, not only for the sake of solidity, but to simplify the connections.

Another interesting fire is shown in Fig. 2 This is a combined radiator and air warmer, the volume of circulating warm air passing

Fig. 2.—The Imperial Fire.

behind the bars being controlled by a regulator. The design of frame also conforms to the latest parabolic principle for throwing the heat forward, and in addition the fire is fitted with foot switches described above, and with a trivet which can be placed either above or below the bars.

Among the cooking apparatus on this stand we noticed a three-heat griller and boiler with a loading of 1 200 W and fitted with a three-heat switch. This griller has a range of rings so that utensils of various sizes may be used. Accessory to it is a sheet body fitted with a top element so that roasting, grilling and boiling can be carried on at the same time at a low cost from a combined apparatus. Needless to say the " Modernette " cooker is in evidence and is now fitted with a hinged top and with a double-grill which can be turned into a boiler by the employment of a reflector plate. The enamel drip tray at the bottom of the cooker collects all the fat which drops right through the element. As before, a most useful accessory is the plate warmer chamber which is fitted at the side.

Sturdy Switches.

Also to be found on this stand are a selection of MK plugs and sockets, noticeable among which is the combined foolproof switch and plug and the D.P. main switch for small houses. This exhibit is really an offshoot of Belling & Co.'s new showrooms at 18, Berners Street, and we are interested to learn that all business done at the exhibition will be executed through contractors in the purchaser's district.

Jackson Junior Joys.

If anyone says Jackson, we all think of cooking. This time we are not far wrong, for the Jackson Electric Stove Company are showing an example of their well-known No. 21 cooker, in which the hot plates are fitted with open elements. They are also displaying a number of electric heating, cooking, and labour-saving devices whose details are so familiar to readers of The Electrician that we need say no more. We, however, did note a 750 W electric fire designed for hanging on the wall, and specially intended for use on board ship or in nurseries, where a certain amount of foolproofedness and untouchableness are desirable qualities. One of the pieces of apparatus on this stand which should cause the greatest attention among " small house " wives is the No. 19 cooker, which consists of two hot plates and an oven, and which in spite of its diminutive size will, we are assured, cook a full size dinner for four full-sized people. No more worrying about whether the fire will burn or burn too well and carbonise the joint! A display of irons, combined grills, and boilers and enamelled iron fires at very moderate prices, should send the anxious housewife away envious and determined to use nothing but electricity in her ideal home.

(To be continued.)

Correspondence.

ELECTRICAL versus MECHANICAL ENGINEERS.

To the Editor of THE ELECTRICIAN.

Sir,—"Nabia's" letter in your issue of February 17 cannot be allowed to go by default as a verdict against the electrical engineer's independence.

His letter is balanced and judicious, and I have considered carefully in consequence the probable reasons for his conclusions. The first reason is, I think, what he himself states: that he has "no special knowledge of railway administration," but it is not so much, I think, the want of knowledge of railway administration as the want of conception of the size of railways, the action of which has given rise to this correspondence.

In a small firm, and possibly in a small railway, the work of the different engineering branches is not of sufficient size to warrant a special independent sectional engineer. This is a disadvantage to the small railways, as they fail to gain the advantages of the imagination and initiative of each engineer, which qualities are only properly fostered and used to the gain of the company if the officer is independent of any control except that of "policy" control; in fact, that of the general manager in the case of a railway.

There are at least ten railways in England large enough to enjoy the great advantages not only of independent civil engineer and independent mechanical engineer, but of an independent electrical engineer.

The argument applies to all three sections of engineering, but it applies with greater force to the electrical side, as modern developments have been and will continue to be almost entirely developments accomplished by electrical means, requiring an electrical engineering knowledge and imagination of a very high order. That such high imaginative work will not be carried out except with an absence of other engineering control I regard as a law of human nature, and am quite prepared to verify it from actual experience.

There can never be a strict line drawn between any of the sections of engineering, and certainly not between electrical and mechanical engineering, but no difficulty should be experienced by a first-class commercial man, having directly under him three independent engineers (one for civil, one for mechanical, and one for electrical work), in apportioning their activities so that each could be doing the work for which he had been mostly trained and for which his imagination best suited him; the work therefore for which he would give the best results to his company. I am, &c.,

"Railwayman."

["Railwayman" asks us to state that he is not accustomed to being anonymous, but that under the circumstances it is inevitable.—Ed. E.]

THE "REVO" ELECTRIC IRON.

To the Editor of THE ELECTRICIAN.

Sir,—We note your correspondent's further letter with reference to the above. He now says there is nothing wonderful in the performance, although he stated in his previous letter that the result was impossible of achievement and by calculation proved this to his own satisfaction; that his calculation was incorrect as well as his statement does not apparently matter. His main idea appears to be to belittle the result somehow; that your correspondent did not make sure of his ground is his own fault, and "the nigger" he has discovered is, to use another simile, "his own baby."

Your correspondent made the mistake of assuming that the electric iron overloaded 150 per cent. would be left on circuit continuously even when too hot to use for ironing, knowing full well that it is one of the easiest things imaginable to disconnect an iron from the supply.

We submit also that it is not fitting for Mr. Scourfield to complain that we are not precise and then deliberately to misquote from our letter. We certainly did *not* say that an electric iron "is never in use continuously *during ironing operations.*"

Your correspondent says that "if an electric iron is to be switched off every few minutes to prevent overheating and burning of the material, ironing under these conditions would become not only laborious, but extremely dangerous," certainly, but is not the user who puts 100 V appliances on 200 V circuit "asking for trouble"? Then your correspondent's remarks tend to show that he is not conversant with modern irons, or else pretends not to be, for they do not lose their heat in a few minutes. We are, &c.,

Cable Accessories Company, Ltd.
P. W. Davis, Engineer.

Tipton.
February 20.

ROTARY CONVERTER PRACTICE.

To the Editor of THE ELECTRICIAN.

Sir,—With reference to the article on "Rotary Converter Practice" in the last issue of The Electrician, it may be of interest to your readers to know that there are at present two 1 500 V 50 cycle 375 kW traction rotary converters in operation in Switzerland which have given excellent results. These machines are at

the Rosental sub-station of the Frauenfeld-Wil Railway, and have been supplied by the Oerlikon Company. Though the machines are now working at a pressure of 1 350 V they are designed for 1 500 V, and have been subjected to exhaustive tests at the latter pressure. The Rosental sub-station is, we believe, the first installation on the Continent to be equipped with 50-cycle rotaries for such a high pressure. We are, &c.,

OERLIKON LTD.

London, W.C. 2. G. WÜTHRICH,
March 6th. General Manager & Chief Engineer.

Electric Light Salesmanship.

At a conference of the ELECTRICAL DEVELOPMENT ASSOCIATION on Feb. 17, Mr. Hadyn Harrison read a Paper on "Salesmanship in Relation to Electric Lighting." Mr. J. W. BEAUCHAMP presided in the absence of Mr. S. T. Allen, who was prevented from attending owing to his work in connection with the N.W.-Midland electricity inquiry.

First Line of Attack.

Mr. HARRISON said that creating a market for anything was generally done by making people dissatisfied with what they already possessed. Just as the advent of the oil lamp had made our forefathers dissatisfied with candles, and the advent of gas made them dissatisfied with oil lamps, so electric light had made many dissatisfied with gas. Even now, however, electric light was far from universal. This was nearly always due to the initial expense, and this should be therefore the first line of attack in order to gain business. Electricity supply undertakings at one time did not encourage lighting as much as they might have done on account of the poor load factor. but now that it had become such a small proportion of their load they no doubt realised that lighting at the present rate was to be encouraged in every way. If the supply authorities had the powers or the means they would probably go in for free wiring and prepayment meters, but this was seldom the case, and the salesman must find some other way of circumventing the difficulty.

The Lower Middle Classes.

The greatest field yet untouched lay among the lower middle classes, the majority of whom lived in houses which were not their own property, and who, therefore, hesitated to install electric light unless the landlord would assist with the expense in some way. The landlord was therefore the man to be tackled. He complained that he was not earning enough on his investment, which was often true, but by spending the necessary capital to wire the house he could increase the rent, for the tenant would be prepared to pay more for the additional advantage of electricity.

In order to ensure that electric light produced a bright and pleasant result it was necessary to do something more than fix a few electric lamps. The endeavour should be made to obtain the same low intrinsic brilliance which gladdened the eye when looking at the light source and yet produced that light which tends to make every occupation a pleasure. The lecturer particularly warned his audience against using too large a shade for the power of the lamp, because the bright appearance would immediately disappear, though the lighting be ample. He also warned them against the use of indirect and semi-indirect fittings, consisting of alabaster or other bowls, unless the cost of electrical energy was of no importance. The "Denzar" fitting used in America was, perhaps, the most suitable for nearly all purposes.

Standard Designs of Shades and Fittings.

Mr. Harrison was in favour of the introduction of a few good standard designs, because the present multitude of inefficient types of shades and fittings confused prospective users of electric light to such an extent that they chose something unsuitable. A salesman should know what he was selling, and a man selling a few lines or even one article, of which he knew the capabilities, was in a better position to do good than the man who brought a hundred and one things to the notice of a customer and knew little about them.

The chief difficulty, however, was to turn scientific facts into talking points, to create the electrical idea. When discussing the proper use of shades, &c., it was best to explain that a saving would be effected in the quarterly bill which would soon wipe off any extra expenditure on the installation. The same applied to cost of electric lighting generally, and it was better to talk of the average cost of an electric lamp per annum than of the total cost of an installation. Mr. Harrison then referred to the difficulties experienced by salesmen with regard to the power of lamps required. Such terms as candle-power, lumens, foot candles, &c., were bandied about in a most careless way by many people who had not investigated what they really meant.

The Study of Decorations.

It was also worth while for an electric light representative to study decorations, and the influence of light and colours upon them. Good artificial lighting, by the influence it had on the appearance of furnishings, &c., would often change the appearance of what was in day-time a dreary room and make it, when lighted artificially, bright and cheerful. Other valuable selling points included the saving in cost of decorating and cleaning, purity of atmosphere and convenience. But all these advantages required to be inculcated by literature or word of mouth, whereas light and brightness spoke for themselves. In order to advance the adoption of electric light every firm or salesman should make certain of marketing something which would help to advance the industry as a whole. It was a mistake to claim too much, as nothing was suitable for every purpose, and claims of such a nature did more harm than good.

The Gasfilled Lamp Criticised.

In the discussion which followed Mr. RAWLINGS said that it was a scandal to the industry the way the gasfilled lamp was being sold. Because it started as a half-watt lamp, the public thought it would only consume half as much current as a one-watt lamp, and the result was that the current consumption was increased, the light was so strong that it almost blinded everybody, and the industry had suffered. If salesmen were a little more careful in advising their clients of the defects as well as the advantages of lamps it would be better.

Mr. SIMON criticised the practice of lamp manufacturers of advertising so extensively their own individual lamps. Valuable space was occupied in that way which could be used for educating the public on the advantages of electric lighting. His experience of contractors—he was a contractor himself—was that they were a self-centred body, and the direction in which they failed was in not helping to develop the industry as a whole. The writing of non-technical articles on electricity in the daily Press would help tremendously.

Mr. CAMPBELL dealt with educational work and blamed the central station people for not approaching consumers as often as they ought. The average consumer was not served properly by any branch of the industry with regard to improving his lighting. He agreed that a standard of some sort should be set up of what a man really wanted.

Supply Engineers' Failings.

Mr. ROGERS dealt with the point that central station people did not approach their consumers. Speaking as a supply station man he could say that, as a rule, the supply stations were condemned and damned for suggesting anything of the sort. He had been struck by the state of some showrooms which contained a conglomeration of fittings, and there was absolutely no chance of showing what any one of them would do.

Mr. BUSH did not agree with Mr. Harrison as to opalised bulbs. If a filament were too bright why bottle it up? Why not put up an efficient reflector? He did not agree with standardising fittings. The Denzar fitting might be very useful in an office, but it was hopeless in a house.

Cheap Current.

Mr. YOUNG said that contractors were doing their best under existing conditions, and pointed out that it would be of great assistance if supply companies gave them current at reasonable rates to enable them to demonstrate their goods in the proper way, and so increase the sale of electricity. He asked that contractors should be registered.

Mr. BEAUCHAMP stood up for the contractors, and said that as a body they were expanding electrically. Co-operation was growing, and that only would enable them to take advantage of expert advice in connection with their advertising. He pointed out the immense advantage of articles such as that which Mr. Simon had mentioned, and asked that others should try to support the industry in that way.

Mr. HARRISON in the course of his reply said he had been misunderstood with regard to standardising. He did not suggest a standard fitting, but that we should if possible have a few standard types of fittings which would give good results. Mr. Simon's suggestion of standardising particular types of illumination, was extraordinarily good. They would then be able to say a reading illumination would be put into one room, a dining illumination in another, and so on. He agreed with the suggestion that electrical contractors should be registered.

Turbo-Alternator Transport.

The York wagon works of the North-Eastern Railway have produced a new 70-ton bogie TROLLEY WAGON for the CONVEYANCE OF STATORS FOR TURBO-ALTERNATORS from the Tyne. The wagon is mounted on two six-wheeled bogies, with plate-side frames, and will carry a load up to 70 tons, either concentrated in the centre or distributed over the well, and is fitted with transverse and longitudinal beams for securing the load. The total length is 57 ft. 6 in., with 54 ft. 6in. over the head stocks; the wheel base of each bogie is 12 ft., the length of well at main girders 14 ft. 6 in., the width 8 ft. 10in., and tare weight 38 tons 16 cwt. 3 qrs. The wagon, it is stated, will shortly convey its first load, a stator from C. A. Parsons & Company, for Shanghai, which will weigh 60 tons.

British Industries Fair, Birmingham.

Domestic Electric Fittings and Fires.

The display of domestic fittings at the Birmingham Section of the Fair is sufficient illustration of the remarkable progress that has been made, particularly since the Armistice, on the artistic side. "Period" styles occupy a leading position, and so do examples of indirect methods of illumination, alabaster being among the most popular of the materials employed. There is also a comprehensive display of electric radiators and cookers, while kettles, boilers, irons, toasters and similar equipment are to be seen in increased quantities.

Electric light fittings, in most artistic designs and of superb finish, are shown by David Shanks & Company, Ltd., of Birmingham (A Building, Stand 20), who have also on view an extensive display of fittings of a specialised kind such as are required in cinema theatres and on ships. Among domestic illumination fittings, the English alabaster bowl occupies a prominent place, these bowls being carved in many beautiful designs. In regard to cinema lighting, specialisation has been greatly developed, and some of the goods displayed show a nice appreciation of the novel requirements of picture houses. Electric signs are also specialised, and may be seen in a very wide range.

The "Angelus Ray" Element.

The British Brass Fittings, Ltd., Birmingham (which includes the firms of Sperryn & Co., Charles Joyner & Co., Ingram & Kemp and Player & Mitchell, all of Birmingham), makes a very representative display of the brass goods produced in the four factories of the amalgamated firm. The range includes electric light fittings, electrical accessories, and tram and railway fittings. Electric heating on the "Angelus Ray" principle is shown to be thoroughly effective in a number of applications, the principle being that the whole of the radiant heat is concentrated and thrown forward by means of reflection. The "Angelus Ray" element consists of an open frame made of nickel-plated steel, which is fitted with a detachable reflector and a double row of small insulators; the latter are of highly refractory material, and between them the resistance wire is suspended. Many artistic patterns of frames of "Angelus" fire are displayed, as well as pedestal fires with a parabola reflector, with surface highly polished, and giving an intense concentrated heat.

On the stand (No. 21, Building A) of William Whitehouse & Co., Ltd., Birmingham, electroliers of beautiful design and in solid brass cast, in oxidised silver, are an arresting feature, and among many other things the firm gives prominence to an elaborate fitting with 12-light Huntalite candles. This exhibit is in itself a fine piece of workmanship and solidity, weighing about ½ cwt.

T. R. Carpenter, Ltd., of Birmingham (Building A, Stand 3) are responsible for a good display of electroliers, shade pendants and bowl fittings, as well as for table and floor standards, many in oxidised silver. Among the table lamps shown the Georgian and Jacobean styles predominate.

Superior Electric Fires.

May & Padmore (Building A Stand 69) feature their "Maymore" electric fires, irons and electric cooking apparatus. These have evidently been designed to conform to the decorations of better-class homes, the colours being carefully selected and the work carried out in vitreous enamel finish. The elements are carried on good-class heat-resisting porcelain, and are designed to give maximum heat in proportion to the current consumed. The stock voltages are: 100/110 V, 200/220 V and 230/250 V, the loading being 375 W and 500 W per element bar. A capital range of electric fires include one, two and four bars, and a new bowl fire is displayed; this tips up and provides a rest for a kettle. A useful immersion heater, loaded at 250 W, is also given prominence.

The Premier Heaters, Ltd. (Building A, Stand 36) display a wide range of electric heating and cooking apparatus, electric fires and radiators, and there are handy and efficient contrivances for use in tailors' and laundry workshops.

On the stand of Evered & Co., Smethwick (Block A, Stand 23), there is a very fine display of electric fittings, which are excellent examples of decorative art. One is an ornate cast brass fitting of the French style, from the centre of which emerges three large alabaster shells. The flambeau for hotel halls and picture houses is also very effective.

For another exhibit of more than ordinary interest, Best & Lloyd, Ltd., Handsworth (Building A, Stand 32) are responsible: it is noteworthy by reason of the artistry that is shown and for the beautiful finishes. Many of the samples are in the Period style. Indirect illumination methods are predominant, English alabaster bowls being an excellent feature. Other items of interest include the "Best" electric heaters.

The Falkirk Iron Co., of Falkirk, have a representative display of their well-known electric cooking apparatus. As this is also being shown at the Ideal Homes Exhibition, we shall describe it in due course under that heading.

Country House Plants.

Engines of various types are displayed on Stand 176 (B Building) by the Heatly-Gresham Engineering Co., Ltd., Letchworth. Among the combined sets shown are some compact models suitable for country house and farm lighting and power requirements, for working cinemas and for the supply of electric light and power in any isolated situation. The dynamos of these sets have been lent by Electromotors. A standard battery charging switchboard, by Crompton & Co., is also exhibited, together with a model storage battery manufactured by Pritchett & Gold and Electric Power Storage Co.

The Austin Motor Company, Northfield, Birmingham (Building A, Stand 49), make a feature of their automatic lighting sets (which are seen in motion), and which are suitable for private installations in country houses, hotels, farms, and the like.

Electric Hoisting Gear.

Holt & Willetts, Cradley Heath and Lye (B Building, Stand 163), make a feature of electric power machines of various kinds. One, a hauling winch, is fitted with warping drums and driven by totally enclosed electric motors, capable of lifting 3 tons at a speed of 50 ft. per min. All gears are machine cut, the pinions being of mild steel. Attention is also attracted to a direct coupled electric hoist gear for passenger or goods lifts, which is of the totally enclosed worm-geared type, with phosphor bronze worm wheel and steel worm. It is fitted with mechanical or electro-mechanical brakes, and either hand rope, switch in car, or full automatic push-button systems of control. The rope drum is of either the winding type or grip sheave type. This gear is made in various sizes to deal with loads from 5 cwt. to 5 tons. The firm also make heavy duty goods or platform hoists for loads up to 50 tons. An electric overhead travelling crab is shown, suitable for double girder electric overhead travelling crane, capable of lifting 3 tons at a speed of 25ft. per min. and travelling along the crane bridge at 75 ft. per min. This crab is of standard type, as supplied with 3 and 4 motor electric overhead cranes, and can be made of any span to suit the centres of gantry rails. Pulley block and friction hoists also command attention.

Controllers and Resistances.

The Electro-Mechanical Brake Co., Ltd., has an exhibit consisting of many examples of controllers and grid-type resistances. A range of steel-cased drum-type controllers for dealing with loads of from 5 to 100 H.P. are included. A special feature of these is the ease with which the drum can be withdrawn by simply loosening back four bolts. There is ample space for cables and entry at the back, side, or bottom of the controller can be arranged. For ships' winches a special watertight design has been produced. The "Midget" controllers shown are similar in some points of construction to the larger type, but are for single pole only and suitable for series motors, being especially adapted to the control of hoists, wall cranes, pulley blocks, or telphers. The frame consists of two cast-iron end plates supported by mild steel bars: the cover is of heavy-gauge sheet steel, and is secured in position by substantial quick-releasing latches. As in the large controller, arc shields are fitted between all contact fingers. These shields are mounted on a pivoted arm, allowing the whole to be swung out. The drum consists of a series of cast-iron sections clamped to a square mild steel shaft and insulated from it by mica. The drum contacts are of hard-drawn copper, fastened to the drum casting by countersunk headed screws, permitting easy replacement. A number of jointless and rustless grid resistances of various sizes are shown. These are made of wire of uniform cross-section and continuous length, with a temperature coefficient and current-carrying capacity similar to those of cast-iron. The insulation is mica and micanite, tested to 3 000 V. a.c. Resistances designed for special purposes such as battery-charging, locomotives, traction and kinema regulating are also exhibited.

Electric Furnaces.

The Ajax-Wyatt Furnace Company, 17, Victoria-street, London, show their electric induction furnace for melting brass, &c., on Stand 195 in Building B. This furnace is of exceptional interest in a centre like Birmingham, as it is specially designed for melting brass and alloys containing zinc and other volatile metals. As the heat is actually generated in the metal, and not conveyed by conduction or radiation, it is claimed that melting costs are much reduced. Clean scrap melted shows a loss of less than 1 per cent. of the total melt charged, while the loss of zinc is less than ½ per cent. of the metal charged in the case of ordinary yellow brass. Other advantages claimed include the complete mixing of the metals in the alloy. These furnaces, which were originally of American origin, are now being made in England by Campbell, Gifford & Company. On the same stand the firm is showing the Soderberg continuous self-baking electrode, which, it is claimed, marks an important improvement in the manufacture of electrodes, eliminating breakages and consequent trouble. Its cost is said to be about half that of the best quality amorphous types, and the consumption is slightly less. There are two types, one for tilting steel furnaces and the other for ferro-alloy, carbide, and other fixed furnaces. It is hoped that one effect of its use will be the cheapening of carbide and of ferro-alloys.

Hancock & Company (Engineers), Ltd., of Wallington, Surrey, show on Stand 169 in B Building their high-temperature electric furnaces, which may be seen working at temperatures up to 2 000° C., hardening high-speed steel, melting steel, &c. The furnace is a muffle-type furnace of the resistance type, the resistances running longitudinally up and down the outside of the muffle tube and being sealed between this and the refractory tube. The muffle and outer refractory tubes are made of a special grade of carborundum, which is capable of withstanding excessive temperature without damage.

The tubes have, we understand, a long life, and will not crack unless subjected to very rough usage. The resistances are made of a special carbon rod. The aim of the designers has been to produce a furnace which is, to all intents and purposes, indestructible.

The Premier Electric Welding Company, Ltd., of St. James's-street, London, S.W. 1, are showing on Stand 1, Building B, a particularly comprehensive exhibit of electric arc welding apparatus. The firm's plants are operated in accordance with their patent design, whereby series resistances have been done away with. They embody a special form of reactance which materially assists the welder in obtaining a steady arc.

"Apex" Switchgear.

An interesting exhibition of welding transformers, spot welders and switchgear of the quick "make" and "break" pattern is made by the Foster Engineering Company, of London (Building A, Stand 39). The principle of this latter action is embodied in the "Apex" switchgear, consisting of knife switches, ironclad switch-fuse gear, and mine-type switchgear. In the "Apex" ironclad switch, which is extremely small, the switch blades make and break contact at the same time, and the action, being a parallel one, ensures, it is claimed, the arc being distributed evenly over all four contacts. The switch blades are mechanically held off the contacts by the cover when the latter is open. Prominence is also given to the "Apex" water-tight fused switch, which is made in three sizes—30, 60, 100 A—the removable switch blades and fixed contacts being a self-contained unit in a box, so that their relative position is not altered when the cover is removed.

Mining Switchgear.

William McGeoch & Co., Ltd., of Birmingham, have a very comprehensive stand (No. 22, Building A), where electrical switchboards, switches, switch gear, fuseboards and couplings for electric railways and tramways are to be found. Prominently displayed is a combined ironclad switch and fuse box suitable for circuits up to 500 V. The switch is of the firm's standard S.D.B. type, the blades break simultaneously from both contacts and are dead in the "off" position; the contacts are mounted on porcelain, and the fuses can be withdrawn without the operator's hand coming in contact with "live" parts. There is also on view a variety of equipment for coal mines and for marine work, and among the former reference may be made to flame-proof switches and fuses for use in fiery mines. These switches are fool-proof and are fitted with steel coupling bars, insulated by micanite, mounted in cast-iron cases, the cable holes being fitted with glands for insulated linings. Other switches to which special attention may be directed are provided with cable-dividing boxes, and popular interest centred also on the Morse code electric flashing apparatus, for night signalling at sea, and on the navigation light indicators. By means of the latter, should a navigation light go out, the corresponding lamp in the engine-room lights up and a bell is rung, so that the fault is at once detected. The firm's display includes a wide range of electrical fittings, artistic and ornate, for use in the home or in theatres and other public buildings.

Power Presses.

Hollings & Guest's exhibits include their hydraulic tyre press for removing and fixing the solid rubber tyres of commercial vehicle wheels. Another important exhibit is a bending press for bending plates cold up to 6 ft. in width, as used for making safe bodies, tanks, conveyors, colliery tubs, and similar work. A hydraulic scrap bundling press is also exhibited by this firm. The press consists of a rectangular cast-iron box, 27 in. by 15 in. by 30 in. deep, with a hinged cover. The hydraulic ram is arranged underneath this box, with a table, which fits closely inside the box. The whole apparatus is let into the ground so as to bring the top of the box to a convenient height for throwing in the material. The box is filled with old tins and other material to be dealt with. The lid is then swung over, and the pressure turned on by the valve. As soon as the maximum pressure is reached, as shown by the pressure gauge, the operator releases the valve and swings off the cover, and the ram ejects the bale from the press. The operation is then repeated. For driving these machines—which are in actual working operation on the stand—a set of two-throw hydraulic pumps is supplied. These pumps present a novel feature, as they consist of a vertical two-throw pump built up on a bed plate and driven by means of chain gears from an electric motor. This gives a quiet and efficient drive, superior to the ordinary noisy spur gear drive.

New Range of Ironclad Switches.

J. H. Tucker & Company are exhibiting (No. 38, Building A) four examples of an entirely new range of small moderate-priced accumulator switchboards, specially designed for use with modern small private plants using low voltage metal filament lamps on the latest wiring systems, in addition to examples of their general switchboard components and various types of fuse and distribution boards. They are also showing an entirely new range of ironclad switches, without and with fuses, combined in the same box, embodying several patented improvements. A representative selection of fusegear for supply services and industrial use, to comply with Home Office requirements, will be on view. In connection with tumbler switches, a special demonstration is given of the numerous controls for electric light obtainable with "Tucker" switches. Though pioneers of this type of switch, several novelties show that the company are keeping in the forefront of modern progress.

Miscellaneous Exhibits.

Fuller's United Electric Works, Ltd., display on their stand (Building A, Stand 48) electric wires and cables, ebonite mouldings, and a complete stand of miners' electric hand lamps. The last named are fitted with block accumulators; they are claimed to be fool-proof and capable of withstanding very rough wear. The firm also show a mine signalling set, and over the stand appears a replica of a miner's electric safety lamp.

There are many interesting electrical contrivances, and one which will appeal to motorists is an inspection lamp (the Kendrick), the exhibit of the Neale Magnet Construction Co., Ltd., London, in A.A. Building, Stand 24. It takes the form of a combined lamp and electro-magnet, which adheres firmly to any iron or steel surface, thus enabling the light to be thrown on any particular point required. The base, which is magnetised, contains a coil connected to the ordinary circuit from the car lighting set; a push switch in the base facilitates rapid removal without putting out the light. The lamp is supplied for 6 or 12 V circuits, with bulb, flexible cord and box, and for 100 to 120 V and 200 to 250 V circuits for garages, engineers and shipbuilders.

The Ebonestos Insulators, Ltd., London (Building A, Stand 43), are well represented by moulded insulators for all classes of electrical work, specially adapted for terminal blocks and nuts, switch handles, bushes and bases. They are made in heat, alkali and acid-resisting grades, the material being in all cases impervious to moisture. Before the war this material was imported largely from Germany, but little has since arrived in this country.

Industrial Appliances, Ltd., of 38, Victoria-street, Westminster (Block B, Stand 255, and in the corridor leading from Block B to Block C), display their "Railodok" industrial freight truck. The reliability of these vehicles is generally recognised, and much help was given to exhibitors for the conveyance of their products from railway sidings to the various stands.

The Consolidated Pneumatic Tool Co., Ltd., London (Building B, Stand 13) make a feature of electric drills for drilling, reaming, tapping and tube expanding; also portable electric grinders and polishers and electric hoist, winch and saw. Electric welding plants on the resistance system, with examples of the work performed, are also shown, on which spot, seam and butt welding may be effected on one machine.

At the stand (133) of W. Canning & Company, Birmingham (A Building), one is able to appreciate by the wide range of goods there displayed how great has been the development in electro-plating and polishing. There is on view a good collection of low-voltage plating dynamos from 6 A to 500 A, though the firm supply complete sets in outputs up to 3 000 A. Space considerations will, of course, not permit of the display of these. Rotating plating barrels and polishing machines in motion give an added interest to this exhibit.

On the stand of Geo. Salter & Co., Ltd., West Bromwich (Building B, No. 236), there is displayed the Salter improved tension indicator and draw tongs for use in fixing and joining up telegraph and other electric lines.

Readers of The Electrician will be interested to learn that all the electricity meters used on the stands in this Fair were supplied by Chamberlain & Hookham, Ltd., of Birmingham.

On Friday last a party of representatives of the Electrical Wholesalers' Federation visited the Fair. They were entertained to luncheon at the invitation of the British Electrical and Allied Manufacturers' Association, many members of which are exhibiting. A cordial welcome was given by Mr. H. O. Worrall, the chairman of the Fair Council, who expressed the hope that all the electrical manufacturers would eventually participate in the Fair, and put up exhibits so extensive and of so attractive a character as to make the exhibition indispensable to those associated with the Wholesale Federation. Mr. A. G. Beaver, the newly-elected president of the Wholesalers' Federation, joined in the hope that some such arrangement might be brought about, and that they would all come in a body to view the exhibits. He believed it would be of mutual benefit.

U.S. Electrical Exports in 1921.

Exports of electrical goods from the United States in December, 1921, amounted in value to $5 177 276, making the total preliminary figure for the entire year $97 935 597. The following information taken from the U.S. "Commerce Reports" show the preliminary figures for 1921 with comparative data for 1920; batteries $3 831 738 ($6 633 542); carbons $433 869 ($1 477 831); dynamos and generators $7 942 473 ($7 796 305); fans $1 270 253 ($1 364 742); heating and cooking apparatus, $1 637 450 ($1 801 127); insulated wire and cables, $8 573 820 ($8 208 539); interior wiring supplies, $1 848 793 ($3 386 068); arc lamps, $13 795 ($25 098); carbon filament lamps, $125 045 ($114 542); metal filament lamps, $3 148 635 ($4 051 835); magnetos, spark plugs, $1 313 614 ($3 601 419); meters and measuring instruments, $2 726 448 ($2 676 538); motors $15 444 024 ($13 421 550); rheostats and controllers, $1 044 393 ($707 719); switches and accessories, $4 033 299 ($4 438 773); telegraph apparatus, including wireless, $1 010 891 ($713 798); telephones, $4 798 923 ($3 898 987); transformers, $7 988 440 ($4 803 158); all other, $28 628 982 ($32 868 433); total electric machinery, $95 814 885 ($101 990 004); electric locomotives, $2 120 712 ($880 430); total, $97 935 597 ($102 870 434).

Legal Intelligence.

The Lodge Tuned Wireless Patent.

On Monday the Royal Commission on Awards to Inventors, presided over by Mr. Justice Sargant, commenced the hearing of claims by Marconi's Wireless Telegraph Company and the Lodge Muirhead Wireless and General Telegraphy Syndicate for an award in respect of infringement by the Admiralty of Sir Oliver Lodge's patent, No. 11575 of 1897, the validity of which was established in 1920 before the late Lord Moulton.

Mr. J. Hunter Gray, K.C., for Marconi's Company, said they and the Lodge Muirhead Syndicate had come to an agreement, and were really supporting the same case. The Lodge Muirhead patents had been sold to Marconi's Company. The late Lord Moulton had found that the Lodge Patent was valid, and that certain instruments used by the Admiralty were infringements, and all the Commission had to do was to assess the amount of royalty to which the applicants were entitled. Lord Moulton's award provided that an amount should be paid by the Admiralty (over and above the amount already agreed for the use of Lodge's patents referred to in the schedule to the award), and that the Royal Commission should be requested to divide their award into three parts to cover the period (1) from the date of the patent (May 10, 1897) to March 31, 1903, (2) April 1, 1903, to Oct. 20, 1911, and (3) April 3, 1914, to May 10, 1918. On April 1, 1914, the Marconi and Admiralty agreement expired, and May 9, 1918, was the end of the 21 years of the Lodge patent, as extended by Mr. Justice Parker. On Oct. 20, 1911, the Lodge Muirhead Syndicate assigned the patent to the Marconi Company. From Oct. 24, 1911, to 1914 there could be no claim, because it was a patent vested in the Marconi Company. The claim of the Marconi Company was for £1 037 736, and that of the Lodge Muirhead Syndicate for £160 600. The royalties charged to the Admiralty and other purchasers had been for a long time £100 per ½ kW for large sets, and various figures down to £25 per ½ kW for very small sets.

The Chairman, being informed by Mr. Gray that the Admiralty had paid the same charge for instruments when there were 14 years of the patent to run as when there was only one year to run, expressed some doubt whether it was right that the Admiralty, who were statutory licencees, should pay the same amount in both cases.

Sir Arthur Colefax, K.C. (for the Admiralty) said the Admiralty claimed that they ought not to have to pay on the kilowatt per annum basis.

Mr. Gray said he was concerned at present with amounts that the Government had paid in later years. They paid £200 for 1½ kW or 1¼ kW. The Admiralty bought apparatus from the Marconi Company and paid a royalty of £200 per kW or part thereof, and he submitted that no other basis was so correct.

Sir Duncan Kerly, K.C. (for the Lodge Muirhead Syndicate) also addressed the Commissioners, and made a point of the fact that Sir Oliver Lodge and Dr. Muirhead made nothing out of the invention, and to this moment Sir Oliver Lodge had only made out of it a retaining fee of £1 000 a year for seven years, while the late Dr. Muirhead and his representatives had made out of it something like "a negative sum of £10 000."

Sir Oliver Lodge's Statement.

At this stage a statement by Sir Oliver Lodge (of which the following is an abstract) was read by Counsel:—In the early stage of wireless telegraphy the method of signalling was by sudden jerk—an electric pulse of whip-crack suddenness was emitted, and its effect at a distance was detected by the sudden snap of an insulating film in a receiving coherer. The emitter was an elevated wire excited by a spark, and the collector was a similar or the same wire attached to a coherer. Under these conditions no selection was possible. It could be done only by the introduction of self-induction in conjunction with capacity. Up to the time of my patent, neither of these ideas had entered wireless telegraphy. I arranged that the emitter should have both capacity and self-induction, which are essential to a tuning fork and every persistent vibrator. The use of self-induction was at that date not really known, even to some telegraphists of eminence, though the theory of electrical vibrations by aid of self-induction and capacity was known to Lord Kelvin and pure science ever since 1853. Self-induction, a name invented by Clerk Maxwell, was ignored by practical men as an unnecessary intrusion. Heaviside had applied it theoretically to cables, but neither he nor Lord Kelvin thought of applying the idea to wireless. The principles of persistent vibration being known, the novelty consisted in the practical application of these principles to wireless. It had not occurred to anyone to apply them, nor was it obvious how to do it. My own experiment of the resonating Leyden jars had given me the clue. I arranged that the oscillations should accumulate in a condenser, associated with a self-induction coil, until it overflowed. The overflow would give the necessary jerk and stimulate the coherer, but no overflow would occur unless the electric oscillations had been gradually worked up by resonance. And for that there must be tuning. The emitter must send out a long series of waves, therefore, instead of a single pulse. So I enlarged it into a capacity area, or pair of capacity areas, and I inserted a coil of variable self-induction between the two areas, or between one of them and the earth. Thus I gave both emitter and receiver capacity and self-induction, the essentials to durable electrical vibration. Emitter and collector forthwith became vibrator and resonator respectively. By the device of signalling on different wave lengths, all the complexity of modern wireless telegraphy became possible, and any one station could henceforth be listened to, to the exclusion of all others. The principle of resonance thus utilised is so powerful that there is no real loss of efficiency and the range of signalling is even increased by this device; for though each pulse may be insignificant, an accumulation of 30 or 40 pulses is wonderfully effective. The resonator picks up the vibrations intended for it, works them up to the desired intensity, overflows, and disturbs the detector and gives the signal. Vibrations of any other wave length cannot be worked up by sympathetic resonance, so they are powerless to disturb unless they are very strong, like occasional atmospherics. There is no other way of achieving this end electrically than by the use of self-induction and capacity, and my patent shows exactly how to use them, and therefore how to do it. It further shows how to modify the self-induction, so as to get oscillations of different wave lengths at will. It also shows how to construct a suitable resonator on the principles of the resonating jars, how to connect up the coherer or other detector, and how to tune the resonator accurately so as to pick up the desired station and ignore all others.

Sir Oliver Lodge accepted Sir Arthur Colefax's statement that at the time of the application for prolongation of the patent the accounts showed expenditure £33 167, which exceeded the receipts by £5 882. The patent was sold in October, 1911, to the Marconi Company, and the syndicate was liquidated. The consideration paid for the patents was £18 000 to the Muirhead Company, and he was to be retained as scientific adviser to the Marconi Company at £1 000 per annum.

Mr. C. F. Wilkins, director and manager of Muirhead & Co., gave evidence, which was chiefly directed to show that the amount of business done under the patent had not been very extensive, and that the charges made for royalties had been substantially on the same basis as those which were now claimed from the Admiralty.

Mr. Wilkins was still under examination when the Court adjourned.

B.T.H. Company v. Corona Lampworks.

On Tuesday Mr. Justice Astbury delivered his reserved judgment in this action to restrain an alleged infringement of plaintiff's patent (No. 23 775 of 1912) for improvements in and relating to evacuated vitreous containers having sealed-in conductors. The defence was a denial of novelty, want of subject matter and utility, anticipation and insufficiency of directions in the specification. After an elaborate survey of the evidence his Lordship found that the patent had been infringed, and granted the desired relief, with costs.

In the course of his judgment his Lordship said that the alleged invention included (*inter alia*) incandescent lamps. Prior to plaintiffs invention in 1912, platinum was almost universally used for the leading-in wires. Efforts had been made to find a less expensive substitute for platinum, and when it was remembered that 300 000 000 lamps were now sold every year, the importance of a substitute for commercial purposes would be realised. Plaintiffs claimed to have solved this problem and to have invented a substitute possessing commercial advantages far exceeding any alternative previously used. That substitute had displaced platinum almost entirely, and the cost of the new leading-in wires was trivial in comparison. In construing plaintiffs' specification it must be borne in mind that the first essential was that the wire should seal in the glass so as not to leak. The length of the wire was about thirty-two times its width and when the glass cooled and enclosed the wire the expansion and contraction of the wire would be largely controlled by the glass, and as the wire, when cold, must keep the hole stopped up, it was vital that the co-efficient of the wire should approximate to that of the glass. He construed the specification as showing an aggregate co-efficient which was what plaintiffs contended for, and if he were right in that construction and the patent was valid defendants' lamps were a clear infringement. On the question of the validity, his lordship examined the alleged prior publications, and said he did not find plaintiffs' invention or anything like it published in any of the prior specifications relied on. The next ground on which validity was attacked was that on insufficient or misleading directions. It was said that no directions were given as to whether the expansion of the wire was to be measured in a radial or longitudinal direction. Having heard the evidence of the experts as to the interpretation of those directions, he was of opinion that defendants' objection on this ground was unsound. The patent was likewise attacked on the ground that the invention was not useful, but this plea also failed. The plea of want of subject matter was hopeless, and in his judgement plaintiffs' patent was valid, and claims 1 and 2 of the specification had been infringed by defendants. There would be judgment for plaintiffs for the relief claimed, with costs.

Sir Duncan Kerly (for defendants) asked for a stay with a view to an appeal.

Sir Arthur Colefax, K.C. (for plaintiffs), opposed, and said defendants were not manufacturers of those lamps: they were dealers, and plaintiffs had had litigation with them before, and there was a matter of costs which had not yet been settled.

His Lordship: If that is the fact, Sir Duncan, things must remain as they are.

The March issue of "The Cost Accountant," the official journal of the Institute of Cost and Works Accountants, contains a full report of the Costing Conference, held under the chairmanship of Lord Weir of Eastwood. Specimen copies may be obtained from 38, Grosvenor-gardens, 1s. 7d., post free.

Parliamentary Intelligence.

Electricity (Supply) Bill.

The second reading of this Bill was moved by Viscount Peel in the House of Lords on the 2nd inst. He explained that it was an amendment of the 1919 Act, and unless the Bill or some similar Bill became law it would render futile and ineffectual a great number of the provisions of the original Act. The controversial provisions and clauses in last year's Bill had been omitted, and, so far as the Electricity Commissioners knew, there was now no controversial clause left. As a result of their general survey of the country, the Electricity Commissioners had come to two main conclusions, namely: (1) The general wastefulness and inefficiency of the present organisation for supply; and (2) the urgent need for joint action among the supply authorities in order to economise in coal, to make better use of capital and to produce, as a result, a cheaper article. The Commissioners had delimited sixteen electricity districts, and when they had finished their work the number would probably be something like twenty. In eight of those districts schemes for re-organisation had been provisionally approved. In the first four of these eight it had been decided to set up joint electricity authorities. In two more joint electricity authorities had been proposed, and in the next two an advisory board and an advisory committee had been respectively suggested. The general note running through the Bill was consent, and not compulsion. There had been found to be a general desire for co-operation, both among companies and authorities, and powers of compulsion were unnecessary. Every encouragement was given throughout the Bill to private enterprise. One of the main objects of the measure was to give powers of raising money to joint electricity authorities.

The debate was adjourned.

(On Tuesday) The Earl of Bessborough said that in spite of two years' constant work by the Commissioners, in no single instance had any Order yet been issued nor any scheme which they had propounded, and he was informed that not a single scheme had been accepted by any of the electricity supply authorities concerned. Clause 5 (4) compelled authorised undertakers to contribute towards any administrative expenses of the joint electricity authority, and to meet deficiencies in the fund established under the Act of 1919. He could not agree that where the Bill was permissive it was necessarily innocuous. Some limit should be placed on the amount which local authorities were to be allowed to raise for the purpose of loans to a joint authority. The proposal which required authorised undertakers to contribute to the expenses of the authority and to make up their trading losses was as highly objectionable.

Viscount Haldane thought that there was a tremendous case for the proposition before the House, in view of the serious position which the country found itself in and the crippling of its industrial powers compared with other nations. The consumption of coal for industrial purposes could be greatly reduced if reasonable care was taken. Small generating stations were always very wasteful. In London there were seventy generating stations, fifty different systems of supply, twenty-four different voltages, and ten different frequencies. How could they have efficiency in that way? If they in that House prevented the public and industries from getting the advantage of a cheap supply of electricity it would be a day of ill omen. He suggested that London might well have one generating station, say, near the mouth of the Thames. Under the conditions that existed, how could it be said that we were in a satisfactory position in this country? There were 600 generating authorities in the country, and their production was ridiculous when compared with modern standards. In the United States of America and on the Continent generating stations were enormously greater than ours and their prices much less.

Lord Monk Bretton, speaking on behalf of the London County Council, said they attached the utmost importance to the second reading of this Bill.

Lord Gainford was convinced that, in spite of the severe handicap which the large London companies had to meet last year owing to the coal strike, there was a steady improvement going on in the way in which private enterprise was dealing with the matter. The fact that there was no more popular investment than those companies showed that the public had confidence in private enterprise. He knew of one of the large companies which recently offered to supply a London borough with electrical energy at 20 per cent. less than the council could produce it, but the council preferred to charge the ratepayers the 20 per cent. more because they preferred to have the supply in their own hands.

After Viscount Peel's reply, the second reading was carried by fifty-nine votes to forty.

Admiralty Electricians.

In reply to Sir C. Kinloch-Cooke (House of Commons, March 6), Mr. Amery said the Admiralty were fully aware of the lack of promotion in the Electrician Branch, which was due to the present authorised establishment being considerably overborne. This position was not peculiar to any one branch. The two officers of the Electrician Branch serving in his Majesty's ships "Ambrose" and "Lucia" were withdrawn, as the complement of these vessels did not provide for warrant electricians being borne; these withdrawals did not cause vacancies. During the last 18 months four retirements of officers of the Electrician Branch had taken place, but, as the numbers now borne were considerably in excess of the authorised establishment, it was not possible to make any promotions in the vacancies. The whole question of the establishment of warrant officers to be maintained would be further considered shortly. The Admiralty were of opinion that no sufficient arguments had been advanced for electrical artificers to have the same allowance as engine-room artificers. The engine-room artificer had to show himself capable of using his knowledge in exercising distinct responsibility in taking charge of moving machinery without the direct supervision of a superior officer, whereas the electrical artificer, except in rare cases, did his work, which was entirely manual, under the direction of an officer. The chief engine-room artificer's allowance was given to him for having proved himself capable of taking complete charge of propelling machinery of a small ship where no engineer officer or warrant officer was borne. There was no parallel in the case of a chief electrical artificer.

German Wireless Press Service.

In reply to Mr. Hurd (House of Commons, March 6), Mr. Chamberlain said his attention had been called to the anti-British and anti-French propaganda which was being scattered over the globe in English by the German wireless Press service from Nauen. With regard to the British wireless means available to counteract this mischief, three wireless messages containing British news were prepared daily by the News Department of the Foreign Office and sent from the General Post Office wireless station at Leafield. They were picked up and widely reproduced in most European countries and by ships at sea. The completion of the wireless station at Cairo would, he hoped, enable these messages to be retransmitted and similarly used in the Far East.

Railway Electrification.

Replying to Mr. Gilbert in the House of Commons of Monday, Mr. A. Neal said he was not aware of any of the London railway or tube companies applying for a grant from public funds for extending or electrifying their lines, and no grant had been made. Applications for guarantees under the Trade Facilities Act had been made by the South-Eastern and Chatham and the London Electric Railway companies and referred to the Advisory Committee appointed under the provisions of that Act, and they are under consideration.

Amateur Wireless Costs.

In a written reply to Sir H. Norman (House of Commons, Feb. 22), Mr. Kellaway stated that the annual expenditure on amateur wireless of £5 200 is made up as follows: Correspondence and inquiries relating to the issue of licences, alteration and removal of installations already licensed, and maintenance of records (including typewriting), £3 575; inspection of stations by engineering officers, £1 000; accounting, £625.

The Urgent Cable Service.

In reply to Sir G. Renwick, the Postmaster-General (Mr. F. G. Kellaway) stated in the House of Commons on Monday that the "urgent" service was introduced as the result of representations from the commercial community; and while the delay remained abnormal, and an urgent service was available in foreign countries, he did not think it would be in the interests of British cable users to abolish it.

Dover's Claim Against the Admiralty.

Mr. Amery stated, in reply to Sir T. Polson (House of Commons, March 6), that a settlement of the claim made by Dover Corporation against the Admiralty, for payment of an account for electricity supplied, would probably be reached at an early date. He added that, pending such settlement, advances on account had already been made, the last of which, amounting to £600, was paid on Feb. 22.

Underground Railway Extensions.

In reply to Mr. Erskine (House of Commons, March 2) Sir Robert Horne stated that Lord Ashfield's scheme for the improvement and extension of the Underground and Tube Railway system had not been finally rejected.

Grampian Electricity Supply Bill.

The Grampian Electricity Supply Bill passed its first reading in the House of Commons last week.

Company Legislation in Australia.

The Commonwealth House of Representatives has passed a Bill to Amend the War Precautions Act Repeal Act of 1920. Section 19 of the latter act, which has now been repealed, required the agents in Australia of all overseas companies and firms to furnish particulars regarding the business of their principals to the Collector of Customs in the State in which their chief place of business was situated. The particulars included the name, address, capital, and balance sheet of the company or firm. Under the Companies and Firms Acts of the States all companies and firms carrying on business in Australia in their own names must be registered, irrespective of whether their head offices are established in Australia or abroad, and the effect of Sec. 19 was to require them to re-register with the Department of Trade and Customs. This obligation imposed a great deal of trouble, and strong exception was taken by British companies, especially to the provision requiring them to furnish particulars of their financial position to their agents in Australia for submission to the Department of Trade and Customs.

Wimbledon's Electrical Engineer.

Mr. Tomlinson Lee's dismissal from the position of Electrical Engineer after twenty years' service was again discussed at a meeting of the Wimbledon Town Council last week, when Councillor A. W. Hickmott, chairman of the Electricity Committee, stated that the reason for the Commitee's action was that they had lost confidence in Mr. Lee. The Committee deliberately came to the conclusion that Mr. Lee should either resign or have notice. He refused to resign, however, unless the Council agreed to pay him £3 000. There was no ill-feeling against Mr. Lee. The Committee thought a change in the management ought to be made, and it was their unpleasant duty to say so to the Council, and, having got their approval, to act. The plain fact was that for some years past Mr. Lee's conduct had not been satisfactory to the Committee. He did not show any desire to work cordially with his Committee or to co-operate with them in what he knew they had much at heart—the greatest economy possible in the working of the undertaking.

In the lengthy discussion which followed Councillor Hickmott's explanation, Councillor Bellingham said that with regard to the alleged difficulties of Mr. Lee working harmoniously with the Committee, and that these difficulties had been accumulating for years, such an explanation was absolutely ludicrous. The Committee was constituted only last November, and at least five new members were upon it who could not have had any knowledge whatever of the way in which Mr. Lee had conducted the department.

Acting on the recommendation of the Electricity Committee, the Council have authorised the appointment of Chief Electrical Engineer to be made by the Staffing Committee and the Electricity Committee jointly.

While the Council meeting was being held a protest meeting was taking place outside the Town Hall, and a deputation waited on the Council with a view to urging them to postpone all steps with the object of filling the vacant position until after a public inquiry had been held and a report had been published concerning the facts. They got no satisfaction, however, from the Council.

Oxford-street Lighting.

Those who watch the signs of the times will note that Oxford-street, always a well-lighted street, has now become one of the best—if not the best—lighted street in London. The St. Marylebone Borough Council have every reason to be proud of this striking improvement in this important shopping centre, and also of their enterprising Electricity Department, who carried out the work, with so much success and in such a miraculously short time in order to be ready for the Royal wedding festivities. When the idea was first put forward of making this an example of the most perfect street lighting possible the Electricity Committee consulted their electrical engineers, who caused samples of new street-lighting lanterns to be erected, among which was a type suggested by Mr. Haydn Harrison, who realised the importance of not only lighting the roads and pavements, but also the shop fronts, for which this street is justly famous. It was apparent from the first that this lantern was the most suitable in every way, and was selected by the Council and Lighting Committee and their engineers, who are to be congratulated on the excellent results obtained.

The work of producing a sufficient number of these lanterns in so short a time was undertaken by the Electric Street Lighting Apparatus Company, who manufacture Mr. Haydn Harrison's designs at their works in Canterbury. The special feature of this lantern is the large light-radiating surface, which is produced by using thin sheet glass, ground on the inner surface, the light absorption of which is very low; this at the same time completely screens the light source from the eye. The lanterns are also very substantial, only cast iron and copper being used in their construction. The former provides a very large area of cooling surface, which, supplemented by an efficient ventilating system, allows of gasfilled lamps of nearly any power being adopted. The reflector being of enamelled earthenware, no diminution in efficiency takes place due to heat, and all parts are easily cleaned.

Southampton Technical Staff Dispute.

A serious difference has arisen between Southampton Corporation, the E.P.E A. and the E.T.U., as the organisations representing the technical staff of the electricity undertaking, owing to the following decisions with respect to all salaries and wages not governed by awards: 1 (a) that a reduction of 20 per cent. be made on all salaries not exceeding £499 per annum, 17½ per cent. on salaries from £500 to £699, 15 per cent. from £700 to £949, 12½ per cent. from £950 to £1 249, and 10 per cent. over £1 250. 2 (a) all awards to operate under present conditions until Oct. 1 next (when the subject will again be considered), except (*b*) the technical and the electricity works clerical staffs electricity award, where special reductions are proposed, but if these do not become effectual by April 1 the above reduction of 20 per cent, shall apply in these instances.

The above recommendations of the Parliamentary and General Purposes Committee were adopted by a majority of eight on the 22nd ult., and notices have been served upon all members of the technical staff, and, in consequence, the executives of the organisations concerned take a serious view of the position created by such a challenge to the prestige of Joint Boards and Joint Industrial Councils. Southampton Corporation put into operation in July, 1920, the schedule of salaries and conditions of employment recommended by the N.J.B. for the technical staffs of electricity undertakings.

The decision of the Corporation is not applicable to any awards in operation, except those in respect of the electricity department, and the decision was come to without consulting, or endeavouring to obtain the views of the employees. In other undertakings where difficulties have arisen, an amicable settlement has been arrived at, either on the District or National Joint Board. Although the E.P.E.A. have addressed several communications to the Corporation upon the matter, no reply has been vouchsafed.

The E.P.E.A. referred the matter to the District Joint Board on the 27th ultimo, when it was decided to ask the Corporation to suspend the notices pending the consideration of the matter by the N.J.B. The E.P.E.A. look upon the matter as a blow aimed at the foundations of Industrial Councils and the National agreements promulgated by such bodies, which have proved their value to the industries concerned. The dispute can still be referred to the Board, and it is to be hoped that the wisdom of such a step will be seen by the Corporation.

Commercial Morality.

Mr. C. H. Wordingham, national president of the Junior Institution of Engineers, at the annual dinner of the Sheffield and District Section of the Institution, in the King's Head Hotel, Sheffield, on Friday, said the young engineers of to-day were having a bad time, and it must be difficult for them to know what to do. To the young man who could not get employment he would say, go abroad. There was more likelihood of getting a position of superior responsibility abroad than at home, because there was less competition owing to the fact that a good many people were not prepared to go abroad. As one who had had some experience in examining papers, he (Mr. Wordingham) found that the young man who had gone abroad possessed superior intelligence. In addition, the pay was very often better, and, at any rate, promotion would be more rapid. Continuing, Mr. Wordingham appealed to the young men of the profession to uphold the reputation of Englishmen in foreign countries for straight dealing. It was well known abroad, he said, that an Englishman's word was his bond, and in that respect he stood higher than other nations. He was not favourably impressed with the changes wrought in regard to commercial morality during the last fifteen years. He hoped his judgment was not warped by age, but it did seem to him that there was not the high standard of commercial morality among engineers that there was fifteen or twenty years ago. If that were true it was very regrettable, because a man who was not straight could not look everybody in the face, and he was doing a disservice to his profession and his country.

Mr. S. E. Fedden, president of the Sheffield Section of the Institution, proposing the toast of "The Institution," said that the membership was now 2 069—an increase of 215 over 1920. Referring to the slump in trade, he said its effects were perhaps felt more acutely in Sheffield than elsewhere, because not only were the whole population of the city engaged on war work, but a large number of people had come into the city during the war. Their own country was not alone in its industrial troubles; the whole world was out of gear, and, until general action was taken to remove the obstacles to international trade, he could not foresee any improvement in trade. Some European countries had paper money which could not be negotiated outside their own borders. There could not be a revival of international trade until financial confidence was established. At home, too, they must have confidence. Labour should remove the canker of declining to give a fair day's work for a fair day's wage. Sacrifices should be made by all sides. The position was desperate for thousands of their citizens, and it could only be remedied by desperate measures.

Electrical Developments in Poland.

In a recent article in the "Manchester Guardian Commercial" it is stated that the need for the application of electricity in Poland on a larger scale than hitherto is making itself more and more felt. A special Electrobank has been lately organised, with a subscribed capital of 150 milliard marks, for the purpose of developing electricity supply. It has acquired patents and concessions for building and exploiting electric railways, tramways, power stations, &c. The bank is forming special companies for the management and financing of these undertakings. The Electrobank is in possession of the majority of shares of the first Polish electric lamp factory of Cyrkon. The building of a suburban electric railway between Warsaw and Modlin is in progress, and the line will, it is stated, be opened for traffic this spring. This is intended to be the beginning of a programme for the construction of a suburban network of electric railways round the capital. The bank has taken steps to exploit the water power of Silesia, and plans for the construction of hydro-electric stations on the Rivers Sau and Dunajec have been presented to the Ministry of Public Works for approval. Together with four other Polish banks, the Electrobank has formed a concern for taking over from the Government the telephone factory in Warsaw. Under the title of "Polish Electrical Undertakings Brown-Boveris Companies," a new joint stock company has been formed to take over the Warsaw branch of Brown, Boveris & Company. It is proposed to manufacture dynamos, motors and other electrical machinery in Poland, and the company has acquired large estates in the vicinity of Warsaw.

Electricity Supply.

The Propaganda Sub-Committee of Glasgow Electricity Committee have been instructed to report upon the feasibility of hiring out electric motors for manufacturing and industrial purposes.

The Disposals Committee of the Ministry of Munitions have agreed to cancel £141 000 of the loan of £150 000 to Rotherham Electricity Committee in connection with the construction of the new power station erected during the war.

The Electricity Commissioners, being of opinion that the sum of £2 500 for the conversion of boilers at Hackney generating station for the burning of oil fuel should not be made the subject of a loan, the Council has decided to proceed with the work and to pay for same out of the reserve fund.

After a three hours' discussion last Thursday on the electricity undertaking, Hull City Council decided to disband the old Electricity Committee and to elect a fresh one of eight members. Seven of these served on the old committee, from the chairmanship of which Ald. Pybus recently resigned. The facts of the situation were given in our last issue.

Hackney Electricity Committee have now completed the arrangements for the Electrical Exhibition they propose to hold from April 24 to 29, and inform us that the whole of the space has been taken up promptly by a number of representative firms, who will together display all the practical apparatus available to-day for lighting, cooking, heating and power in the home.

In connection with the scheme for the reorganisation of electricity supply in South-East Lancashire, which was recently investigated by the Electricity Commissioners, the organising committee have now agreed to accept the decision of the Commissioners in any appeal made to them, provided it does not involve the constituent authorities of the committee in any capital expenditure they may be unwilling to incur.

A recommendation by the Leeds Electricity Committee to the City Council that £1 600 should be paid to a firm of contractors, over and above the fixed contract price, to make good, to a certain extent, a loss sustained because of increases in wages and in the prices of material since the agreement was entered into, has been rejected on the ground that it would be setting up a vicious precedent, and the matter has been returned to the committee for further consideration.

We are glad to learn that the scheme for the reorganisation of electricity supply in the North-West Midlands Electricity District is not to be an exclusively municipal one. The Midland Electric Corporation for Power Distribution, which owns an important supply undertaking, and has done very useful pioneering work, will have a larger representation on the proposed Joint Authority than any other individual undertaking. The Joint Authority will acquire the generating stations, but the supply powers of the various undertakers in their existing areas will not be affected.

Responding to the toast of "The Town and Trade of Skipton," at the annual dinner of the Skipton Tradesmen's Association last week, Mr. J. W. Broughton (chairman of the Urban District Council), at the request of the chairman, made reference to the Council's electricity scheme. The Electricity Commission, Mr. Broughton stated, had practically approved the Council's scheme, and had authorised the borrowing of £11 800 for the expenses of the distributing mains and stations in the town. The old Grammar School would be used as a sub-station, and electricity would be supplied by Keighley Corporation. The Commissioners' approval of the Council's agreement with Keighley was held over, pending the completion of the local scheme for the reorganisation of electricity supply.

The Lord Mayor of Cardiff, Councillor F. H. Turnbull, addressing the Cardiff Rotary Club on Monday, replied to the protests in the Press against the allocation of £15 000 of the electricity department surplus profits to the reduction of the rates, instead of it being applied to the reduction of charges to electrical consumers. He said that the £15 000 did not represent sums provided out of the rates to meet deficits on the electricity undertaking in the past. But even if all such deficits had been repaid, he would still claim that the ratepayers were entitled to relief from the profits, on the ground that the undertaking itself was set up in the first place for the ratepayers generally; the money to establish it had been provided at a cheap rate on the credit of the ratepayers, and it was only fair to make them some return. Although the tramways had a trading loss for the past half-year, owing to high wages and coal prices, the electricity and tramways undertakings were both flourishing concerns, and in the twenty-two years of their existence 55 and 49 per cent. of the capital respectively had been set aside for redemption.

New Schemes and Mains Extensions.

Barnstaple Electricity Committee are applying for sanction to borrow £2 341 for condensing plant at the electricity works.

Watford Electricity Committee have applied for sanction to borrow £38 940 for extension of plant at the electricity works.

Derby Electricity Committee recommend the Town Council to apply for sanction to borrow £11 000 for new plant and extensions.

Harrogate Town Council has received sanction to a loan of £3 250 for h.t. mains.

The Electricity Commissioners have decided to issue a Special Order for providing electricity supply in Cookham and Cookham Dean.

Matlock Town Council are to lodge a protest with the Electricity Commissioners against being included in the North-East Midlands electricity district.

A municipal scheme for lighting the town of St. Heliers has been adopted, and application is to be made to the States for permission to raise a loan not exceeding £100 000.

The Electricity Commissioners have made special orders to authorise (1) Risca, (2) Mynyddislwyn, and (3) Bedwas and Machen Urban Councils to supply electricity in their respective districts.

Croydon Corporation Electricity Committee has decided to expend £2 400 out of Reserve and Renewals on a pump and repairs to two cooling towers, and £23 000 out of capital for a new boiler and equipment.

The recommendations of Birmingham Electricity Committee to extend the supply cables to the outside areas on the east and south side of the city, mentioned in our last issue, were approved by the City Council on Tuesday.

Newark Town Council have decided to apply for powers to supply electricity. A revision of the scheme submitted in November, 1920, has resulted in a reduction in the estimated cost from £200 000 to £140 250.

The Electricity Commissioners have sanctioned a loan of £80 000, on account, in respect of the Accrington scheme of electricity extension. The Commissioners add that they will be prepared to consider the sanction of any further sum when the actual cost of the work intended has been ascertained.

Growth of Liverpool Electricity Undertaking.

It is estimated that users of electricity in Liverpool will benefit to the extent of £227 000 by the reductions in electricity charges announced in our issue of the 10th inst. Since 1913 the demand for electricity has grown from 37 765 000 to 88 188 000 units. In his report Mr. H. Dickinson, the city electrical engineer, states that the load is growing so rapidly at the Lister Drive power station that it may be necessary to add to the generating plant this year. Provision has been made in the estimates to cover the cost of one generating set. The maximum load at present is about 14 000 kW, and when the plant on order is in operation this station will be capable of dealing with a load up to 50 000 kW.

Good progress is being made with the erection of a second generating set at Lister Drive No. 3 power station. Alterations have been in progress at several of the sub-stations to provide for the rearrangement of plant and additional switchgear. An additional 1 500 kW rotary converter has been put into service at both the Paradise-street and Fairclough-lane sub-stations. Provision has been made in the current estimates for four 1 500 kW rotary converters which will be installed in sub-stations, and for an auto-rotary sub-station in the Walton Town Hall or adjacent district. Provision will also be made for the installation of transforming plant and switchgear for static sub-stations on consumers' premises, and also additional switchgear in sub-stations. Some further provision will have to be made in the outlying districts to meet the increasing demands. The h.t. mains from Paradise-street sub-station to the Herculaneum Dock, for the supply to the Dock Estate, are to be completed.

Application is to be made by Liverpool Corporation for sanction to borrow £200 000 for the provision of a sub-station, electrical plant, &c.

In regard to Bootle, the transference of the Bootle undertaking will not involve any immediate change in present arrangements, but the intention of Liverpool Corporation is ultimately to change the whole system to three-phase. As Liverpool contemplate the erection at an early date of a new station to meet the increasing demands, the decision as to the closing of the Bootle station will probably be deferred. The Liverpool Corporation have run to the boundary of Liverpool and Bootle two 3 sq. in. 6 600 V three-phase cables, and Bootle Corporation have extended the mains from the boundary to Marsh-lane station, and these mains will be sufficient for some time to come to meet the demands of Bootle.

Obituary.

We regret to record the death, which took place on Feb. 27, at his residence, Cleveland House, Gainsborough, of Mr. James Marshall, chairman and managing director of Marshall, Sons & Company. Mr. Marshall was in his 86th year.

We regret to announce the death last week from an accident in the hunting field of Mr. Randal Beresford Slacke, manager and publisher of "The Engineer." Mr. Slacke, who was a son of Sir Owen Slacke, joined the staff of "The Engineer" in the spring of 1919 to fill the place occupied for many years by Mr. Sydney White, and brought to his work a long experience of commercial engineering. He was for some years manager of the London office of Messrs. Galloways, but left in January, 1917, to take a commission in the Royal Engineers, and after serving for a few months with Inland Waterways and Docks he was lent to the Admiralty for duty as Deputy Assistant Director and Assistant Director of Materials and Priority.

It is stated that Metropolitan-Vickers Electric Company are considering a superannuation scheme for their staff, with contributions from the employees and the company.

Electric Traction.

The Ministry of Transport has decided to hold an inquiry on the subject of CENTRE POLES IN PRINCES STREET, Edinburgh.

Over a MILLION MORE PASSENGERS were carried on the L.C.C. tramcars during the two weeks ended Feb. 15th, compared with the corresponding period last year.

It is estimated that five million PASSENGERS were CARRIED by the Underground railways ON PRINCESS MARY'S WEDDING DAY last week. On the L.C.C. tramcars about two and a half millions were carried.

HULL Tramways Committee have decided to contribute £10 000 out of the Tramways' compensation account to the relief of the rates. The chairman, in making the announcement, said he did not agree with the principle of applying profits to the relief of the city rates, but in the exceptional circumstances, and with the rates 20s. in the £, he thought it only fair to make the proposal.

Proposals for varying THE 1919 AGREEMENT were considered by the Joint Industrial Council of the Tramway Industry last Thursday. The chief question considered was the suggestion to abolish the 48-hour guaranteed week. Common ground was reached upon several points, but equally important matters were adjourned until this week. It is understood that the crisis that had arisen on the question of the guaranteed week is regarded as practically over.

The strike of the NEWCASTLE-ON-TYNE tramway men still continues. A ballot has been taken on the terms offered by the Tramways Sub-Committee on Sunday, but as we go to press the result is not yet to hand. The terms offered are :—(1) That the working hours shall be forty-eight, and in all respects the terms of the National Agreement shall be observed. (2) The rates of wages to be as at present and to be subject to the National Wages Agreement.

The Minister of Transport has extended for a further year from Aug. 28, 1921, the periods allowed by the SWANSEA CORPORATION LIGHT RAILWAYS (EXTENSIONS) ORDER, 1914, for compulsory purchase of lands for railway No. 2, and for completion of railways 1, 2 and 3, and has also extended for a further year from Sept. 14, 1921, the time allowed by the SWANSEA CORPORATION LIGHT RAILWAYS (EXTENSIONS) (REVIVAL AND EXTENSION OF TIME) ORDER, 1918, for compulsory purchase of lands for railways 1 and 3.

At SCARBOROUGH recently two local tram drivers, T. Ramsbottom and T. Morley, were fined 5s. for exceeding the speed limit of four miles per hour down Eastborough on Feb. 4. The limit of four miles per hour between Leading Post-street and Palace Hill is fixed by the Board of Trade regulations, and the police evidence showed that one driver was driving at the rate of nine miles an hour and the other at the rate of 9⅜ miles an hour. Both defendants urged that it was far more dangerous to drive down the hill at four miles an hour than at eight miles, as with the latter speed they were able to use the electric instead of the hand brake. They said that when the rails were greasy it was impossible to drive at four miles an hour. The attention of the Board of Trade is to be drawn to the statements made by the drivers, so that some modification may be made in the regulations if necessary.

Social Notes.

The tenth annual dinner of the staff of FERRANTI, LTD., was held on Friday, March 3, at the Midland Hotel, Manchester, and was followed by a dance. The chairman of the company, Mr. A. W. Tait, received the guests and presided over the dinner. The arrangements were admirably carried out, and after an excellent dinner the usual toasts were interspersed with musical items, including the song "My Old Shako," with chorus, by Mr. Campion, rendered for the tenth year in succession, and now known as the Ferranti anthem.

The G.E.C. TRAVELLERS' DINNER was held on Friday, Feb. 24, at the Old Falstaff, in Cheapside. Mr. H. W. Roberts (London sales manager) occupied the chair, and was supported by Mr. M. J. Railing (general manager of the G.E.C.), Mr. L. C. Gamage (secretary), and several of the London departmental managers. After interesting and humorous speeches by the chairman, Mr. Railing, Mr. Gamage, Mr. Riley, and Mr. Joyce, a select musical programme under the direction of Mr. Ashman was given, and the meeting dispersed in excellent spirits.

On the 1st inst. the ELECTRICITY SUPPLY COMMERCIAL ASSOCIATION (Greater London Division) held their second Bohemian concert at Anderton's Hotel, and Mr. D. C. Clark (Chairman of the London Divisional Council) occupied the chair. We learn from the General Secretary (Mr. G. R. Smith) that the influence of the Association is still increasing, but, as its activities are not usually attended by any great degree of publicity, the practice of holding these occasional concerts has been resorted to, with the object of calling attention to the Association and increasing the spirit of *camaraderie* amongst its members and the classes of workers which it represents. The entertainment provided at last week's concert spoke well for the organising ability of Mr. T. J. Archer (Secretary, Greater London Division) and Mr. S. George (hon. musical director), and, as the entertainment was, in our opinion, at least equal to that given in some public entertainment halls for a higher charge, similar functions organised in future by the Association should be well attended.

The marriage of Mr. CHRISTOPHER WILSON, manager of the General Electric Company's Osram Lamp Works, to Miss Jessie Wilson, sister-in-law of the bridegroom, took place recently at the church of St. Sepulchre, Holborn.

Business Items, &c.

The address of A. W. BEUTTELL, LTD., is now 53, Victoria-street, S.W.1. Telephone, Victoria 7789.

The URBAN ELECTRIC SUPPLY COMPANY, LTD., have transferred their offices and showrooms at Grantham from East-street to 34, St. Peter's-hill.

The name of the Union Cable Company, Ltd., was inadvertently omitted from the advertisement of the CABLE MAKERS' ASSOCIATION which appeared on page xxxvii. of our last issue. We are asked to state that the Union Company is a member of the Association.

ELECTRICAL COMPONENTS, LTD., have taken Nos. 88 and 89, Great Charles-street, Birmingham, premises adjoining those already occupied by the firm. After alterations, the new premises will be opened as warehouses and showrooms. The company announces a further reduction in their manufacturers.

A large number of orders for the "Invincible" (wet) air filter have been executed by WM. GRICE & SONS, of Birmingham, for electricity supply stations, both municipal and company owned. Contracts have also been carried out for collieries, iron and steel works, &c., and, in addition, a number of the machines have been exported to France, India, and elsewhere.

The WESTINGHOUSE MORSE CHAIN COMPANY have added to their range of inverted tooth chain drives a 1¾-in. pitch. Westinghouse Morse silent rocker-joint chains are therefore now made in the following twelve pitches :—½ in., ⅝ in., ¾ in., 0·9 in., 1 in., 1·2 in., 1·25 in., 1·5 in., 40 mm., 1¾ in., 2 in., 3 in. Each of the above sizes is made in two distinct types, and in widths according to pitch from ¾ in. to 30 in

ALFRED DANKS, LTD., of Gloucester, have purchased the Emlyn Works, to which, it is understood, the operations now carried on at the Westgate Iron Works in the name of Alfred Danks, Ltd., and the Kingsholm Foundry under the style of J. M. Butt & Company, will be transferred. The Emlyn Works were formerly utilised as an iron foundry and engineering works by Mr. C. D. Phillips, from whom they were purchased three years ago by the Avon Malleable Iron Foundry, Ltd. This firm went into liquidation, but the liquidators have continued to run them as a going concern until their purchase by Danks, Ltd.

Personal and Appointments.

Mr. HORACE WARREN has been appointed superintendent of the Sydney station of the Eastern Extension, Australasia & China Telegraph Company.

Mr. ALEX. SPENCER has been appointed vice-chairman of the Metropolitan-Vickers Electrical Company, Ltd., in succession to the late Sir Francis Barker.

Mr. C. O. MAILLOUX, consulting engineer and president of the International Electrotechnical Commission, has been raised from the rank of chevalier to that of officer in the French Legion of Honour.

Mr. H. J. CASH has been nominated a representative of the Institution of Electrical Engineers on the Council of the British Electrical Development Association in the place of Mr. B. Welbourn, who is unable to attend the meetings.

TONBRIDGE Urban Council has appointed Mr. F. SPRINGATE, installation inspector, assistant engineer at the electricity works, in succession to Mr. E. G. STAYGLE, who has been appointed assistant engineer at the Worthing Electricity Works.

Mr. WILLIAM STEPHENS has been appointed general manager of the Electrical Federation (Victoria), the successor of the Electrical Traders' and Contractors' Association of Victoria. Mr. Stephens has held during recent years the positions of editor of the "Industrial Australian" and editor of the "Commonwealth Engineer."

Mr. H. C. ANTHONY, who has been on the Newcastle office staff of Merz. & McLellan for many years, has relinquished his engagement with the firm in order to take up the appointment of constructional engineer to the Shanghai Municipality. Mr. Anthony was entertained by his colleagues before leaving Newcastle and presented with a token of their friendship and esteem.

Mr. CHARLES I. BAKER, traffic superintendent and chief executive officer of the Blackpool Corporation Tramways, has been appointed general manager of the Ashton-under-Lyne Tramways in succession to the late Mr. ERNEST HOLT. A native of Tynemouth, Mr. BAKER first held an appointment with the Newcastle Corporation Tramways Department. Since he came to Blackpool great developments have taken place in the department, the revenue of which has grown from £58 699 to £284 472, whilst the passengers carried have increased from 9 013 540 to 35 700 000.

Sir WILLIAM CLEGG is to receive the Freedom of the City of Sheffield on April 21, to mark the anniversary of his 70th birthday. Ever since 1896, when, on the introduction of the municipal tramway service in Sheffield, he was elected chairman of the first Tramways Committee, Sir William's services to the city can hardly be overestimated. In 1898 he accepted the office of Lord Mayor. In 1902 he was elected chairman of the Education Committee, and since the inception of Sheffield University he has represented the Sheffield Education Committee on the University Council. In 1912 he received from the University the Honorary Degree of Doctor of Laws, and in 1918 was made a C.B.E. in recognition of his work as chairman of the local munitions tribunal.

Institution Notes.

Dr. C. Chree has been elected president of the Royal Meteorological Society for the ensuing year.

At the annual meeting of the Royal Astronomical Society Prof. A. S. Eddington was elected president for the ensuing year.

The annual conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum, South Kensington, S.W., on Thursday, June 29.

Among the fifteen candidates selected by the Council of the Royal Society for election as fellows are :—Dr. F. W. Lanchester, Prof. Geo. A. Schott and Sir Alfred Yarrow, Bart.

A new List of Members of the Institution of Electrical Engineers has just been published. Members desirous of having a copy can obtain it on application to the Secretary.

Mr. W. C. Acfield, O.B.E., of Derby, has been elected president of the Institution of Railway Signal Engineers for the year 1922. The hon. secretary is Mr. M. G. Tweedie, G.W.R. Signal Department, 80, Caversham-road, Reading.

The annual meeting of the Elektrotechnischer Verein was held in the Technische Hochschule, Charlottenburg, Berlin, on Tuesday, Dr. Adolf Franke presiding. It was reported that the membership of the Verein was 2 450, compared with 2 194 at the end of 1920. State Secretary Dr. Bredow was elected president for 1922.

The Council of the Institution of Electrical Engineers have agreed to the inclusion of the counties of Flint, Denbigh, Merioneth, Montgomery, Carnarvon and the Island of Anglesey in the area governed by the North-Western Centre. The North-Western Centre have agreed to allocate this area to the Liverpool Sub-centre of the North-Western Centre.

The annual Report of the Institution of Mechanical Engineers for the year 1921 shows the total membership to have increased by 491 to 7994. The accounts for the year show a balance of revenue over expenditure of £50. The total assets amount to £161 400, and deducting £34 025 debentures, and other liabilities, together with the total amount of the four reserve funds (£57 408), there is a credit balance of £66 285. The report contains a summary of the year's work of the five research committees.

The annual dinner of the Birmingham and District Electric Club was held at the Grand Hotel, Birmingham, on Feb. 24, Mr. Norman Deykin (president) being in the chair. Councillor H. K. Beale (chairman of the Corporation Electric Supply Committee), replying to the toast of "The City of Birmingham," remarked that enormous developments had taken place in the production of electricity in Birmingham during the past twenty-five years. In 1895 half a million units of electricity were generated, as compared with 137 millions last year. By the time the Committee had developed all their schemes the city, he thought, would be the largest generating authority in the country.

At the first ordinary meeting of the newly-formed Electrical Society of Glasgow the constitution framed by the special committee was, with certain modifications, approved by the members. A committee was elected representative of the electrical contractors, supply authorities, manufacturers, factors, and consulting engineers, with Mr. R. A. Ure, of Allan Arthur & Ure, as chairman, and Mr. G. Morgan, deputy engineer and manager, Glasgow Corporation Electricity Department, as vice-chairman. The objects of the society are the promotion of the interests of its members, their advance in new, progressive and successful business methods, the interchange of technical information relating to electrical practice, and to afford members an opportunity of co-operating in social, commercial and industrial development. Membership of the society is open to all engaged in the electrical industry. Mr. R. B. Mitchell, engineer and manager of the Glasgow Electricity Department, stated that the organisation should act as a feeder to the Institution of Electrical Engineers, the parent body of all electrical men.

Exhibition Notes.

Owing to the depressed state of trade, the directors of the British Trade Ship have postponed the scheme until the latter end of 1924.

At the International Model Housing Exhibition, to be held in Turin from April 8 to 21 inclusive, there will be a section devoted to electric lighting, heating and domestic appliances. The address of the Secretary is 8, Via Goito, Turin.

The electrical industry is well represented at the Ideal Homes Exhibition, which was recently opened by Lord Provost Hutchison in Waverley Market, Edinburgh. The Corporation Electricity Department have taken a large central stand, and a considerable number of electrical contractors in Edinburgh have combined in their association to make an official exhibit on a large double stand.

A booklet, entitled "Central Station Voltages and Charges," issued by S. Rentell & Co., at 1s. net, contains in a condensed form some of the useful information given in our own Electricity Supply Tables, the details being confined to the name of engineer, the voltage of supply, system, and prices per unit. As far as we can see, the information given is substantially correct, though it is a little unfortunate, from this point of view alone, that the prices in many cases have now been revised in the downward direction.

Telegraph and Telephone Notes.

The Swedish telegraph service in 1921 showed a surplus of 19 070 000 kroner.

It is announced that the Swedish Cedergren Telephone Company, which owns the Warsaw telephone system, comprising about 33 000 subscribers, will be taken over by a new concern, which will acquire the Warsaw system as well as the State systems in Looz, Lublin, Lemberg, Bialistok, Sosnowice, and Drobowiez, and gradually other systems. The combine has received a concession for 25 years.

A Reuter's message from Berlin states that, according to the local newspapers, the German Atlantic and German South-American Telegraph Companies have concluded an arrangement with the American telegraph companies, whereby the German companies will be enabled to resume cable traffic. The German companies will work the Emden-Azores section, while the Azores-New York section will be worked in conjunction with the American concerns.

Bishopsgate, the new London telephone exchange, was opened on Saturday, when 750 numbers from Clerkenwell, City, Central, London-wall, Avenue, and Bank were transferred, while by the end of the month another 500 will follow. The new exchange, which is in the Clerkenwell Exchange Buildings, Ironmonger-row, Old-street, is temporary, pending the equipment of a new building in the vicinity of Bishopsgate-street. It is equipped for 1 500 numbers.

Wireless Notes.

Mr. Walter Addy, of Buxton, has given his private wireless installation, which has a 1 200 miles radius, to the Town Council. This will enable the council to receive each morning weather reports from the Meteorological Office.

The Marconi wireless high-speed service with France which was affected by the recent flooding of an underground cable conduit in Cheapside, has now been restored. There is also no longer any delay on Marconigrams to North and South America, Australasia, Spain, &c.

Electrical Machinery for British Malaya.

There is a growing demand for electrical machinery in the British portion of the Malay Peninsula. Imports in 1920 were valued at £241 923, against £60 525 in 1917, and exports increased to £51 002, against £18 795 in 1917. Though classified as exports, the electrical goods sent out of the Straits Settlements do not, to any great extent, leave the Peninsula, but find their way into the Federated and Unfederated Malay States—in 1917 to the value of £14 823; in 1918, £10 317; in 1919, £22 818; and in 1920, £32 497.

Of the machinery imported in 1920, the United Kingdom supplied £123 122, against £50 430 in 1919; the U.S.A., £46 985 (£74 593); Canada, £25 398 (nil); Japan, £11 963 (£611); Holland, £8 675 (nil); Hongkong, £7 816 (£592); Italy, £5 724 (£857); Denmark, £4 777 (nil); France, £1 773 (nil); Australia, £1 024 (£1 074); and China, £898 (£4 651).

It is gratifying to note that the imports from the United Kingdom, which were in 1919 some £15 000 below those of the United States, were in 1920 £76 000 above the American figures.

In the Federated Malay States the supervision of electrical machinery is entrusted to the Senior Warden of Mines, and, according to Mr. A. R. Mynott's report, the number and capacity of the installations of generating plant in 1918, 1919 and 1920 were as follows :—106 (9 360 kW), 109 (9 544 kW), and 110 (10 376 kW). In addition there were 45 self-contained low-voltage lighting plants in private houses, and about 900 kW of plant were in course of erection at the close of the year. The motors employed aggregated 10 047 kW, against 9 067 kW in 1919 and 8 911 kW in 1918.

The generating plant employed in 1920 was classified as follows :—Mining, (power) 9 551 kW, (light) 217 kW; agriculture, (power) 56 kW, (light) 214 kW; general, (power) 109 kW, (light) 170 kW; and Government, (power) 331 kW, (light) 2 469 kW, making a total of 13 117 kW.

In the report for 1920 of the Director of Public Works, it is stated that during the greater part of the year many houses in Kuala Lumpur, the capital of the Federated Malay States, were without meters, but by December meters were installed in all the houses. The supply in the town, considering the shortage of material and the condition of the plant, was well maintained, and only one serious stoppage took place. Sale of current brought in £31 019, against £23 567 in 1919.

Unbreakable Glass.

A correspondent of the "Times Trade Supplement," writing from Prague, states that at one of the oldest of the glass factories in Bohemia, after many years of experiment, a glass has been produced which, it is claimed, is absolutely unbreakable. Receptacles made from the material, it is said, can be thrown about, made red hot and then put into cold water, and yet do not break. It is claimed that hammers made from the material can be used for ordinary purposes. It is difficult to cut even with a diamond, while the ordinary carborundum stones are useless for the purpose. It is important to note, however, that this invention can only be placed upon a commercial basis when a special kind of sand has been found and is available in large quantities. At the present time this sand is said to exist only in the neighbourhood of Dresden, in comparatively small quantities.

Miscellaneous.

Among the first ALLOCATIONS OF MONEY from the fund constituted under Section 20 of the Mining Industry Act, 1920, is £12 000 to provide for important research work in connection with (*a*) miners' safety lamps, both flame and electric, and (*b*) coal dust dangers; also the preparation of abstracts of research data both in this country and abroad.

The Board of Trade have issued an Order exempting from the GERMAN REPARATION (RECOVERY) ACT, 1921, any "publication in the German language which is proved to the satisfaction of the Commissioners of Customs and Excise to be a periodical publication of a German learned society, or other scientific or philosophical periodical publication."

The fourth annual report of the WORKS COMMITTEE of the CHLORIDE ELECTRICAL STORAGE COMPANY shows that much useful work has been done by the committee for the welfare of the employees. Grants from the Employees Benefit Fund have been made in several necessitous cases, and the recreation of the staff has also been well looked after. At the end of the financial year a sum of £5000 was voted to the Employees' Benefit Fund by the shareholders.

A SHOPPING WEEK AND TRADE PAGEANT is to be held in Cardiff from May 1 to 6, under the presidency of the Lord Mayor, Councillor F. H. Turnbull. The competitions will include window displays in various classes and sections, a free gift scheme, spotting competitions, in addition to special prizes which are being offered by various wholesale houses. One of the special features is the trade pageant. Prizes are being awarded for the best advertisement or display of goods by retailers as well as wholesale houses.

The FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION, whose recovery from moribundity we noticed a short time ago, has now issued a magazine, which not only contains a large amount of information of interest to past and present students, but is inherently a sufficient indication that the Association is going very strong. With it is published a list of members, and, more striking still, a list of known non-members. We should suggest that this list be sent to every defaulter concerned, when we feel sure that the jump in the membership curve would be very satisfactory.

Catalogues, Price Lists, &c.

Nos. 5 and 6 of "TRANSFORMER ABSTRACTS," published by Johnson & Phillips, deal respectively with the despatch, installation and maintenance of O.I.S.C. transformers, and the "drying out" which must precede the installation of a transformer plant.

THE JEARY ELECTRICAL COMPANY have just issued the tenth edition of their L. and B. catalogue, containing illustrations and prices of the chief accessories used with electric bells, fittings, telephones, also electric light accessories, conference lamps, cables, wires, &c.

The A.C.E.C. (Ateliers de Constructions Electriques de Charleroi) have resumed the publication of their interesting "Bulletin," which, owing to German occupation of their country during the war, had to be suspended for five years. The January number, just to hand, contains an article, excellently illustrated, on the company's works before, during, and after the war.

JOHN M. HENDERSON AND CO. are among the few firms who are sufficiently enterprising to publish their catalogues in other than the English language. We congratulate this company on the illustrated booklet they have lately published of their electric overhead travelling crane, in which full explanations are given in English, French, Italian, and Spanish.

The delicate and varied colours of the SILK LAMP SHADES manufactured by Charles Selz are well shown in a coloured leaflet we have recently received from this firm. Thirty different designs of lamp shades are shown, and among the latest novelties put on the market by Mr. Selz is a combined trinket box, pincushion, watch-stand, electric light stand and shade carried out in beautiful colourings.

The catalogue of GALSWORTHY, LTD., contains a number of very choice designs of electric light fittings, table and candle lamps, in a variety of finishes. The company specialise in adapting glass or china ornaments and metal fittings for electric lighting. The designs in the present catalogue are registered, and though the fittings are intended for electric lighting purposes, they lend themselves readily to treatment for other methods of lighting.

The various types of PRESCOT METERS manufactured by the British Insulated and Helsby Cables, Ltd., are described in Booklet No. P172, which is being circulated by the firm. Among the meters which are fully described and illustrated are the Prescot a.c. energy meter—house service type P.A., two wire, single phase; the a.c. prepayment meters—"Prescot" type, two wire, single-phase, up to 250 V, and electrolytic prepayment meters for direct current, types "B" and "C."

CAMPBELL & ISHERWOOD, manufacturers of electrical machinery for marine and industrial use since 1898, have recently published a new illustrated catalogue of their various manufactures, including "C and I" d.c. generating sets, up to 250 kW, with either steam or combustion engines, d.c. and a.c. electric motors, electric cranes, capstans and winches, patent silent electric hoists for ashes, baggage or warehouse use, electric portable tools, noiseless gearing, in paper or raw hide, up to 3ft. diameter, and machine cut gearing—spurs, bevels, spirals, &c., up to 8ft. diameter.

Tenders Invited and Accepted.

UNITED KINGDOM.

LEEDS EDUCATION COMMITTEE. March 13.—Electric wiring work for twelve months. Forms of tender from the Architects' Section, Education Department, Calverley-street, Leeds.

DUBLIN GUARDIANS. March 15.—Supply of electric fittings, &c., for three months. Forms of tender can be obtained at the Union Offices, 1, James'-street, Dublin.

HAMPSTEAD (LONDON) BOROUGH COUNCIL. March 15.—Supply of various stores for six or twelve months, including electrical engineers' stores and oils for the electricity station. Form of tender, &c., from the Town Clerk.

BLACKPOOL CORPORATION. March 16.—Supply, delivery and erection of h.t. switchgear and switchroom equipment for West Caroline-street power house, and Bispham and Cleveleys sub-stations, suitable for controlling 6 600 V, three-phase, 50 periodicity supply (section 4); h.t. armoured transmission three-core cables suitable for above supply; 12 miles 0·2 sq. in. three-core feeder, 5 miles 0·175 sq. in. three-core feeder, and 8½ miles six-core pilot cable (section 5). Particulars from the Borough Electrical Engineer and Tramways Manager, Mr. C. Furness.

BELFAST ELECTRICITY COMMITTEE. March 16.—Supply of various materials, including v.b. insulated cable, v.i.r. cables and wires, electrical accessories, lamps, carbon brushes, bitumen, rubber tapes, fuse wires, troughing, meters, m.d. indicators, cut-outs, &c. Forms of tender from the City Electrical Engineer.

DUBLIN ELECTRICITY SUPPLY COMMITTEE. March 16.—Two water-tube boilers, &c. Specifications from the City Electrical Engineer.

BRISTOL DOCKS COMMITTEE. March 17.—Four 30 cwt. movable electric jib cranes. Specification, &c., from the Engineer, Avonmouth Docks.

EDINBURGH CORPORATION. March 20.—Auxiliary plant and pipe-work for Portobello power station. Specifications from Sir A. B. W. Kennedy, 17, Victoria-street, Westminster, S.W. 1.

WEST SUSSEX COUNTY MENTAL HOSPITAL, CHICHESTER. March 24th. Six months' supply of electric lighting sundries. Particulars from the Clerk and Steward at the hospital.

CHEADLE AND GATLEY U.D.C. April 3.—Extra high-pressure, medium-pressure, and low-pressure mains and street-lighting accessories. Particulars from the Council's Engineer, Mr. C. H. Wordingham, either from 11, Mosley-street, Manchester, or 7, Victoria-street, Westminster, London, S.W.

LONDON COUNTY COUNCIL. April 10.—(*a*) Ash-conveyor of the water immersed, drag-link type; (*b*) ash-hopper. Both for Greenwich Power Station. Particulars from the Clerk of the Council, County Hall, Spring Gardens, S.W.

SOUTH AFRICA.

STANDERTON (SOUTH AFRICA) MUNICIPAL COUNCIL. March 24.—H.M. Senior Trade Commissioner in South Africa reports that STANDERTON MUNICIPALITY invite tenders for electric power plant, including two water tube boilers (4 600 lb. per hour evap. capacity), two feed pumps, feed tanks, two 100 kW steam alternators (three-phase alternators, 0·8 power factor, frequency of 50 and voltage of 3 300 between phases), switchboard, distributors, &c.; the d.c. two-wire system is to be altered to the three-phase four-wire system, 240 and 420 V. Specification and blue prints may be seen on application at the D.O.T., 35, Old Queen-street (Room 49), up to March 11, after which date it will be available for loan to firms in the provinces. Tenders to the Town Clerk's Office, Standerton.

MUNICIPAL COUNCIL OF JOHANNESBURG. March 27.—Supply and delivery of spares for Brill tramcar trucks.

BULGARIA.

BULGARIAN DIRECTION OF POSTS AND TELEGRAPHS. April 3.—*Supply of the following telephone pole-line hardware: 36 000 straight supports for insulators (German type); 35 000 bent supports for insulators (German type); 5 500 fixing clamps; 6 500 yokes.

BULGARIAN GOVERNMENT. April 21.—*Switchboards.

YORK ELECTRICITY COMMITTEE have accepted the tender of the A. E. G. Company, of Berlin, for the supply of meters.

CLAYTON & SHUTTLEWORTH have secured a contract from the London County Council tramways for patent boilers of 70 000 lbs. steaming capacity, able to develop 10 000 H.P.

LIVERPOOL Electric Power and Lighting Committee have accepted the offer of Belliss & Morcom for the installation at Charters-street Destructor Station of a 500-kW generating set.

Callender's Cable and Construction Company have secured the annual contract for the supply of cables and accessories to the LIVERPOOL Corporation for the year ending March, 1923. The City Council have also accepted the tender of the Metropolitan-Vickers Electrical Company for four 1 500-kW rotary converters, with switchgear, accessories, and spare transformer, &c.

GLOUCESTER City Council have accepted the tender of the ENGLISH ELECTRIC COMPANY, amounting to £22 414, for supplying, erecting and maintaining for twelve months two of their geared turbo-generators of 1 500 kW capacity each, with Cole, Marchant & Morley's condensing plant. Thirty-two tenders were received, twenty-six from British and six from foreign firms. The tender of Byard & Son, at £2 687, for building extensions was also accepted.

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* *Particulars from the Department of Overseas Trade.*

Companies' Meetings, Reports, &c.

Midland Counties Electric Supply.

Presiding at the annual meeting of the Midland Counties Electric Supply Company on Tuesday, Viscount Chilston (chairman of the company) said that notwithstanding the coal strike and the trade depression, the output from the generating and distribution stations throughout the areas of supply of their two power companies largely exceeded that of the previous year. The total units sold amounted to 15 131 938, compared with 11 640 266 for 1920, and the number of consumers totalled 3 489 (3 098) The total load connected in the various power and lighting undertakings amounted to 19 611 kW (14 823 kW). The gross receipts of the power and lighting companies amounted to £167 561 (£129 323).

During the year steps were taken to obtain special orders for certain districts in the areas of supply of the power companies. It was found that whenever a supply was introduced in any of the small townships for power there was almost an immediate demand for a supply for lighting, which supply the power companies could not give at rates which were remunerative. Of the four applications made, two special orders had been granted and confirmed by Parliament, viz., (1) for Belper and district, and (2) Bedworth and Bulkington. The third order, the Wigston Magna and District Special Order, had been made by the Electricity Commissioners, approved by the Ministry of Transport, and only awaited confirmation by Parliament. The fourth order, dealing with the district between Hinckley and Tamworth, and including Atherstone, was delayed by the attitude of one or two local authorities.

The Derbyshire and Nottinghamshire Electric Power Company was still seriously prejudiced by the refusal of the Electricity Commissioners to allow that company to erect a new station on the River Trent. In July, 1920, the Council was permitted to erect a large station, but the turbine plant for that station was only ordered a few weeks ago, and the corporation was temporising with the situation by constructing a temporary station to deal with its own immediate requirements.

With regard to their traction undertaking, these had naturally suffered from the effects of the coal strikes and trade depression. Compulsory travelling was curtailed and pleasure travelling considerably diminished. The gross receipts for the year from the traction properties amounted to £112 676 against £117 562 for 1920. The number of passengers carried was 9 167 304 (11 949 134), and the car-miles run 1 148 130 (1 226 605). Taking the combined power, lighting, and traction undertakings, the gross revenue for the year amounted to £280 247, compared with £246 885, the increase being wholly due to the development of the electric supply business.

The revenue received by the company from its various subsidiary undertakings amounted to £65 602, against £58 194. After payment of administration expenses, there remained £60 296 available (against £53 697), and with the amount brought forward the total was £62 555, out of which the following appropriations and payments had been made: loan and debenture interest (less tax) £29 461; debenture and redemption account, £4 653; reserve, £5 000. Out of the balance of £23 440 it was proposed to pay a dividend on the ordinary shares at the rate of 4 per cent. per annum (less tax), leaving £2 440 to be carried forward.

County of London Electric Supply.

The report for the year 1921 of the County of London Electric Supply Company states that the net capital expended during the past year an account of the company's districts amounted to £195 749, and the net total expenditure amounted to £2 929 751 10s. After adding the balance from the last account, after payment of the final dividends on the preference and ordinary shares for the half-year ended Dec. 31, 1920, less income tax (£18 595), and the balance from revenue account No. II., after deducting generation and distribution costs, repairs, general establishment and other charges, and a proportion of salaries and wages (£342 201), there is a total amount available for the year of £360 795. From this sum has to be deducted interest on debenture stock and temporary loans to Dec. 31, 1921, less income tax (£64 384), amount written off expenses and discount on 1921 debenture stock issue (£25 000), amount carried to reserve for taxation (£20 000), amount carried to reserve for depreciation, renewals, &c. (£60 000), and amount carried to general reserve (£100 000), leaving £91 411 for distribution. Interim dividends have been paid, less income tax, on 65 000 six per cent. fully-paid preference shares for the half-year ended June 30, 1921, and on 75 578 ordinary shares for the same period at the rate of 5 per cent. per annum, which has absorbed £26 876, and leaves £64 535 for further distribution. The directors now recommend a further dividend on the 65 000 six per cent. fully-paid preference shares for the half-year ended Dec. 31, 1921, less income tax; and on 75 578 fully-paid ordinary shares for the same period at the rate of 11 per cent. per annum, less income tax, making 8 per cent. for the year. The last-mentioned payments will absorb £42 747 10s. and leave a balance of £21 787 10s. to be carried forward. Applications received during the past year amounted to the equivalent of 6 908 kW, making the total at Dec. 31, 94 000 kW; total units sold numbered 51 220 079, as against 49 553 223. The consumers supplied directly or indirectly by the company now number over 43 000. Mr. J. A. Hosker has been appointed to succeed the late Mr. J. Atherton on the board; Sir Bernard E. Greenwell, Bart., has also been appointed to a seat on the Board. In order to provide for the normal capital requirements of the company an issue of £500 000 seven per cent. redeemable debenture stock was made in October last. The issue was heavily over-subscribed. The directors propose to submit resolutions at the forthcoming annual meeting for dividing each of the existing preference and ordinary shares of £10 each into 10 shares of £1. As to the associated companies, the directors of the South London Electric Supply Corporation, Ltd., have declared a final dividend on the ordinary shares at the rate of 9 per cent. per annum, making 7 per cent. for the year. The directors of the Bournemouth and Poole Electricity Supply Company have declared a final dividend on the ordinary shares at the rate of 7 per cent. per annum, making 6 per cent. for the year. The business of the Coatbridge and Airdrie Electric Supply Company, Ltd., continues to progress.

Charing Cross, West End and City Electricity Supply.

In their report for 1921 the directors of the Charing Cross, West End and City Electricity Company state that the gross earnings of the West-End undertakings from sales of current, rents, &c., were £312 532, against £311 045 in 1920; expenses, including depreciation, were £212 116 (£208 214), and the net earnings, £100 415 10s. (£102 830). Adding the balance brought forward from the previous year (£12 391), and interest accrued for 1921 £5 506 10s.), the total available amounted to £119 313. After providing for interest on debenture stock (£17 829), and setting aside for depreciation £22 000, there was a balance of £79 483, out of which has been paid the dividend on preference shares for the year, amounting to £18 000, and an interim dividend for the first half of the year at the rate of 3s. per share on the ordinary shares, amounting to £12 000, leaving £49 483 to be dealt with. The directors recommend that a final dividend be paid on the ordinary shares for the second half-year at the rate of 6s. per share, making 9 per cent. for the whole year, absorbing £24 000, that £12 500 be carried to reserve, and that £12 983 be carried forward. The company has now connected to its West-End mains a total equivalent of 847 060 (30-W.) lamps: in lighting, 490 245; in heating, 104 481; and in motive power, 253 334 (10 147 h.p.).

The gross earnings of the City undertaking from sales of current, rents, &c., were £439 772, compared with £418 746 in 1920: expenses were £328 493 (£355 062), and the net earnings £111 279 (£63 685). Adding the balance brought forward from the previous year (£4 491), there is a total available of £115 770. After providing for interest on debenture stock, 6½ per cent. 5-year secured notes, loans, and advances (£47 889), there is a balance of £67 880, out of which has been paid the dividend on the preference shares, amounting to £18 000, leaving £49 880. The directors recommend that £32 181 be transferred to reserve, and that £17 700 be carried forward. The company has now connected to its City mains the total equivalent of 982 370 (30-W.) lamps: in lighting, 360 811; in heating, 164,233; and in motive power, 457 326 (18 391 h.p.).

W. T. Henley's Telegraph Works.

In the course of his remarks at the annual meeting of W. T. Henley's Telegraph Works Company last week, Mr. George Sutton (chairman and managing director), who presided, stated that the balance-sheet showed the falling-off in trade they had experienced, notwithstanding that the result of the year's working showed the largest net profit the company had made in its long history, and that the assets had a higher value compared with the liabilities. The item of creditors was down by £100 000 after deducting from the previous year's figures £100 000, which as he then informed them was the amount of a bank loan included. On the other side the debtors were down by £145 000, and the stocks by £179 000. Those items were a sure indication of the falling-off in business and the pace had been accelerating during the entire year. How, in spite of this fall in trade, they were able to produce a profit in excess of the previous years was mainly due to the fact that the value of the orders they had brought into 1921 was a high record, so that in the earlier months of the year those orders, together with the current orders coming in, kept them busy; but gradually, as the year advanced and those old orders were completed, their factories became less busy. With regard to the present position of trade, he could not see any immediate prospect of improvement in the foreign trade. There was a demand in foreign countries, but they were unable to meet the low prices due to low wages and depreciated exchanges. What foreign orders they obtained were taken at unremunerative prices to enable them to give as much employment as they possibly could. With regard to the home trade and trade with the British Overseas Dominions, there were decidedly signs of improvement. The demands for quotations had considerably increased in the past two months, and were many more than they were receiving in the latter months of last year. He did not think the home trade was going to boom yet, but it was satisfactory to be able to see signs of improvement.

Woking Electric Supply.

Mr. M. W. Ashby (chairman) presided at the annual meeting of the Woking Electric Supply Company last week. The total revenue for the year amounted to £44 219, less expenditure of £25 717, leaving a balance of £18 502, to which was added £1 201 brought in, making a total balance of £19 703. After deducting various charges, including over £4 000 for payment of dividends, there remained a balance of £12 014, out of which the directors propose to pay a dividend of 7 per cent. on the ordinary shares, to place £6 000 to depreciation, £2 000 to reserve, &c., and to carry forward £1 222. In the course of his remarks the chairman said there had been a saving on coal of £1 930, due very largely to the new plant and machinery. The turbo of the new boiler had been working very satisfactorily, and was undoubtedly a most useful addition to their equipment. During the year consumers had in-

creased by 127, and the number of lamps connected by 5 343. The number of units generated was 2 614 521, compared with 2 771 743 the previous year, a decrease of 157 222, due almost exclusively to the abnormally light and warm year, and also to the industrial depression which had prevailed. There had been an increase in the sale of both lighting and cooking units. As to the future, all the company asked was to be let alone. Given freedom from industrial unrest, restrictive legislation, excessive rates, and what had been described as "Poplar" finance, the outlook was bright, and they might look forward to a period of increased prosperity.

Metropolitan Electric Supply.

In the course of his remarks at the annual meeting of the Metropolitan Electric Supply Company on Tuesday, Mr. A. W. Tait (chairman of the company), who presided, said that the revenue from sales of current for the year was £520 802, as compared with £497 675 in 1920, being an increase of 4·6 per cent. In the number of units sold, 26 945 465, there was a decrease of 3·1 per cent., which was accounted for by the falling off in the demand of power consumers, due to trade depression. The units sold for lighting and heating showed an increase of 294 050. There was every reason to believe that the consumption for lighting and heating purposes would continue to show expansion, but he was doubtful whether the power load would increase to any extent in the current year. It was, however, satisfactory to be able to record that the development in the company's western area of supply continued, where fresh industries were being established. The costs of generation and distribution of electricity showed an increase of approximately £4 000 over the previous year. The company had already commenced to make certain reductions in their general power rates for small consumers, and he hoped that before long they would be able to give some concessions to their general consumers. The increase in charge so far as lighting consumers were concerned had not risen above 25 per cent. at any time since the commencement of the war. This was only rendered possible by the increase in efficiency of generation by the introduction of up-to-date plant. The directors recommended a final dividend at the rate of 10 per cent. per annum, making a total distribution for the year of 7 per cent., and leaving £3 609 to be carried forward. Apart from maintaining the dividend, they had applied an additional sum of approximately £5 000 out of revenue to the depreciation and reserve account.

Chelsea Electricity Supply.

The report for 1921 of the Chelsea Electricity Supply Company shows a profit for the year of £43 437, to which was added £2 249 10s. brought forward and £2 424 interest, making a total of £48 110 10s. After deducting interest on debenture stock (£4 260), interim dividend on the preference shares at the rate of 6 per cent. per annum (£900), and interim dividend on the ordinary shares at the rate of 5 per cent. per annum (£6 179 10s.), there remains a balance of £36 771, which the directors recommend shall be appropriated as follows:—To reserve, £17 000; to writing off the balance of the cost of extinction of founders' shares, £9 804; to final dividend on the preference shares at the rate of 6 per cent. per annum, making 6 per cent. for the year, £900; to final dividend on the ordinary shares at the rate of 7 per cent. per annum, making 6 per cent. for the year, £8 651; leaving a balance to be carried to the next account of £415. The number of 30-W lamp equivalents connected on Dec. 31 was 359 278, an addition of 5 763 during the year, and the total number of units sold was 4 828 604, being 87 524 less than that for the previous year.

Westminster Electric Supply.

Sir Edward Goulding (deputy chairman), presiding at the annual meeting of the Westminster Electric Supply Corporation last week, said that the erection of the new plant at the Central Company's station enabled them to shut down Davies-street station, and as this building (which was held on a lease) would no longer be required for the purposes of the company, it had been sold, together with the plant, at a satisfactory figure. The whole of the expenditure on this station had been written off, and the shutting down of the station would lead to greater economy in generation. It was not until the last quarter of the year that the new plant erected at Grove-road and Horseferry came into use. Since then the costs of generation had been substantially reduced. After prolonged negotiations they had been able to come to terms with the City of Westminster as to the replacement of the arc lighting with modern incandescent lamps. These lamps, without using any more current, had a greater illuminating power. The change over was completed early in February. An abstract of the accounts was given in our issue of Feb. 24.

City of London Electric Lighting.

The report of the City of London Electric Lighting Company shows a balance available for dividends on preference and ordinary shares, and for "carry forward" to 1922, of £132 243 10s. Dividends amounting to £97 044 were paid in September last, and the directors now recommend that balance dividends be paid, making a total distribution for the year on the first preference shares of 6 per cent. per annum, on the second preference shares of 8 per cent. per annum, and on the ordinary shares of 14 per cent. per annum. These dividends will absorb £67 200, leaving a balance to be carried forward to 1922 of £29 844. The company's service during the prolonged coal strike was maintained with great difficulty and expense, and, in May, recourse was had to oil fuel, the use of which the directors have determined to continue as an alternative source of fuel supply. The additional plant, referred to in the last report, has now been completed.

The Globe Telegraph & Trust Company have declared a quarterly dividend of 5s. (net) on the ordinary shares for the current year.

Stavely Coal and Iron Company announce a dividend of 5 per cent. per annum, tax free, for the half-year, payable March 31.

For the half-year to Jan. 31, 1922, Aberdeen Suburban Tramway Company made a profit of £1 050, making, with £2 293 brought in, £3 343.

The directors of O. C. Hawkes, Birmingham, recommend a final dividend on the ordinary shares at 10 per cent. per annum, less tax, making 8 per cent. for the year.

The Clyde Valley Electrical Power Company recommend a final dividend at the rate of 10 per cent. per annum, less tax, making 7½ per cent. for the year, the same as last year.

The net profits for 1921 of the Wemyss and District Tramways Company were £5 840, and £1 154 was brought forward. A dividend of 6 per cent., tax free, on the ordinary shares is recommended, leaving £401 to be carried forward.

The directors of Newcastle-on-Tyne Electric Supply Company recommend, subject to audit, that, in addition to the final dividend on the 7 per cent. cumulative preference shares, a dividend at the rate of 5 per cent. for the year be paid on the 5 per cent. preference shares.

Clarke, Chapman & Co. announce a dividend of 1s. 6d. per share, less tax, on the ordinary shares for the half-year, payable Mar. 15, making 2s. 6d. per share for the year. The sum of £20 000 is placed to reserve, £5 000 to reserve for workmen's compensation, £27 917 for depreciation, and £15 719 is carried forward.

The profit of Electro Bleach and By-Products for 1921, less repairs, standing charges, depreciation, and making reserve for income tax, excess profits duty and corporation tax, was £13 115, plus £5 921 brought in, making £19 036. The directors recommend a final dividend of 3½ per cent. on the preference shares, making 7 per cent., writing off patent account £4 957, and carrying forward £79.

The directors of the Western Telegraph Company have declared the second quarterly interim dividend of 5s. per share, free of income tax, for the year ending June 30, 1922, payable to shareholders registered on March 11, being at the rate of 10 per cent. per annum. The transfer books of the Company will be closed from the 11th to the 17th inst. inclusive.

The Report of Hastings and District Electric Tramways Company for 1921 shows a profit of £11 044, plus £1 000 brought in. The directors recommend the payment of 1½ per cent., being the balance of arrears of preference dividend for 1919, and a dividend of 6 per cent. on the preference shares for 1921. The sum of £5 000 has been placed to depreciation and £1 044 carried forward.

The Stock Exchange Committee have ordered $294 720 common stock of the Canadian General Electric Company and $1 750 000 first and second refunding mortgage 5 per cent. 30-year gold bonds of the Montreal Tramways Company to be quoted in the Official List, and have specially allowed dealings in 28 654 10s. fully paid ordinary shares of Fellows Magneto Company and £250 000 6 per cent. cumulative second preference stock of the North Metropolitan Electric Power Supply Company.

The revenue of the London & Suburban Traction Company for 1921 was £112 598, plus £2 100 brought in, making £114 697. Deducting administration and general expenses, interest on debenture stocks and deposits, 5 per cent "A" debenture stock service fund and corporation tax, the balance is £67 644. The directors propose a balance dividend of 2½ per cent. in respect of the year ended Dec. 31, 1917, on the cumulative preference shares, and 1 per cent. on account of the year ended Dec. 31, 1918, carrying forward £11 523.

In moving the adoption of the report and accounts of the Fife Tramway Light & Power Company at the annual meeting last week, Mr. W. Low, who presided, said that the gross receipts of all properties owned by the company amounted to £326 634 for the year ended Dec. 31, 1921 as compared with £303 904 for the previous year. The gross revenue from the company's properties amounted to £78 394, against £72 801 in 1920. The directors recommended payment of a dividend on the ordinary shares at the rate of 8 per cent. per annum, less tax.

For 1921 the gross revenue of the Underground Electric Railways Company of London was £770 000, an increase of £190 322. The balance available for interest on the 6 per cent. income bonds and for reserves was £387 958, an increase of £186 963. The interest on the income bonds is 4 per cent. for the year, and the balance of £26 241 is carried to the special reserve for equalisation of interest. For 1920 2 per cent. was paid on the income bonds. The loss in exchange owing to the encashment of coupons in New York and Amsterdam was £82 925, against £58 171 in 1920.

Presiding at the annual meeting of the Liverpool Overhead Railway last week, the chairman, Mr. H. C. Woodward, said that the decrease of 7 000 000 passengers during the past year was caused by the serious loss of trade and dock work of all kinds in the port, together with the departure of several big steamers from Southampton instead of Liverpool. The railway was entirely dependent upon the trade of the port for its prosperity, and for the past twelve months that trade had been almost in a state of paralysis. The ordinary weekday at the docks nowadays looked as Sunday once did. The general tone of commerce, however, led them to hope that things were on the turn, and he hoped that the tide of trade might take a rapid turn in the right direction. The accounts of the company were dealt with in our issue last week.

New Companies.

Cardiff Electrical Repairs, Ltd.

CARDIFF ELECTRICAL REPAIRS, LTD. (178 894). Private company. Registered Feb. 23. Capital, £1 000 in £1 shares. To take over the business of electrical and mechanical engineers carried on by E. A. Waugh and T. Richmond at Northcote-lane, Cardiff, as the Cardiff Electrical Repairs Company, and to carry on the business of electrical, mechanical, motor, and general engineers and contractors, &c. Permanent directors: A. E. Waugh and T. Richmond. Solicitor: T. J. Shackell, 2, Church-street, Cardiff.

Donaldson & Kelso, Ltd.

DONALDSON & KELSO, LTD. (12 067). Private company. Reg. in Edinburgh Feb. 23. Capital £1 500 in £1 shares. Electrical, mechanical, consulting and contracting engineers, &c. Subscribers: J. B. Muir, W. R. C. Murdoch, C. Murdoch. Secretary: W. R. C. Murdoch. Registered office: 98, West George-street, Glasgow.

Guaranteed, Ltd.

GUARANTEED, LTD. (179 993). Private company. Registered Feb. 28. Capital, £100 in £1 shares. Electrical manufacturers, supply agents and wholesale factors, electrical engineers and contractors, &c. Permanent directors: C. Seymour and H. Feneron. Qualification, £1. Registered office: 1 and 3, Sun-street, Finsbury-square, E.C. 2.

Henderson, Clifton & Co.

HENDERSON, CLIFTON & COMPANY, LTD. (179 995.) Private company. Registered Feb. 25. Capital, £1 500 in £1 shares. To take over the business carried on by A. J. Henderson at 35, Sackville-street, W. 1, as "Arthur Henderson & Company," and to carry on the business of consulting, mining, mechanical, electrical, petroleum, mining, and general engineers, &c. Permanent managing directors: A. J. Henderson and Major E. H. Clifton. Registered office: 35, Sackville-street, W. 1.

Matthew Wylie & Co., Ltd.

MATTHEW WYLIE & COMPANY, LTD. (12 065). Private company. Registered in Edinburgh Feb. 22. Capital, £50 000 in £1 shares. Engineers, machine makers, machinery importers, electricians, iron and brass founders, &c. Subscribers (each with one share): G. F. Todd and J. McKechnie. Registered office: 81, Portman-street, Kinning Park, Glasgow.

Selco, Ltd.

SELCO, LTD. (179 702). Private company. Registered Feb. 14. Capital, £100 in £1 shares. Consulting, mechanical and electrical engineers, &c. Subscribers (each with one share): Mackie Galstaun and Nellie Schofield. Solicitors: Gisborne, Woodhouse & Company, Temple Chambers, Temple-avenue, E.C. 4.

Southall Engineering Company.

SOUTHALL ENGINEERING CO., LTD. (180 058). Private company. Registered March 2. Capital, £3 000 in £1 shares. To adopt an agreement with A. Bailey, J. C. Weber and E. J. Selby, and to carry on the business of manufacturing mechanical and electrical engineers, &c. First directors: A. Bailey, J. C. Weber and R. Carter. Registered office: Pioneer Works, Hammond-road, Southall.

R. B. Wilson, Ltd.

R. B. WILSON, LTD. (N.I. 15). Private company. Reg. in Belfast Feb. 18. Capital £1 000 in £1 shares. Electrical and heating engineers, &c. First directors: D. Thompson and R. B. Wilson. Registered office: 103, Roden-street, Belfast.

COMPANIES INCORPORATED OUTSIDE THE U.K.

Bombay Electric Supply & Tramways Company, Ltd.

BOMBAY ELECTRIC SUPPLY & TRAMWAYS COMPANY, LTD. Incorporated in India on Oct, 1, 1920. Capital, Rs.3 90.00.000 in 600 000 ordinary and 180 000 preference shares of Rs.50 each. To acquire the undertaking and all or any of the assets and liabilities of the Bombay Electric Supply & Tramways Company, Ltd., incorporated in England in 1905, including the benefit of a deed of concession, dated Aug. 7, 1905, between the Municipal Corporation of the City of Bombay, W. D. Sheppard (Municipal Commissioner for City of Bombay), the Brush Electrical Engineering Company, and the Bombay Electric Supply and Tramways Company, to acquire certain licences granted to the Brush Electrical Engineering Company and the Bombay Electric Supply and Tramways Company, &c. British address is 3-4, Clement's Inn, Strand, W.C. 2, where F. C. Austen (London secretary) is authorised to accept service of process and notices on behalf of the company. Directors at date of incorporation: Sir Sassoon David, Bart., Sir Fazulbhoy Currimbhoy, F. E. Dinshaw, A. H. Froom, Chunilal V. Mehta, Sir Stanley Reed, F. C. Remington, and R. D. Tata. File number, 2 074F.

Clatworthy & Son, Ltd.

CLATWORTHY & SON, LTD. (2 083F.). Particulars filed Feb. 27. Capital 40 000 dollars in 100 dollars shares. Incorporated in Canada on Nov. 28, 1908, to manufacture, import and sell display fixtures, shop fittings, electric fixtures and appliances, &c. British address: Poland House, 167, Oxford-street, W. 1, where H. R. Hollinshead is authorised to accept service. Directors: G. Clatworthy, C. G. Clatworthy, W. F. Putt and Mrs. K. Clatworthy, all of Toronto.

An order was made on Feb. 9 RESTORING PATENT No. 19 851/1910 granted to Alphonse Constant Reyrolle and A. Reyrolle & Company, Ltd., for "Improvements relating to electrical cut-outs."

COMMERCIAL INTELLIGENCE.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

BAILEY (GEORGE) & SONS (WOLVERHAMPTON), LTD. Registered office: 170, Stafford-street, Wolverhampton, electricians. £37 10s. 11d. Nov. 3.

BALL & BROCKHURST, Meridian Works, Chingford, electrical engineers. £23 12s. Jan. 3.

BRANSON BROS., 56, Australia-road, Cardiff, electrical engineers. £10 15s. 10d. Jan. 9.

CAREY TRANSMISSION, LTD., Arneway-street, Horseferry-road, S.W., engineers. £28 16s. 7d. Dec. 19.

GRAY, Arthur, 9, Denmark-street, W.C., electrical engineer. £23 0s. 8d. Nov. 24.

LAWRENCE, Mr. W., Rock-road, Torquay, electrical engineer. £11 4s. 9d. Nov. 29.

LIMBREY, F., & COMPANY, 38, Gondar-gardens, West Hampstead, electrical engineers. £13 13s. 5d. Nov. 14.

RIGBY, J. H., 22, Higher Hillgate, Stockport, electrical engineer. £16 10s. 8d. Dec. 22.

ROTHWELL, Peter (the elder), and ROTHWELL, Peter (the younger) (trading as PETER ROTHWELL & COMPANY), 64, Hr. Bridge-street, Bolton, electricians. £13 11s. 7d. Jan. 11.

THOMAS, Mr. J., 16A, Albion-street, Tunbridge Wells, electrical engineer. £36 10s. 1d. Dec. 23.

ULTRA MARINA TRUST, LTD., 8, Poland-street, W., magneto manufacturers. £78 9s. 7d. Nov. 11.

WESTON, Mr. G. A., 330, London-road, Westcliff-on-Sea, electrician. £14 19s. 4d. Jan. 3.

Bills of Sale.

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1822 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

GILL, Frederick John, Electric House, 26, Hardwick-street, Buxton, co. Derby, electrical engineer. Feb. 21. £150.

JOHNSON, Norman, 20, Stirling-road, Enfield, trading as NORMAN JOHNSON & COMPANY, at Hop Poles Engineering Works, Baker-street, Enfield, manufacturing mechanical and electrical engineers. March 4. £50.

KELLS, Joseph, 13, Abbey-road, Anfield, Liverpool, electrical engineer. Feb. 28. £100.

MATTHEWS, Henry Grindell, 2, Harewood-place, Oxford-street, W., electrical engineer. Feb. 28. £400.

Receivership.

BISHOPS CASTLE ELECTRIC LIGHT AND POWER CO., LTD.—W. H. Thomson, of 19a, Coleman Street, E.C., was appointed as receiver and manager on February 23, 1922, under powers contained in debentures dated February 8, 1915.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

BODMIN ELECTRIC LIGHT AND SUPPLY COMPANY, LTD. Registered Feb. 21, £2 000 debentures, present issue £1 900; general charge. *Nil. Dec. 31, 1920.

BOULTON MAGNETOS, LTD., Wolverhampton. Registered Feb. 17, £800 debentures: general charge. *——. Nov. 21, 1921

BRITISH MICA COMPANY, LTD., Bedford. Registered Feb. 16. £800 debentures, balance of £1 500: general charge. *£700. April 21, 1921.

ELECTRIC BRASS WARES, LTD., Liverpool. Registered Feb. 15, £500 debentures: general charge. *——. Sept. 19, 1921.

HARRISON BROTHERS (ELECTRICAL ENGINEERS) LTD., Middlesbrough. Registered Feb. 22, £2 000 debentures to Branch Nominees, Ltd., 15, Bishopsgate, E.C.; general charge. *Nil Aug 1, 1921.

McBEAN (J. H.), LTD., Batley, electrical engineers. Registered Feb. 18, £1 000 (not ex.) debentures, to National Provincial & Union Bank of England, Ltd.; general charge. *——. April 18, 1921.

MELBOURNE ELECTRIC SUPPLY COMPANY, LTD. (late ELECTRIC LIGHTING & TRACTION COMPANY OF AUSTRALIA, LTD.), London, E.C. Registered Feb. 7, trust deed dated Jan. 31, 1922, securing $2 500 000 in gold currency of the U.S.A.; charged on freehold properties of company in Australia, also general charge. *£702 178. Feb. 21, 1921.

PEWSEY ELECTRIC LIGHTING COMPANY, LTD. Registered Feb. 13, £2 000 debentures; general charge.

Private Meeting.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

GROVER, SMITH & WILLIS, electrical and mechanical engineers, Sarum Hill, Basingstoke. A circular has been issued in this matter stating that a conference of the larger trade creditors has been held, when it was stated that an offer might be forthcoming for the business at a figure sufficient to satisfy the claims of the creditors in full, the assets being £2 765, subject to realisation, and the liabilities £2 694. The circular further stated, "Unfortunately this offer has not been obtained, and at such conference it was resolved that in that event the debtors should execute a deed of assignment to Mr. E. H. Hawkins (Poppleton, Appleby & Hawkins) as trustee, together with a committee of inspection consisting of three of the principal creditors—Brown Brothers, Ltd., United States Rubber Company, and W. & A. Bates—and in accordance with such resolution the debtors have now assigned their estate to the trustee."

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Companies Winding-up Voluntarily.

MIDLAND ELECTRIC ROTARY BLOWING COMPANY, LTD. J. W. Massey, of 46, Cherry-street, Birmingham, appointed liquidator. Meeting of creditors at 32, Curzon-street, Derby, on Thursday, March 9, at 12 noon.

READ, F. O., & COMPANY, LTD. C. H. N. Nathan, of Norfolk House, Norfolk-street, Westminster, appointed liquidator. Meeting of creditors at Donington House, Norfolk-street, London, W.C. 2, on March 14, at 12 noon. Particulars of claims by April 15 to the liquidator.

SEMCO, LTD. F. B. Darke, of Darke, Robson & Batty, 146, Bishopsgate, London, E.C. 2, appointed liquidator. Meeting of creditors at the Abercorn Rooms, Great Eastern Hotel, Bishopsgate, London, E.C. 2, on Thursday, March 16, at noon.

THANET ELECTRIC COMPANY, LTD. H. Kirby, of 840, Salisbury-house, London, E.C. 2, appointed liquidator. Meeting of creditors at the Institute of Chartered Secretaries, 59a, London-wall, E.C. 2, on Monday, March 20, at 11 a.m.

Bankruptcy Information.

GOSS, Frederick Charles, 32, Windsor-road, St. Andrew's Park, Bishopston, and at 71, North-road, Bristol, electrical engineer. Receiving order, Feb. 28. Debtor's petition. First meeting, March 10, 2.15 p.m., 26, Baldwin-street, Bristol. Public examination, April 21, 12 noon, Guildhall, Bristol.

HASLIN, John Joseph, 30, Nestfield-street, Darlington, Co. Durham, electric welder. Receiving order, March 1. Debtor's petition. First meeting, March 17, 2.15 p.m., 80, High-street, Stockton-on-Tees. Public examination, March 29, 11 a.m., Court House, Bridge-street, Stockton-on-Tees.

LIDDELL, Robert Henry, carrying on business under the name of LIDDELL & McINNES, at 4, The Crescent, Carlisle, electrical engineer. First meeting, March 15, 12 noon. 34, Fisher-street, Carlisle. Public examination, March 20, 11 a.m. Registrar's Chambers, 32, Lowther-street, Carlisle.

Notice of Dividend.

DRYSDALE, William, 24, Paxton-street, Barrow-in-Furness, electrician. Amount per £ 1d., final. Payable, March 11, 4, Ramsden-square, Barrow-in-Furness.

Partnerships Dissolved

CLARKE, Charles Henry, and DAVEY, William Charles, electrical and telephone engineers, under the style of W. E. WEEKES & COMPANY, by mutual consent as from Jan. 31, 1922. Debts received and paid by W. C. Davey, who will continue the business.

HERNE, Charles Thomas, and PITT, Frederick George, electricians, etc., 17, Motcomb-street, London, S.W., under the style of HERNE & COMPANY, by mutual consent as from Dec. 31, 1921. Debts received and paid by C. T. Herne, who will continue the business.

RUSSELL, Arthur Stanley, and MOORE, Harold Foster, electrical engineers, at Shafton-lane, Holbeck, Leeds, under the style of FIRTH & RUSSELL, by mutual consent as from Jan. 20, 1922. Debts received and paid by H. F. Moore, who will continue the business.

Edinburgh Gazette.

GRAFTON DYNAMOS, LTD. J. W. MacKinnon, Glasgow, appointed liquidator in voluntary winding-up of company.

Bankruptcy Proceedings.

INCE, Arthur Courtenay, trading as the NEWCASTLE ELECTRICAL ENGINEERING CO., late in partnership with another as the TYNE ELECTRICAL INDUSTRIES, 21, Fenkle Street, Newcastle-on-Tyne, electrical contractor. The first meeting of creditors was held last week. The statement of affairs showed liabilities of £413, against assets £170. The Official Receiver stated that there were several matters to be inquired into and he suggested that they should remain over until debtor's public examination on the following day. He proposed to ask for an adjournment of the examination. The creditors decided to adopt this course. The following are creditors: English Electric and Siemens Supplies Ltd., London, £40; General Electric Co., Newcastle-on-Tyne, £18; Lee, A. and Co., Ltd., Newcastle-on-Tyne, £36; Newcastle and District Electric Light Co., Ltd., Newcastle-on-Tyne, £10.

HOPKINS, J. Howard, formerly trading as the ELECTRICAL MAINTENANCE COMPANY, 140, Wardour Street, W. The above debtor, with total liablities £6 575 of which £956 is unsecured and no assets, attended at the London Bankruptcy Court, on the 3rd inst. for public examination. The Official Receiver elicited from the debtor that from 1906 to 1918 he was in employment latterly as managing director of a cinematograph company. In July of the latter year with a capital of £1 000 he commenced business as an electrical engineer at 87, Shaftesbury Avenue under the above style. The business was originally intended to maintain Cinema Electrical plants but developed into a Cinema Equipment Company. In or about March, 1919, he was joined in partnership by a Mr. C. A. Hale, who introduced £3 000 capital, of which witness received personally £1 200, and £1 800 went into the business, and in August, 1919, the business was transferred to the above address. Unfortunately he was unable to agree with his partner, and in September, 1920, the partnership was dissolved, witness purchasing his partner's interest for £5 000, payable £500 down and the balance by instalments of £40 a week. Unhappily he was not conversant with the equipment part of the business, and various mistakes which were made resulted in loss of orders and loss on contracts, and he admitted that the latter part of his trading was carried on at a loss. He consulted his solicitors, and on December 20, 1920, a meeting of his creditors was held, and as a result he executed a deed of assignment to Mr. O. Sunderland and Mr. A. F. Stoy as trustees for the benefit of creditors. The claims of the creditors who assented to the deed were £20 000, and they comprised the whole of his creditors with the exception of the petitioning creditor, Mr. Rayman, who did not join in the deed. Under the deed up to the present dividends aggregating 2s. in the £ had been paid, and he believed a further 2s. or 3s. would be paid. He attributed his failure to his liability under a judgment obtained against him by the petitioning credtor for cash advanced. The examination was ordered to be concluded.

Prices of Metals, Chemicals, &c.

TUESDAY, MARCH 7.

		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£62 5 0	—	—
Electro Wirebars ..	,,	£66 10 0	£1 0 0	—
H.C wire, basis	per lb.	0s. 10¼d.	¼d.	—
Sheet	,,	0s. 9 1/16d.	—	—
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze wire, basis	,,	1s. 2¼d.	¼d.	—
Brass 60/40—				
Rod, basis	,,	0s. 7¼d.	—	—
Sheet, basis	,,	0s. 9¾d.	—	—
Wire, basis.....	,,	0s. 10¼d.	—	—
Pig Iron—				
Cleveland Warrants .	per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 SWG	,,	£19 0 0	—	—
Lead Pig—				
English	,,	£22 5 0	£0 10 0	—
Foreign or Colonial ..	,,	£20 15 0	£0 2 6	—
Tin—				
Ingot	,,	£145 0 0	—	£3 0 0
Wire, basis	per lb.	2s. 0d.	—	¼d.
Aluminium Ingots	per ton	£120 0 0	—	—

Spelter.— Per ton £25 2s. 6d.
Mercury.—Per bottle £12
Salammoniac.—Per cwt. 65s.-60s.
Sulphur (Flowers).—Ton £10 10s.
,, (Roll-Brimstone).—Per ton £10 10s.
Sulphuric Acid (Pyrites, 168°).—Per ton £9 17s. 6d.
Copper Sulphate.—Per ton £27
Boric Acid (Crystals).—Per ton £65
Sodium Bichromate.—Per lb. 5¾d.
Sodium Chlorate.—Per lb. 3½d.
Rubber.—Para fine, 11d.; plantation 1st latex, 7¾d. to 8¼d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

Arrangements for the Week.

FRIDAY, March 10th (to-day).

PHYSICAL SOCIETY.

5 p.m. At the Imperial College of Science, South Kensington, London, S.W. Papers on "The Electromagnetic Screening of a Triode Oscillator," by Mr. R. L. Smith-Rose; "A New Form of High Vacuum Automatic Mercury Pump," by Dr. H. P. Waran; and "Viscosity Determination by Means of Orifices and Short Tubes," by Mr. W. N. Bond.

INSTITUTION OF ELECTRICAL ENGINEERS.

NORTH-WESTERN CENTRE.

7.30 p.m. At the College of Technology, Manchester. Exhibition of Cinematograph Films, by Dr. C. C. Garrard and Mr. F. Gill, O.B.E.

SCOTTISH CENTRE. STUDENTS' SECTION.

7.30 p.m. At the Royal Technical College, Glasgow. Annual General Meeting and Paper on "Electricity in Mines," by Mr. J. C. Stewart.

IRISH CENTRE.

8 p.m. At the Royal College of Science, Upper Merrion-street, Dublin. Paper on "Wireless Communications in the Campaign in France," by Prof. R. Stanley.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Paper on "Friction," by Mr. C. H. Plant.

ELECTRO-HARMONIC SOCIETY.

8 p.m. At Cannon-street Hotel, London, E.C. Smoking Concert.

ROYAL INSTITUTION.

9 p.m. At Albemarle-street, London, W. Discourse on "Problems in the Variability of Spectra," by Prof. T. R. Merton, F.R.S.

SATURDAY, March 11th.

ROYAL INSTITUTION.

3 p.m. At Albemarle-street, London, W. Lecture on "Radio-Activity," by Sir Ernest Rutherford, F.R.S. (Lecture II.)

BIRMINGHAM AND DISTRICT ELECTRIC CLUB.

7 p.m. At the Grand Hotel, Colmore-row, Birmingham. Paper on "Ball Bearings," by Mr. A. Macaulay.

MONDAY, March 13th.

INSTITUTION OF ELECTRICAL ENGINEERS.

DUNDEE SUB-CENTRE.

7.30 p.m. At University College, Dundee. Papers on "Electric Motor Starters," by Mr. J. Anderson, and "Induction-Type Synchronous Motors," by Mr. L. H. A. Carr.

NORTH-EASTERN CENTRE.

7.30 p.m. At Armstrong College, Newcastle. Address on "Primary and Secondary Education of Engineers," by Mr. J. S. Highfield.

TUESDAY, March 14th.

WOMEN'S ENGINEERING SOCIETY.

6.15 p.m. At 26, George-street, Hanover-square, London, W. Lecture on "Women's Place in Industry," by Mr. F. S. Button.

NATIONAL ASSOCIATION OF SUPERVISING ELECTRICIANS.

6.45 p.m. At St. Bride's Institute, Bride-lane, London, E.C. Paper on "The Determination of Heat Loss from Buildings, with Special Reference to Electrical Heating," by Mr. W. W. Nobbs.

INSTITUTION OF ELECTRICAL ENGINEERS.

SCOTTISH CENTRE.

7 p.m. At the North British Station Hotel, Edinburgh. Paper on "Telephone Line Work in the United States," by Mr. E. S. Byng.

NORTH-WESTERN STUDENTS' CENTRE.

7.30 p.m. At Houldsworth Hall, Deansgate, Manchester. Paper on "Commutation, Armature Reaction, and the Selection of Carbon Brushes for Dynamo Electric Machinery," by Mr. J. W. A. Abernethy.

WEDNESDAY, March 15th.

SOUTH MIDLAND CENTRE.

7 p.m. At the University, Birmingham. Paper on "Electric Motor Starters," by Mr. J. Anderson.

SHEFFIELD SUB-CENTRE.

7.30 p.m. At the Royal Victoria Hotel, Sheffield. Paper on "Notes on the Practical Operation of E.H.T. Protective Gear," by Mr. F. Langley.

INDUSTRIAL LEAGUE COUNCIL.

7.30 p.m. At Caxton Hall, London, S.W. Lecture on "Psychology in Industry," by Mr. W. Piercey, C.B.E.

THURSDAY, March 16th.

INSTITUTION OF ELECTRICAL ENGINEERS.

6 p.m. At Savoy-place, London, W.C. Paper on "Phantom Telephone Circuits and Combined Telegraph and Telephone Circuits Worked at Audio Frequencies," by Mr. J. G. Hill.

FRIDAY, March 17th.

LONDON STUDENTS' SECTION.

7 p.m. At Savoy-place, London, W.C. Paper on "The Electron Theory," by Mr. C. C. H. Wade.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION.

7.30 p.m. At the Chartered Institute of Patent Agents, Staple Inn-buildings, London, W.C. Salesmanship Conference. No. 5, "Salesmanship in Relation to Showroom Displays and Demonstrations." Speaker: Mr. A. C. Bostel.

Patent Record.

APPLICATIONS FOR PATENTS

December 2, 1921.

32 321 AMBERTON. Electric control systems.
32 342 TAYLER. System of electric lighting in combination with piano, &c
32 352 METROPOLITAN-VICKERS ELECTRICAL CO. Switches. (2/12/20, U.S.)
32 363 GES FÜR DRAHTLOSE TELEGRAPHIE. Thermionic generators. (3/12/20, Germany.)
32 364 GES FÜR DRAHTLOSE TELEGRAPHIE. Generation of electrical oscillations by thermionic valves. (4/12/20, Germany.)
32 365 GES FÜR DRAHTLOSE TELEGRAPHIE. Calling apparatus for high-frequency telegraphy. (4/12/20, Germany.)
32 377 AKT. GES. BROWN, BOVERIE ET CIE. Apparatus for preventing occurrence of higher harmonic currents in working of metal vapour rectifiers. (6/12/20, Switzerland.)
32 380 B. T.-H. CO. & FARMER (G. E. Co.). Electric motor control.
32 381 B. T.-H. CO. (G. E. Co.). Switches.
32 385 DETMOLD. Coupling electric leads to terminals.
32 386 DETMOLD. Electric terminals, adaptors, &c.

December 3, 1921.

32 421 COLEBROOKE & WILLIAMS. Vacuum, &c., tubes for electrical discharges.
32 422 JACKSON. Motor control systems.
32 447 BUDD MFG. CO. Automatic electric welding machines. (13/12/20, U.S.)
32 493 VAUDERVELL. Electric machines.
32 499 RUNBAKEN & TORRANCE. Means for varying intensity of illumination of road vehicle electric lamps.
32 501 STERLING TELEPHONE & ELECTRIC CO. Indicator systems for lifts, &c.
32 502 SEFTON-JONES (Lorenz Akt. Ges.). High-frequency telephony.

December 5, 1921.

32 523 ROLLER. Electric generator. (4/12/20, Germany.)
32 527 COLLINGHAM & OWEN. Driving mechanism of electric generators.
32 530 DEPREE & HOKER. Electric heaters for internal combustion engines.
32 549 BERESFORD. Combined electric heating and lighting apparatus.
32 580 DORNIG. Wireless telegraph antennæ.
32 583 POLLAK, SIEMENS & HALSKE A. G. Telephone systems.
32 595 MASCHINENFABRIK SCHIESS, A. G. & BECKER. Driving machine tools with independent electrical drives. (6/12/20, Germany.)
32 596 MITCHELL. Anti-climbing devices for posts carrying electric wires, &c.
32 597 REGAN. Electric train control systems.
32 621 SHAWMUT MACHINE WORKS, INC. Thermostatically-controlled socket switches. (3/12/20, U.S.)

December 6, 1921.

32 628 WATSON. Electric pianoforte-driers.
32 693 CHARLIER. Heating devices and electric furnaces.
32 715 B. T.-H. CO. & WHITAKER. Electric machines.
32 716 B. T.-H. CO. (G. E. Co.). Electric lamp fittings.
32 725 FERRANTI. Fastening transformers in their oil tanks.
32 726 FERRANTI. Supporting devices for transformers, &c.
32 732 AKT. GES. BROWN, BOVERI ET CIE. Method of installing turbines for driving dynamos. (7/6/21, Switzerland.)

December 7, 1921.

32 780 SUTHERLAND, LTD. & COOKE. Switches and contacts.
32 805 BECKER & DEGGE. Dimming switch for lighting system of automobiles.
32 808 ARTHUR, SPROSEN & HARDY. Dimmer switches for headlights of motor-cycles, &c.
32 872 MCLACHLAN & LANGRIDGE. Wireless telegraph receiving apparatus.
32 874 BRYAN. Electric radiators.
32 875 BUCKLEY. Multi-pole switch.
32 876 BUCKLEY. Electric starting motor for engines.
32 892 MOULLIN. Measurement of alternating voltages.

December 8, 1921.

32 872 LANGRIDGE. Wireless telegraph receiving apparatus.
32 893 LYMBURN. Electric lamp bulbs.
32 904 LEWIS. Magnetos.
32 917 FOX. Electric torches.
32 930 ROHNER & SIMIC. Incandescent lamps.
32 963 OPTISCHE ANSTALT C. P. GOERZ A. G. Electromotive devices for calculating machines. (11/12/20, Germany.)
32 971 MOODY. Variable inductance and transformer coils for wireless circuits.
32 976 WESTERN ELECTRIC CO. Oscillation generators. (22/12/20, U.S.)
32 977 WESTERN ELECTRIC CO. Telephone systems.
32 981 INGGS & LUCAS. Electric horns for motor vehicles.
32 982 SIBILS. Incandescent lamp holders.
32 987 SAYERS. Connection of windings to commutators in electric machines.
32 997 HUTCHESON. Devices for registering telephone calls.
32 999 GES. FÜR DRAHTLOSE TELEGRAPHIE & GEWESKE. High-frequency telephony. (26/1/21, Germany.)

December 9, 1921.

33 047 STRONG. Railway or tramway rail joints.
33 051 VERITY'S, LTD., & PIPKIN. Switches, and operating gear therefor.
33 060 CABLE ACCESSORIES CO., REEVES & CRAWFORD. Fuse boards.
33 098 CALLENDER'S CABLE & CONSTRUCTION CO., MATHER & HUNTER. Feeder connectors for contact rails on electric railways.
33 099 CALLENDER'S CABLE & CONSTRUCTION CO., MCCALLUM & MACALISTER. Supports for cables, pipes, &c.
33 116 WESTERN ELECTRIC CO. Microphones. (24/12/20, U.S.)
33 119 WHITE. Mounting and driving magnetos.
33 129 COVENTRY AUTOMATIC TELEPHONES, LTD., PEEL-CONNER TELEPHONE WORKS & MCBERTY. Machine-switching telephone exchange systems.
33 132 SEFTON-JONES (Lorenz Akt. Ges.). Process for increasing frequency.
33 135 DONNISTHORNE. Production of h.t. unidirectional currents.
33 137 FOX & HAYES. Electric heating systems.
33 151 SIEMENS-SCHUCKERTWERKE. Electrical precipitation of suspended particles from fluids. (28/6/21, Germany.)
33 153 CROSS (Mordey). Electricity meters.
33 154 STROHMENGER. Arc welding appliances.
33 160 VEDOVELLI. Transformers.

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CONTENTS.

Notes of the Week.

Electricity Bill Propaganda.

Now that the Electricity Bill has passed the second reading in the House of Lords the virulent propaganda to which we drew attention last week has publicly died down, though we have no doubt it is still being conducted under the surface. We suspect that this opposition emanates from certain private interests. It is therefore local rather than national and of a stertorousness out of all proportion to its size. If it wins the day it may improve its own position, though that is by no means certain, but it will inevitably retard the progress of the electricity supply, and therefore malevolently affect the electrical industry. We are not surprised to learn that its course is being watched with anxiety in official circles and by those who recognise that the passing of such a measure is vital to electricity well-being. We are pleased, however, to notice that Sir Harry Renwick, chairman of the County of London Company, and one of the soundest authorities on electrical legislation and finance, recognises that the Bill contains many useful provisions, though he hints at certain amendments being necessary. These are surely a matter for arrangement, not propaganda.

The Financial Bogey.

Watching is not enough, however. And it is high time the supporters of the Bill were up and doing. Articles and speeches such as those to which we called attention last week, ill informed though they be, will inevitably do a great deal of harm unless the fallacies they contain are promptly exposed. Especially is it necessary that municipal authorities should take action, as they stand to lose most if the Bill fails to pass. This is the more essential, as the principal and most subtle argument against the Bill is that voiced by Lord Buckmaster, who complained that granting a local authority free powers to finance a Joint Electricity Authority would tend to the multiplication of local burdens, a thing, of course, which we all wish to avoid. But the frenzied finance which Lord Buckmaster fears can be adequately prevented not only by the ratepayers themselves but by the policy of the Commissioners. Incidentally, the grouping of stations and the extended control over the electricity supply in a large area, which the establishment of Joint Electricity Authorities will make possible, is likely to be cheaper for the ratepayers than continuing on present lines, interested arguments to the contrary notwithstanding. If, however, these safeguards are considered to be insufficient, a provision might be inserted whereby the contribution of each municipality is based on the proportion that its own assessable value bears to the assessable value of the district of which it forms a part.

The Real Danger.

These, however, are details, and we would ask the opponents of the Bill to pause and consider what will happen if the present measure is dropped. It is certain that development will be at once stunted, and uncertainty will continue to reign, with all its disadvantages, while in the not unlikely event of a Labour Government coming into being private enterprise will be replaced by bureaucratic control. Even from the most selfish point of view, therefore, it would be as well for the opposition to take what is now given than to wait longer and then to receive nothing. We therefore hope that those who are responsible for this propaganda will see the error of their ways and realise that not only the development of the whole industry but their own well-being depends on the passing of this measure. If with that measure could be combined a modification of the purchase clause, great good would be done, and we suspect that much of the present opposition would be neutralised. But while objection may be rightly used as a means of gaining concessions, care must be taken that it is not pushed too far. In this case that is a real danger.

Unfair Criticism.

Most unfair in this connection is Lord Bessborough's complaint that the Commissioners have done nothing. In truth they have done a great deal. That they have not done more is solely because their powers have been limited, a limitation which is one of the things that the Bill designs to remove. In addition, their task is a gigantic one, beset with difficulties and complications. The view may be taken that the official conception of electricity supply reorganisation is wrong, in which case both the present Bill and the Electricity Supply Act are unnecessary, but it is hardly fair to give the Commissioners a blunt chisel and then complain that they have not turned out a finished sculpture.

London "Underground" Extensions.

The announcement made by Lord Ashfield at the meeting of the Underground Electric Railways Company last week, that the Government had now agreed to guarantee the principal and interest upon a capital sum not exceeding £5 000 000 means that the amended scheme of tube railway extension and improvement has been accepted in principle. This is a very welcome decision, as it will mean a considerable addition to the transport facilities of the metropolis in the immediate future. Some of the projected improvements, such as the enlargement of the tunnels of the City and South London Railway and the provision of a connecting link between it and the Charing Cross Railway at Euston, are long overdue, but financial and other difficulties have hitherto prevented progress being made with them. Others include the extension of the electric railway from Golders Green to Edgware and the linking up of the Central London Railway with Richmond. The latter will afford an alternative route between the City, Kew and Richmond and relieve the congestion on the District Railway. In addition to providing increased transport facilities the scheme will give a good deal of employment at a time when it is badly needed.

Early Railway History.

The history of the pioneer electric railway is a striking illustration of the slow, though certain, development of British schemes. Originally incorporated in 1884 as the City and Southwark Subway Company, the title was altered in 1890. The first section of the line was opened for traffic in December of the latter year, and was at once a pronounced success. The consulting electrical engineer was the late Dr. E. Hopkinson, and Mather and Platt supplied the locomotives and rolling stock. Extensions have since been made at both ends of the line, but, like all pioneer undertakings, it has been affected by the march of progress. Other tube railways, with larger tunnels and better rolling stock, followed in due course, and for a long time it has been evident that improvements were essential in order to enable it to cope with modern conditions.

Regenerative Braking and Single Phase Traction.

A short time ago we drew attention to the economic and operating advantages which might be obtained by the introduction of some system of regenerative braking on the London Underground Railways. These advantages would, however, be accompanied by the disadvantages that extra equipment would be required and that the average speed would be reduced. On the other hand, where long down grades have to be negotiated energy can be returned to the line in sufficient quantities, if some system of regenerative braking is employed, to make the use of one of the systems available worth consideration on at least some of the sections of railway in this country. The possibilities of regenerative braking depend to some extent on the system of traction employed, and at a time when opinion in this country is beginning to favour single-phase working the article by Mr. E. Nordefeldt on "Regenerative Braking and Single-Phase Commutator Motors," which appears on another page of this issue, will be of interest.

Disadvantages of the Series Motor.

Mr. Nordefeldt, who discusses the question exhaustively, begins by pointing out that for regenerative braking on the single-phase system the use of series motors has been found impracticable. This may be a grave disadvantage in the light of past experience with this type of motor in traction work, and, if Mr. Nordefeldt is to be believed, would necessitate the employment of a shunt motor in which the phase angle of the field is rotated. A better arrangement, however, seems to be to employ a separately excited motor, but Mr. Nordefeldt holds the balance very equally between these varieties, and by means of diagrams compares their properties, especially with regard to braking at variable speeds. On the score of utilisation of the regenerated power and ease of control the most suitable type of machine is one whose excitation is independent of the speed and whose phase angle varies by 60 degrees from that of the transformer. To provide such conditions means the use of a special converter, and therefore a certain addition to the weight and cost of the locomotive. It may, however, be that these disadvantages are more than set off by the advantages gained.

Commutation Difficulties.

Commutation is always a bogey in such cases. But Mr. Nordefeldt's analysis of the problem shows that devices for obtaining the proper phase on the commutating field at all speeds can be provided without any great difficulty. Obviously this is a problem which cannot be decided without excursions into more practical fields than those explored by Mr. Nordefeldt. For local conditions will play a great part, as will the cost of energy and the density of the traffic. But regenerative braking is a device for which a good deal can be said, and we hope that traction companies will not neglect its possibilities in working out the schemes which we hope are to come into being in the near future.

Industrial Electrical Heating.

The strenuous and organised efforts made by advocates of gas to obtain a heating load have not yet been paralleled in the electrical industry, but with the continued growth of E.D.A. we may look forward to an equally earnest presentation of the electrical case. In the meantime the lecture given by Mr. J. G. Pearce to the Sheffield Gas Consumers' Association is an admirable example of the service which can be rendered to the industry by its members. Sheffield is an enormous consumer of industrial gas and a great stronghold of gas users. It is significant that they should seek light on electrical heating, and we urge Mr. Fedden and the salesmen of the Electricity Supply Department to lose no time in following up the matter. We are so preoccupied with questions of lighting and power that we may well question whether engineers as a body realise the full advantages of electrical heating. But when every electrical engineer's house is an all-electric house, when every electrical factory is a standard example of the advantages of electrical industrial heating, we may expect more progress in other industries.

Heating an Ideal Load.

Mr. Pearce's restraint in dealing with gas is specially commendable, for a statement which bears all traces of fair and impartial treatment is worth more than an unlimited amount of partisan propaganda, but the influence of electrical developments on the future price of power, the efficiency and convenience of electrical transmission, and the efficiency of the application of electrical heating cannot be ignored. When these advantages are combined with freedom from products of combustion, ease of temperature control, and absence of spoiled work the case for electricity for precision heating is unanswerable. Furthermore, the resistance furnace offers an ideal load both from the point of view of power factor and load factor, and station engineers might with advantage give preferential rates to consumers installing such furnaces for large outputs even where the ordinary power rate is already low. American experience suggests that such a load will become an appreciable fraction of the total output.

The Use of Light as an Aid to Aerial Navigation.

The use of light as an aid to traffic, particularly on motor vehicles, has been much in the public mind of late. At a recent meeting of the Illuminating Engineering Society a more novel and highly intricate problem—the use of light in aerial navigation—was discussed. Lieut.-Colonel L. F. Blandy, who read the introductory Paper, first described the lighting arrangements on the aircraft itself and afterwards passed on to the illumination of aerodromes. Light for the use of the crew and passengers is derived from a generator driven by the engine and is thus necessarily limited. We observe that in the passenger accommodation 48 lamps of 8 c.p. are contemplated, while in the body of the airship devoted to the crew's quarters, etc., there are ten lights of 3 c.p. An interesting development is the attempt to follow the usual procedure in the case of ships at sea by providing a white light forward, a green light on the right side, and a red light on the left side. In view of the high speeds attained by aircraft (approaching 200 miles per hour, or 3·3 miles per minute), the design of such lights is obviously important, for from the time of sighting the head lights to the moment of collision would be only 90 seconds!

Landing Lights.

As regards lights to facilitate landing, we observe that both chemical flares and electric lamps have been developed, the concensus of opinion being that the electric lamp is as serviceable as the chemical one. Aerodrome lighting involves three distinct problems—(1) obstruction lights, *i.e.*, lights used to indicate buildings or other obstructions; (2) illumination of the actual landing ground; and (3) fixed illuminated signs to show direction of wind, etc. Groups of coloured lights may also be used to identify particular aerodromes. The International Aircraft Convention has occupied itself with these problems, one recommendation being the arrangement of lights in the form of " L's " to facilitate landing; such lights have been installed at the Croydon aerodrome with fair success. It would appear that the aerial lighthouses have now reached a fair stage of development; apparently these are commonly supplied by dissolved acetylene, but doubtless electric light may be used in localities where electricity is readily available. It is evident that finality in such methods has not yet been reached, but the Paper furnishes a useful review of existing methods and future possibilities.

The Lock-Out.

In spite of eleventh-hour efforts of the kind to which we have become accustomed, the lock-out of members of the Amalgamated Engineering Union by federated firms came into operation at midnight on Sunday. At the time of going to press little has been done to overcome the deadlock, and the activities of both sides have been mainly engaged in re-stating their case and refuting each other's arguments. This is not likely to lead to peace, and is the more deplorable since the men's leaders have adopted a conciliatory attitude throughout, and their present position is the combined result of the strategy of the employers and the hot-headedness of certain of their followers. As we have already argued, the contention that managerial functions can be exercised by a trades union must fail, but with its failure may go the fall of the present moderate leaders and the appearance of a condition of things which will only be welcomed by the extremists of both parties. At a time when increased trade is essential to the well-being of the country the dispute should never have been allowed to reach this acute stage, and we hope that the moderates on both sides will see that it is composed without delay, and that, at any rate, it is not allowed to spread to other unions. Unfortunately, the extremists are active, and the E.T.U. especially seem anxious to join in the fray.

Supply Companies in 1921.

If dividend-earning capacity be treated as the criterion of success of public companies, then those engaged in the business of electricity supply must be looked upon as among the most successful of undertakings. For in the great majority of cases the results for 1921 show a marked improvement over those of the previous year. With a few exceptions, the ordinary dividend has been maintained at the same level as in 1920, and in some instances there has even been an increased distribution. At the present time the stock and shares of electricity supply companies are readily taken up by investors, and the developments likely to ensue upon the reorganisation of the industry are sure to enhance this attractiveness. For nowhere is there any indication that the demand for electricity has yet reached the saturation point, and the next few years should witness considerable expansion, more particularly of the power and domestic loads.

London Companies.

Among the companies serving the London area five have declared a higher rate of dividend on their ordinary shares than in 1920. These are the Charing Cross, the Kensington and Knightsbridge, the London Electric, the North Metropolitan Electric Power, and the South Metropolitan Electric Light and Power Companies. The remaining London companies, while maintaining the same rates of distribution as in the previous year, show improved results as indicated by the larger sums placed to reserve and depreciation and the increase in the amounts carried forward. Generally speaking, the gross receipts, the net profit, the units sold, and the connections all showed appreciable advances, but in four cases—the Westminster, St. James's, Kensington, and Metropolitan companies—there was a slight drop in the number of units sold. It will be noticed that all these companies are supplying in high-class residential areas, and the restrictions imposed during the coal strike, coupled with the fine summer, would be more than sufficient to account for this slight falling off in the consumption, which was mainly in the lighting and heating units.

Reductions in Charges.

It is, however, satisfactory to notice that these companies, as well as the other undertakings, report that the demand for new services and connections is as great as ever it has been, and that the prospect is exceptionally bright. Some of them have wisely decided to make a reduction in the price of electricity, and this should still further increase the consumption and also the receipts. With the fall in the cost of fuel and with the reductions in the price of materials and other expenditure the question of a substantial drop in electricity charges should now be seriously considered by all supply undertakings. It would have a most beneficial effect upon demand and it would greatly assist industrial development by reducing the cost of manufacture.

The Year's Anxieties and Troubles.

Though the year's results have been so satisfactory, success was only achieved after a good deal of anxiety and by the exercise of constant vigilance. The long and disastrous coal strike seriously affected all undertakings by increasing the price of fuel and by limiting the consumption. Many of the undertakings were fortunate in having reserves of coal, and a few were able to use oil fuel as a temporary expedient, and thus the storm, which had such disastrous effects on industry as a whole, was successfully weathered. As might be anticipated, the tendency to employ larger, more efficient, and more economical turbo-generating sets continues, but we notice that complaints of delay in the delivery of plant are still being made. Whatever justification there may have been for belated deliveries in the past, there should be none now, and it is to be hoped that manufacturers for their own sakes will make every effort to work off outstanding orders.

Rising Rates and Heavy Taxes.

Many of the chairmen, naturally, made reference in the course of their speeches to the increasing and almost unbearable burden of rates and taxes. Mr. R. H. Benson, chairman of the London Electric Supply Corporation, made use of a diagram to show graphically the increase in the rates since 1914. In the latter year rates, etc., accounted for 1s. 9d. out of every pound of the company's gross revenue, but in 1921 they represented 3s. 5¾d. This is a very good way of bringing home to the man in the street the incidence of these public burdens, and other companies might follow his example. The Corporation Profits Tax, another heavy and unfair burden, came in for general condemnation. In effect this will mean an addition to the cost of electricity, and is a clog upon progress. Therefore we wish the companies success in their endeavours to get it abolished.

Future Prospects.

Notwithstanding these difficulties and troubles, general optimism was the prevailing note at the meetings. Provided the companies obtain, as the result of the scheme of reorganisation at present under consideration, an extended tenure of their distribution business, we feel sure that the receipts will continue to expand in a satisfactory manner, and that the shareholders can look forward with confidence to increased prosperity and higher dividends in future. We are pleased to notice that the companies fully realise the necessity for the reorganisation of supply, and though there are two main problems—management and engineering—to be solved, the engineering question is by far the more important. As Mr. Fladgate, of the Charing Cross Company, rightly points out, unless the engineering details are worked out on sound and economic principles the success of any scheme is impossible. Having regard to the knowledge and experience of their joint advisers, he was not willing to advise any serious departure from the engineering scheme they had prepared. No doubt there are exceptional difficulties to be solved before the London supply problem can be settled, but with patience and skill we believe that the Commissioners will overcome all obstacles, though it may eventually be necessary to pass special legislation to deal with the case properly.

Provincial Companies.

In the main the results obtained by the provincial companies are quite as good as could be expected under the circumstances. A few of them, such as the group controlled by the Midland Counties Electric Supply Company, which operates in industrial areas, were badly affected by the restrictions imposed by the coal strike, and do not show up as well as in the previous year. The majority, however, including the Yorkshire and Clyde Valley Electric Power, the Fife Tramway Light and Power, the Oxford, Bournemouth, Northampton, Rushden, and Woking companies, record an increase in both gross and net revenue, and the previous year's dividends have also either been maintained or increased. The new consumers and connections to the mains have been up to the average. It is also gratifying to learn that there is now a decided downward tendency in generating costs, and, provided there are no industrial troubles, the current year's records should show a marked improvement in sales, revenue, and connections.

Developments.

Though the Northampton and Rushden Companies serve highly industrialised areas, they have been able to increase the ordinary dividend by one per cent., mainly through the good demand for power. Both companies have in operation a useful scheme for the hiring out of motors, and so successful has this been and so extensively is it taken advantage of by small manufacturers that nearly half the motors in use are on hire. This is an example which might be followed by other companies with advantage. We also notice that the power companies controlled by the Midland Counties Company are gradually transforming themselves into retail distribution authorities, for four special orders for the supply of electricity have been secured by them. This is also a development that might be expected, though it will eventually lead to a transformation in the character and duties of power companies. Hitherto these have been too restricted by their statutory authority, and greater flexibility and freedom of action would be an advantage to all concerned. It should certainly lead to an expansion of electricity supply in small urban and rural districts.

Institution Affairs.

The special general meetings of the Institution of Electrical Engineers which are to be held on Thursday next to transact certain business necessitated by the granting of the Royal Charter, may or may not be seized as an opportunity by persistent critics of the Council's policy to come into the limelight and air their views on things in general and themselves in particular. There will, however, be little excuse for the exercise of oratory at the first meeting, where the business is innocent enough both in intention and in fact. It should therefore be easily transacted in the fifteen minutes allotted.

At it the Council will ask permission to transfer to the Chartered Institution the remainder of the liabilities of the

old Institution, such as the mortgages on the building in Savoy Place and the property in Tothill Street, Westminster. It may be thought that in these days of high land values there is an excellent chance of getting rid of the Tothill Street site at a good price, but no doubt the advantages and disadvantages of this course have been duly weighed. There is this to be said for it that the site is a valuable one, and, with the demand for increased office accommodation in the Victoria-street area, may even improve in this respect as time goes on.

The New Bye-Laws.

Proceedings at the second meeting, which is confined to Corporate members, may, however, be a little more interesting. The granting of a Royal Charter has necessitated the conversion of the Articles of Association into Bye-Laws, with consequent more or less formal changes in wording involving no questions of principle. But the Council have not resisted the temptation to make other changes, and criticism may therefore have a slight chance in dealing with these alterations where they affect the supposed interests of members.

Critics may, for instance, object to the deletion from Bye-Law 12 of " prominent association with the objects of the Institution " as a qualification for full membership, if in the opinion of the Council such membership would conduce to the interests of the Institution. But they should have short shrift. For we agree with the Council that this alteration is essential to preserve the strictly technical character of the qualifications for membership, and that those whose connection with the Institution can only be evaluated on such a profit and loss basis must be dealt with by other methods than by election to full membership. As it stood the Article provided a temptation to which it was sometimes only too easy to give way to, as anyone who glances through the membership lists of twenty years ago can discover for himself.

Isolation of Associates.

Again, transfers to the class of Associates from other classes of membership is not in future to be permitted, and Associates who wish to transfer to other classes will have to go through the usual procedure of election. The modified procedure of transfer from Associateship to the other classes which is now to be dropped was a relic of the time when the former class contained members with technical qualifications, whose progress into fields where they more properly belonged it was desired to facilitate. But now it consists almost entirely of those who are " interested " in the work of the Institution, but are without the necessary technical qualifications for the other classes, and no difference in procedure is necessary. This class should, in fact, more and more become a haven for the non-professional members of the electrical industry whence they can mutually assist and be assisted.

Life Membership Payments and Expulsion.

The subject of life membership and the payment therefor have always been irritating to some people, and there may therefore, be a storm over the suggestion to calculate the sum to be paid for a life composition on the candidate's expectation of life. But the idea is theoretically sound, though it will not encourage younger men to provide the Institution with capital. Democrats will doubtless, also, object to the Bye-Law which places the authority for expulsion in the hands of the Council instead of depending on the vote of a General Meeting. We hope, however, there will be few cases where this will be necessary, and even for those it is kindest and best for the proceedings to be conducted *in camera*.

The office of honorary solicitor is to be abolished. This may upset the economists, but it is considered that the time has come when the Institution should pay the customary remuneration for any legal work. We agree. At the same time we view with regret the passing of an office that, whatever its disadvantages, did at least provide an answer to the slur that a solicitor's first consideration is his own pocket and that his clients' interests are only secondary.

Council Elections.

But the main storm will, we feel sure, rage round Bye-Laws Nos. 44 to 51, which deal with the election of the Council and alter present procedure not a little. In future only British subjects will be eligible for election, while vice-presidents and members of the Council will be elected for a definite term of three years. This fixed term is considered preferable to the former system, under which a certain number of vacancies were created each year, with the result that members sometimes had to retire before they had served their full term.

The Honorary Treasurer will, as now, be re-elected every year, but he can only hold office for a total of three years. We are not certain whether this is altogether progressive. The finances of a body such as the Institution are a complicated matter, and it is not true economy which permits the honorary treasurer to retire just when he is really becoming familiar with their working. An Associate will now be eligible for this office.

Extending the Powers of Nomination.

On the other hand, the proportion of three Associate Members and three Associates now serving on the Council will be altered to four of the former to two of the latter class. A more startling change is that in future the Council will nominate only for the number of vacancies, though the obligation that three of those nominated should not have previously served on the Council still remains, with the modification that they can belong to any class of Corporate Member. Associate Members, as well as Members, will now have the privilege of nominating those of their own class to serve on the Council, and the nomination and election of new officers will take place between May 31st and July 8th instead of between March 31st and May 8th as at present, to avoid pressure on the staff.

These alterations tend to throw the responsibility of electing a Council which shall carry out their wishes on to the general body of members, and to that extent are an advance in the right direction. At the same time they will more clearly differentiate between unofficial and official nominees.

Less Democracy.

Less democratic is the placing of the carrying out of the affairs of the Institution more securely in the hands of the Council by making reference to the general body of members only necessary when questions relating to the sale of the building or sinking fund policies have to be decided, though this is probably more apparent than real, as the general body of members have a fairly good check on the Council's doings at the annual election if they would only take advantage of it. That being the case it is to be hoped that these changes, which do not amount to very much, will be adopted so that the Institution can settle down to its new career. We shall look forward to the discussion with interest and hope that the various speakers will stick to the point.

Regenerative Braking and Single-Phase Commutator Motors*

By B. NORDEFELDT.

The author discusses regenerative braking on electric railways, especially from the point of view of the problems which arise when this is employed with single-phase traction. He points out that regenerative braking is of two kinds, that required as a speed check on long down grades and that required for bringing the train to a standstill. He describes the various methods of single-phase regenerative braking that have been used or suggested, and indicates the various advantages and disadvantages of each from the technical point of view.

One of the advantages of electric traction is the possibility of regenerating a good deal of the energy which would otherwise be lost by braking. In direct-current systems, such regeneration necessitates the use of a special exciter, but this complication has not prevented its use on a large scale, as, for instance, on the Chicago, Milwaukee and St. Paul Railway in the U.S.A.

The problem of regenerative braking on single-phase railway systems using commutator motors has long been studied. It has, however, not been put to practical use until recently on the Erstfeld-Bellinzona St. Gotthard line in Switzerland. As the question single-phase *versus* direct-current traction is now of great interest in many countries, an outline of the most important systems of single-phase regenerative braking will not be out of place.

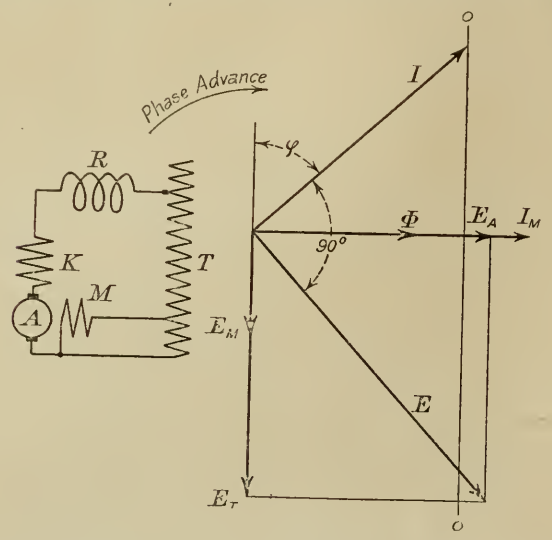


Fig. 1. Fig. 2.

Diagram of Connections and of Vectors, pure shunt excitation

The question whether such braking is economically warranted depends upon a number of circumstances, such as power economy, topography and traffic arrangements. The price of each unit saved must of course be sufficient to compensate for the increase in first cost. Whether the regenerated energy can be utilized depends in some degree upon the intensity of traffic. Long grades are an important factor in the economy of such a system. In direct-current (as also in three-phase) systems it has not generally been possible to regenerate energy otherwise than on long down grades. It will be shown below that the single-phase system, on the contrary, can be advantageously arranged in such manner as to regenerate a good deal of the energy by braking to a standstill. In such cases regenerative braking may be useful even when the topographical conditions are not favourable, for instance on local lines with frequent stops.

Different Systems of Regenerative Braking.

In describing the different systems hitherto proposed for regenerative braking, experiments with series excitation are excluded as being of only negative interest. Theoretically† as well as practically it has been proved that the single-phase series generator is unstable without the insertion of large ohmic resistances, which consume the major part of the generated energy. This system is, therefore, not applicable to regenerative braking in the proper sense, but only to a combination of such braking with resistance braking.

The methods of true regenerative braking comprise various schemes, from pure shunt to separate excitation, inclusive. The best survey of these systems is obtained by starting from the pure shunt machine and regarding the others as modifications thereof.

Pure Shunt Excitation.

The diagram of connections for the shunt generator in its simplest form is shown in Fig. 1. *A* is the armature, *K* the compensation, winding (which may include a separate commutating winding), *M* the magnet winding and *T* the secondary of the transformer. As the magnet winding has only a small number of turns, it cannot, of course, be connected in parallel with the armature and compensation windings, but must be connected to a portion only of the transformer winding. The result with respect to the machine characteristic is, however, the same.

If the ohmic resistance and other losses are neglected and attention is paid only to the reactance, the voltage and current diagrams of the machine are shown in Fig. 2. Here E_T is the transformer voltage on the armature circuit, and E_M the voltage on the magnet winding, which is exactly in phase with the former. The excitation current I_M, the flux Φ and the armature E.M.F. E_A are 90 deg. behind E_M. The armature E.M.F. combines with the transformer voltage E_T to give a resultant voltage E, and thereby an armature current I which is determined by the resultant reactance of the circuit and is in quadrature with E.

It is obvious that to keep this armature current within reasonable limits the circuit must contain several times the reactance which is permissible from the power-factor point of view. If it is to be possible to use the pure shunt motor, it is therefore necessary to insert a large additional reactance in the armature circuit (in Fig. 1 referred to as *R*). If it is assumed in a certain case that the two voltages E_T and E_A are equal, their resultant will be $E_A\sqrt{2}$. For keeping the current at the normal value of the machine the additional reactance must then be provided for a kVA value which is above that of the transformer.

The Braking Torque.

The braking torque is determined by the product of the flux and the projection of the current on that flux. With the above assumption it will be proportional to $\frac{I\Phi}{\sqrt{2}}$. It is obvious that a change in the speed does not alter the torque. For Φ being constant, E_A varies in proportion to the speed, but, as I is increased or decreased, its angle with respect to Φ varies so as to keep the projection thereon constant. This property—of giving a constant braking torque at all speeds, if the impressed voltage and the flux are constant—is a characteristic not only of the pure shunt generator, but also of the modifications which are described below. The

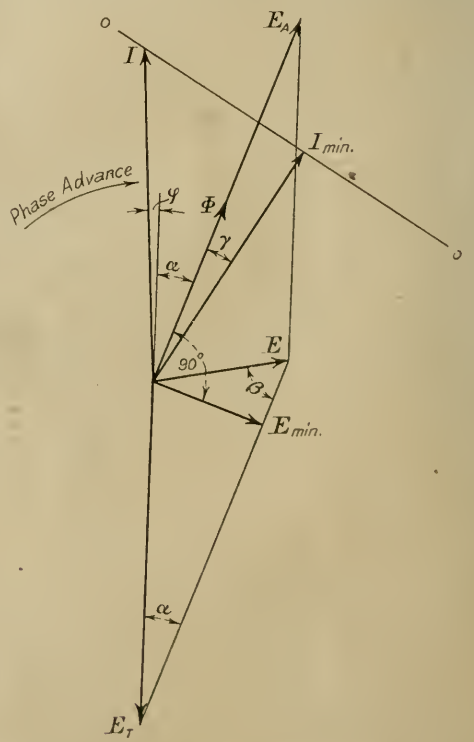


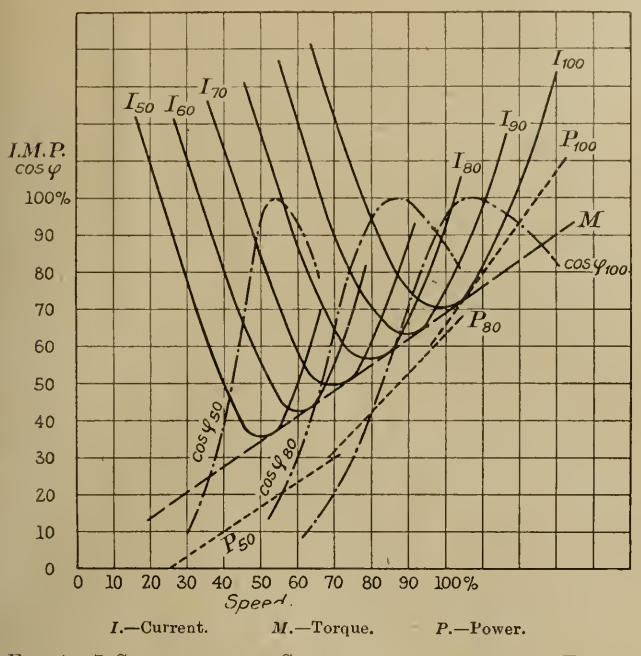
Fig. 3.—Vector Diagram corresponding to Fig. 8.

* Abstract of an article in the "Teknish Tidskrift."

† *See* F. Rusch, "Uber die Nutzbremsung der wichtigsten Kollektormotoren," Elektroteknik und Maschinenbau 1911, p. 1.

ohmic and other losses must, however, be negligible in comparison with the reactances.

In the machine described this condition can be regarded as practically fulfilled, because the reactance of the magnetic circuit is always large and that of the armature circuit is increased by artificial means. It is, therefore, superfluous to consider the case where the ohmic losses or the ion losses cannot be neglected,



I.—Current. *M.*—Torque. *P.*—Power.

FIG. 4.—7 CHARACTERISTIC CURVES FOR CONNECTION IN FIG. 8.

especially as this case will be reviewed in connection with the general theory of the generator with a phase displacement between the excitation and armature voltages.

If the excitation is assumed to be such as to give a generated voltage equal to the normal transformer voltage at normal speed, the ratio of the braking torque to the normal motor torque of the machine (at the same excitation) is as that between $\frac{E_T}{2\pi c(L_R+L_A)}$ and the normal full load current I_n. If it is further assumed that the generator current is limited to the value of the normal full load current, we obtain $I_n=\frac{E_T 2}{2\pi c(L_R+L_A)}$. The constant braking torque will thus only be $=\frac{1}{\sqrt{2}}$ of the motor torque at the same excitation, while on the other hand L_R+L_A must be $=\frac{E_T\sqrt{2}}{2\pi c I_n}$. As L_A in all normal series motors is only a small fraction of this value, the additional reactance must be practically equal thereto, *i.e.*, it must be designed for 40 per cent. more kVA than the transformer. If this reactance is reduced, the result will only be that the transformer voltage as well as the excitation must be reduced to keep the current within reasonable limits. As stated above, the braking torque is equal to the product of these two factors. If the main object of regenerative braking is to save the mechanical brakes on long downward grades, it is not advisable to make the braking torque less than 0·7 times the motor torque at a corresponding speed.

Braking Torque and Speed.

As already stated, the braking torque at constant excitation and transformer voltage is independent of the speed (because E_A is directly proportional to n). The generated power is, therefore, by the same assumption, directly proportional to the speed. The current vector in Fig. 2 moves with its end along the straight line $o-o$ which thus can be referred to as the current diagram. The minimum will be at the state of rest when φ is 90 deg., as no power can be transmitted to the line.

The necessity of using a reactance coil designed for more kVA than the transformer is obviously a disadvantage of this system. Another disadvantage is that the power factor of the regenerated current will usually be low. In the example above referred to it will not exceed 0·7 at full load. By increasing the excitation 25 per cent. and reducing the transformer voltage in proportion it can be increased to 0·84. This necessitates, however, a 5 per cent. increase in the reactance to keep the current within reasonable limits.

In spite of the necessity of the large reactance, which both increases the weight and necessitates additional space on the locomotive, this system is the only one which has hitherto been used in practice. The explanation lies in its great simplicity, which must be sacrificed if the other disadvantages are to be lessened.

Phase Displacement of the Machine Flux.

It is obvious from the diagram in Fig. 2, that the resultant voltage E is considerably reduced for constant values of E_T and E_A by increasing the angle between the latter above 90 deg. An example of a diagram thus modified is shown in Fig. 3, where the supplement angle of that just mentioned is called α. In this diagram the losses in the armature circuit have also been taken into account. Its angle of losses is γ. Fig. 3 can then be considered as the general diagram of a single-phase commutator generator with constant excitation, operating on constant voltage.

If the same symbols are used as before, we obtain:

$$\sin\beta=\frac{E_T}{\sqrt{E_A^2+E_T^2-2E_AE_T\cos\alpha}}\cdot\sin\alpha;$$

$$I=\frac{E_T\sin\alpha}{2\pi c(L_R+L_A)\sin\beta};$$

braking torque $$M=\frac{30}{\pi n}E_AI\sin(\beta+\gamma)$$

$$=\frac{30}{\pi n}\cdot\frac{E_A}{2\pi c(L_R+L_A)}\cdot[E_T\sin(\alpha-\gamma)+E_A\sin\gamma]$$

$$\varphi=\alpha+\beta+\gamma-90^\circ;$$

regenerated power $$P=E_TI\sin(\alpha+\beta+\gamma).$$

The expressions derived in the last section are easily shown to be special cases of those above, by putting $\alpha=90^\circ$ and $\gamma=0$.

Torque at Constant Excitation and Voltage.

At constant excitation and transformer voltage the torque will no longer be constant, but will increase with the speed. It is easily found to be a linear function thereof, which will also be the case with the regenerated power. The current diagram will still be a straight line, $a-a$ forming the angle $90^\circ-\gamma$ with E_A. Its distance from the origin depends on the scale chosen and will obviously represent the minimum current which is obtained for $\beta=90^\circ$, *i.e.*, $E_A=E_T\cos\alpha$. The current may also lead the transformer voltage in phase, so that the generator delivers

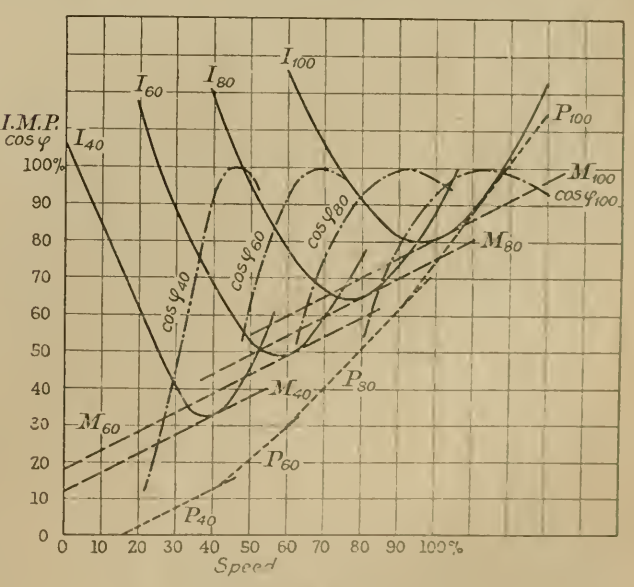


FIG. 5.

reactive power to the line. The condition, therefore, is that $\alpha+\beta+\gamma<90^\circ$. As α and γ are constant, φ solely depends on β, which grows when the speed decreases. It is thus only at the higher speeds that reactive power can be delivered.

The characteristic curves for a machine with excitation of this type for different values of α are shown in Figs. 4 to 7. The angle γ is in all cases equal to 11 deg. 30 min. which corresponds

to an ohmic resistance equal to 1·5 of the total impedance. The angle a in Fig. 4 equals γ, in Fig. 5 $\sin^{-1} 0{\cdot}3$, in Fig. 6 $\sin^{-1} 0{\cdot}5$ and in Fig. 7 $\sin^{-1} 0{\cdot}8$.

The curves for current I, torque M, $\cos\varphi$ and regenerated power P as functions of the speed are drawn for a certain excitation and different transformer voltages. The values are given in percentages of the normal ones. Indices for the different quantities represent the corresponding transformer voltage as a percentage of the normal.

In Fig. 4 six different values of the transformer voltage are assumed. The total impedance in the armature circuit is chosen

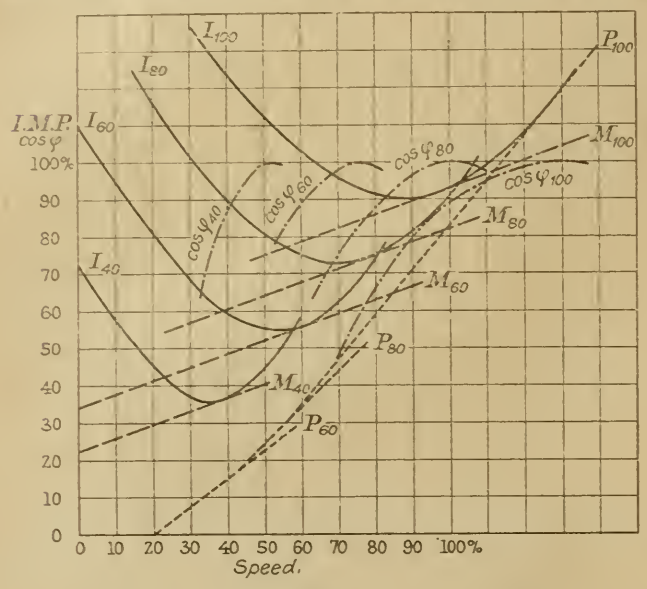


Fig. 6.

so as to make the current about equal to 1·3 times the normal at 1·3 times the normal speed. The impedance voltage in this case will be 0·288 of the transformer voltage, or only about 1/5 of what is required with the connections shown in Fig. 1. This advantage is, however, compensated to a certain extent by a sharpening of the minimum of the current curve so as to cause large current fluctuations for comparatively small speed changes. Instead of at rest, as in Fig. 1, the current minimum is in this case obtained at nearly full speed with full transformer voltage, and below this

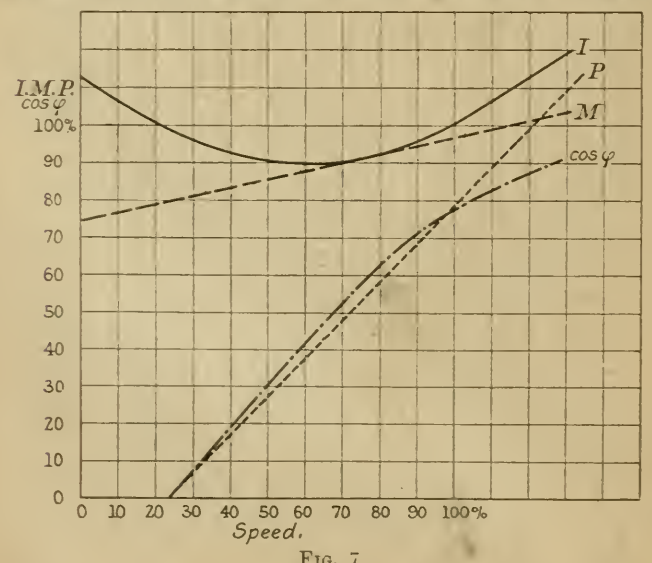


Fig. 7

speed the value rises as fast as above it. Braking with an excitation at this phase angle therefore necessitates the use of several voltage steps for the armature or for the excitation, and the motorman must be relied upon to shift the controller position at the right moment so as not unduly to overload the machine. For braking down, three controller positions can be employed corresponding to 100, 80 and 50 per cent. of the normal transformer voltage. A speed of 12 per cent. of the normal speed can thus be reached without exceeding the normal current by more than 30 per cent.

A remarkable feature of this diagram is that the braking torque, instead of being constant, as in Fig. 1, varies in exact proportion to the speed and at the same time is independent of the transformer voltage. This is due to the fact that the angles a and γ are equal, as can easily be seen from the expression for the torque.

Torque Variation Questions.

Whether a variation of the torque with the speed is desirable or not depends on whether the main object of the braking is to provide safety on downward grades or to utilise the energy in stopping. In the former case, a braking torque increasing with the speed has the advantage of stabilising the action, but in the latter it should be as nearly constant as possible.

The power factor and regenerated power are shown in Fig. 4 only for the three transformer voltages 100, 80 and 50 per cent. The first named one is found to have its maximum (= 1) at the speeds which make $E_A = 1{\cdot}07\,E_T$. Above this speed there is a leading current. At lower speeds the power factor sinks rapidly to zero, the whole power being degraded in ohmic losses. This is as might be expected. The curves for the regenerated power are straight lines, which are easily found to be tangents of a parabola which in turn touches the current curve for full voltage at the point where $\cos\varphi = 1$.

In Fig. 5, which corresponds to $a = \sin^{-1} 0{\cdot}3$ and an impedance voltage of the complete armature circuit equalling 0·375 of the transformer voltage, two controller positions should be sufficient for braking down from 1·3 times normal speed to rest. The power is, however, better utilised and the machine more lightly loaded if one or two intermediate positions are added.

In Fig. 6, which corresponds to $a = 30°$, and an impedance voltage of 55 per cent., the conditions are still more favourable for braking to standstill. Fig. 7, with $\sin a = 0{\cdot}8$ and an impedance voltage of 89 per cent., approximates to the condition shown in Fig. 1. The full transformer voltage may here be used down to rest without inconvenience.

(To be concluded.)

Review.

The Absolute Relations of Time and Space. By A. A. Robb, Sc.D., D.Sc., Ph.D. (Cambridge: University Press.) Pp. viii.+80. 5s. net.

This little book is intended as an introduction to the author's "Theory of Time and Space (1914)," and also as a summary which will convey to a larger circle of readers the main results arrived at in that work, which was prompted by his dissatisfaction with Einstein's foundations, more especially his view that events could be regarded as simultaneous to one observer and not to another, which seemed to destroy all sense of reality of the external world and to convert the physical universe into a nightmare. Assuming the correctness of the proofs, given only in the larger work, the author has succeeded in formally developing a theory of time and space based upon twenty-one postulates involving only the relations of *before* and *after*, and leading to the conception that spatial relations are to be regarded as the manifestation of the fact that the elements of time form a system in a conical order which is capable of analysis in terms of the relations of *before* and *after*. The conical space-scheme, which forms, as it were, a scaffolding, guiding the author in the selection of his postulates and in the general development of the formal argument, and greatly assisting the reader in following the latter, is so suggestive from the very beginning of the geometry of the Minkovski space-time as to make it a question of interest to the reader whether or no it was suggested—consciously or subconsciously—by the latter.

With respect to simultaneity, the view developed and shown to be logical is that of the instants corresponding to two events of which an observer is directly conscious, or pertaining to the same particle, one must be after the other, but that otherwise an instant may be neither before nor after a given instant without being identical with it; that, in fact, the present instant does not extend beyond here. The logical or mathematical development, which demands no more from the reader than a knowledge of Euclid's Elements, leads to a fourfold space-time, containing within it a threefold formally identical with ordinary Euclidian space, and two other threefolds corresponding to the two types of Lobachevsky geometries. Co-ordinates are then introduced, still by merely descriptive methods, employing only the relations of *before* and *after*, and being physically interpreted in optical terms, or by means of any physical criterion of *before* and *after*, such that the relations denoted by these terms satisfy the postulates, there emerges a fourfold Euclidian space-time, in which there is no absolute distinction between rest and motion, and is, in fact, the Minkovski space-time. The author shows that the various complex geometries of Einstein's gravitation theory may be derived from this by simple modification of the measure of interval in the space-time, from which he concludes that the space-time is the essential thing and that the complex geometries are merely analytical developments useful for special purposes.

G. W. de T.

Directional Transmission of Electromagnetic Waves for Navigational Purposes.*

By J. ERSKINE-MURRAY, D.Sc., and J. ROBINSON, Ph.D.

The Paper criticises the differences between directional transmission and reception as used in navigation and describes in particular a number of directional transmission methods which have been developed by the Royal Air Force. The methods include several in which the determination of a bearing depends on the timing of the moment of equality of signals as heard in the receiver, and also a new class of directional transmitters in which a characteristic of the radiation, such as a particular wave-length, is allotted to each direction in azimuth.

In directional reception special apparatus is carried by the craft by means of which the bearing of any ordinary transmitting station within range can be obtained. On the other hand, the determination of the bearing of a directional transmitter can be made either, as in some of the new methods described below, with the ordinary wireless receiving gear alone, or, as in others, with only the addition of a stop-watch or some equally simple accessory. The entire directional part of the system is in the transmitter.

So far the results obtained with directional transmission systems recently tried in the R.A.F. indicate that there is a prospect of obtaining as great an accuracy of observation as with the receptional systems.

The usual methods of direction finding depend on the assumption that the electromagnetic waves travel with the electric vector vertical and the magnetic vector horizontal, and in consequence the directional apparatus has an axis of rotation which is vertical. If the magnetic vector is not horizontal there will be errors of observation when using such a system.

Another factor on which accurate observation of direction from ordinary transmitting stations depends, is that the waves should be simple plane waves. It is known, however, that in many cases the waves are not simple, but that reflection or refraction occurs in the atmosphere,† thus causing a complex wave to arrive at the receiving station. The receiving apparatus does not resolve these various influences, but gives a result depending on the relative intensities, directions of propagation, orientation of the vectors and phases of the various components which may or may not coincide with the true bearing.

In the case of directional transmission, on the contrary, orientation of the electric and magnetic vectors has no direct influence on the accuracy of bearing, assuming that the waves are simple.

Types of Directional Transmitter.

The methods available for giving a directional system capable of rotation are as follows: (1) A loop aerial which is rotated. (2) A series of horizontal aerials radiating from a centre, a switch being used to change from one to the other. (3) A single horizontal aerial which is capable of rotation. (4) The Bellini-Tosi system of aerials. (5) Braun's or Bouthillon and Pettit's arrangements in which complex radiation curves may be obtained by variation of phases in the aerials. Experiments were made with the Bellini-Tosi system, but the difficulty of obtaining the accuracy required was so great that work on it has been postponed. With regard to the Telefunken system, the fact that the aerials are separated by 4 deg. introduces discontinuities which are objectionable. The use of rotating loops is limited by the fact that the radiation from loops is much smaller than with open aerials.

Timing Methods.

The first method of timing is one in which the directional beacon radiates waves which are a maximum in one direction and a minimum in another direction. The whole system is made to rotate in a definite period, say, 60 seconds. A special signal is sent out when the maximum or the minimum radiation is in some predetermined direction. This special signal should preferably be sent out by an aerial system which radiates equally in all directions. A distant observer will record the interval between the special signal and the instant of his maximum or minimum radiation, and thus obtain his bearing from the beacon. Accuracy cannot be obtained by using the maximum signal, and the observer must observe the minimum signal, noting usually the instant when the signal disappears and that at which it appears again, and taking the mean of these two observations as the instant of his minimum. The Bellini-Tosi radio-phares erected in France, and the German "B and C" stations are examples of this method.

If it were possible to concentrate wireless energy of ordinary wave-lengths into one direction, *i.e.*, into a form of searchlight beam, it would be possible to determine a bearing by the maximum signal. Using very short wave-lengths such a method is possible and has been realised by Round and Franklin, but involves the installation of special receiving aerials and apparatus on ships and aircraft.

The Use of Audible Signals.

Instead of using the minimum signal it is possible to use audible signals for purposes of observation, and such a method is very advisable for aircraft purposes, and is used in all the new methods described below. One manner of doing this is the reverse of the R.A.F. receptional system of direction finding. Two loops a and a^1 at right angles to each other (see Fig. 1) are used for transmitting purposes. These loops are joined in series through a reversing switch r, and have also in circuit a tuning condenser t and the secondary coil s of an oscillation transformer. Power is led to the aerial system through the coupling system p. The aerial system a and a^1 is made to rotate at a uniform rate, say, 60 seconds per complete rotation, and the reversing switch continuously operated, say, two to four times per second. A distant observer will hear a series of signals which will usually be in the order: loud, quiet, loud, quiet. However, when either of the aerials a or a^1 is pointing towards him the successive signals will be of equal intensity. This instant of equality of signals is what he requires for observation purposes. A special signal will be required when either of the aerial coils a or a^1 is in a predetermined direction. This special signal may be made by the aerial coils or by a special equi-radial aerial system. In this case, however, the

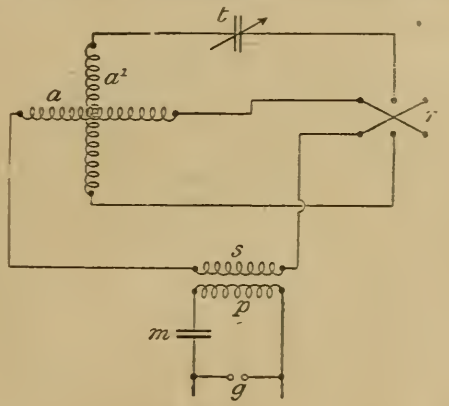


FIG. 1.

equi-radial system is scarcely necessary, as signals are audible in any case in all directions. To prevent the ambiguity of 90 deg., which is present if the two aerials are of the same dimensions, it is advisable to make one of these aerial coils of larger dimensions than the other.

Revolving Aerials at Right Angles.

Another method which enables signals to be heard continually makes use of two revolving aerials at right angles radiating waves of slightly different wave-lengths. In the case of continuous waves the difference in wave-length is so small that the waves heterodyne one another and a note is heard in any receiver. If a local heterodyne is added a chord is heard constantly, except when one of the aerial coils is at right angles to the line from the observer. Instead of recording a minimum, the observer listens for the disappearance of the chord. By making the two waves differ only very slightly, instead of a chord being heard in the receiver it can be arranged that a beating note is heard.

The disadvantage of the preceding methods lies in the fact that a considerable time may elapse before a bearing can be obtained. In order to obtain accuracy of observation it is essential to make the period of rotation fairly long, not less than 2 minutes for 360 deg. For aircraft whose speeds are large this may be troublesome.

An automatic timing method has been suggested to make the observations more or less instantaneous.

Special Characteristic Methods.

The principle employed in special characteristic methods is to radiate waves having some special physical characteristic for every orientation of the transmitting system.

One example of the new method is to vary the wave-length

* Abstract of a Paper read before the Wireless Section of the Institution of Electrical Engineers.

† J. Erskine-Murray: Proceedings of the Wireless Society, "Wireless World," 1920, Vol. 7, p. 651.

continuously during rotation of the beacon, and here we have the introduction of a new principle in directional transmission, for in this case the physical characteristics of the wave depend on the orientation. Suppose that the form of the aerial is such that the energy is being radiated in the ordinary figure-of-eight diagram. The aerial is rotated carrying its beam of radiation with it; as the bearing changes, however, the wave-length emitted is altered. In this case the arrival of any given portion of the radiation curve, such as the maximum or minimum, at a given bearing, will always take place on a definite wave-length. If the receiver is therefore able to distinguish either a maximum or a minimum its bearing from the transmitter can be determined by measurement of the wave-length. By recording at the observing station the wave-length of the minimum or maximum signal, or for any other definite position on the directional curve, the bearing is at once known.

It must be noted that although the wave-length of the radiation from a variable-wave beacon may be varying through quite a large range, it does not jam this range of wave-lengths at all, as the radiation on any given wave-length is only emitted for an infinitesimal fraction of the time of each revolution.

The Determination of the Decrement of a Distant Station.*

By J. ERSKINE-MURRAY, D.Sc., and B. WILLIAMS, B.Sc.

The determination of the decrement of a distant station depends on the equalisation of received currents without measurement of their absolute values. If a loop is placed with the plane of its winding pointing in the direction of a transmitting station the electromotive force induced in it is a maximum. If the loop is inclined at an angle to this direction (hereafter called the bearing) the induced E.M.F. is proportional to $E_{max}\cos\theta$. If $\theta=45°$ then $E_{45°}=E_{max}\sqrt{2}$, or if the coil is in resonance with the transmitter $I_{45°}=I_{max}\sqrt{2}$.

In the usual method of determining the decrement of a transmitter a receiving circuit consisting of a coil, condenser, and thermometer is coupled to the transmitter, and the two valves of capacity C_1, C_2, are noted at which the current in the circuit is $I_{max}\sqrt{2}$, where I_{max} is the current at resonance.

If d_1 = decrement of transmitter and
d = decrement of apparatus,

then
$$d_1+d=\pi\frac{C_2-C_1}{C_2+C_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

The Loop Aerial.

In the case of the loop aerial (assuming the signal strength to be proportional to the received current) inclined at 45 deg. to the bearing, the signal strength is $I\sqrt{2}$ times the signal strength when the loop is on the bearing—it being understood that resonance is obtained in both cases. If now the loop on the bearing be detuned on either side of resonance until the signal strength is equal to that obtained with the loop at 45 deg. and in resonance, then the capacity values so obtained may be substituted in Equation (1) and the total decrement of the transmitter and apparatus be determined. The conditions to be fulfilled and the general procedure to follow are therefore:

(1) Find the bearing by any suitable method.
(2) Set the loop at 45° to bearing and tune accurately. Note the signal strength.
(3) Set the loop on bearing and detune on either side of resonance until signal strength is equal to that obtained in (*b*). Note the capacities C_1 and C_2 and hence determine d_1+d.
(4) Find d (= the decrement of the apparatus) by a continuous-wave method. d_1 is then determinate.

Determination of Total Decrement.

Two possible methods can be adopted, namely: (1) The visual, and (2) the aural.

(1) *Visual method.*—This is the more accurate method and is less complicated than method (2); it is, however, only applicable to strong signals of a regular character where there is no appreciable interference. One coil and one condenser are required. The signals on the bearing are equalised with those obtained on the 45° to bearing position, by making them produce equal effects in a recording instrument. Using a 7-valve amplifier across the coil and tuning condenser, the two signals may be said to be equal if they produce the same drop in the anode current of the last valve.

(2) *Aural method.*—In this method the signals on the bearing are made equal to those obtained on the 45° position by comparison in telephones.

This method is not so easy or accurate as the visual method; it can, however, be employed on weak signals and, with good operation, can be used on ordinary routine transmission. It is the only suitable method where there is appreciable interference.

Two coils and two condensers are required, as it is obviously impossible to keep in mind the strength of the signal on the 45 deg. position during the time it takes to turn the loop back on to the bearing. The two coils must (*a*) have the same inductance and decrement, (*b*) have the same area-turns, (*c*) be set accurately at 45 deg., and (*d*) be provided with a change-over switch which renders one coil dead when the other is in action, thus preventing any mutual induction effect.

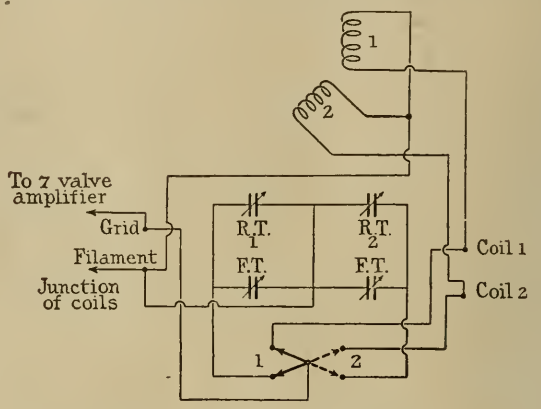


FIG. 1.—TELEDECREMETER CIRCUITS.

There are various methods of determining the decrement of a circuit; of these the easiest of application is that of determining the resistance of the circuit, using as excitation continuous waves of the required wave-length. A description of these methods has been given in "Circular of the Bureau of Standards," No. 74, entitled "Radio Instruments and Measurements.

DISCUSSION.

The above Paper was discussed jointly with one on "Directional Transmission of Electromagnetic Waves for Navigational Purposes," an abstract of which appears on page 315 of this issue.

In opening the discussion Capt. H. J. ROUND questioned the accuracy and novelty of the methods suggested in the Paper for the measurement of decrement. The definition of decrement with which he was familiar was the logarithmic ratio of two successive maxima in any wave train. The formula given in the Paper depended upon a comparison of R.M.S. values. Actually the method relied upon equality of signals, and these being rectified did not vary as their R.M.S. values. He considered that the apparatus was no more than a decroscope. In 1908 he had produced a similar instrument which had been criticised by Prof. Fleming for reasons similar to those which he now put forward. Another point to remember was that for the useful measurement of decrement the whole resonance curve must be investigated; the taking of only two points was useless. At this stage of development something was wanted with a good theoretical basis.

Major H. P. T. LEFROY emphasised the need for selective receivers in connection with the methods described in the second Paper, not only on account of jamming but also for use with the system in which the wavelength was varied as the beacon rotated. For standardising receivers for use on various wavelengths he advocated heterodyning all incoming signals to one standard supersonic frequency.

6s. 8d. an Ounce.

Wing Commander J. B. BOWEN explained that the origin of the decremeter described by Major Erskine-Murray lay in the need felt by the Services for information regarding the degree of interference caused by stations, and the number that could be placed in a given area. They wanted figures for tonic train and high-speed transmitting stations. There was much to be said for the Robinson directional receiver, but there was a fly in the ointment, he might even say there were nails in the wood! And they were due to the added weight when this system was applied to aircraft. In the unlikely event of his brain being examined when he was dead, he thought there would be found upon it the words "6s. 8d. an ounce," for that was the extra cost of construction of engine and machine for every additional ounce which had to be carried. The direction-finding gear had presumably to help a pilot find his landing ground when visibility was bad, and he could picture a machine coming towards an aerodrome equipped with one of the beacon stations described. Under probable conditions the machine would circle round the station about once in two minutes, and would therefore be

*Abstract of a Paper read before the Wireless Section of the Institution of Electrical Engineers.

putting up quite a sporting race with the signal which was to guide it!

Capt. J. Hollingworth considered that the use of a 2 V cell and a potentiometer was simpler than an extra valve for balancing the d.c. component in the anode circuit when measuring the drop of anode current in the determination of decrement. He doubted whether a receiver had the same decrement for tonic train as for C.W. He did not find decrement to vary with signal strength.

Practical Difficulties.

Mr. R. L. Smith-Rose pointed out a number of difficulties in the rotating beacon method of direction finding. It was not suited to the aircraft requirement of receiving on a maximum, and minimum readings were not symmetrical, since it was easier to hold on to a signal than to get it again. Also there was an error from vertical effect; and jamming was liable to make a reading impossible. With the crossed coil method the disadvantages were slow speed and lack of accuracy. He considered the change of wave-length method to be better for getting bearings quickly, but in this everything depended upon the accuracy of calibration of the receiver. He questioned the effect of a trailing aerial upon the tuning of the receiver, and consequently upon the possibility of making the latter very selective. Night errors were greater with a closed coil transmitter.

The Hard-Worked Ether.

Capt. P. P. Eckersley considered that warlike considerations had been made unnecessary by the Washington Conference. Beacon stations were not necessary for commercial work where ground stations could give a machine its bearing on request. If the machine was to take its own bearing he preferred the gear in the machine, so that it might take bearings upon all transmitting stations. The ether was a hard-worked medium, and if the proposed beacon stations were erected he would, instead of having 6s. 8d. engraved upon his brain, have hopeless jamming impressed upon his ears.

Dr. J. Robinson considered that the apparatus described in the second Paper, whether decremeter or decrescope, had its uses.

Dr. G. W. O. Howe took the flicker photometer as an analogy to the two coil transmitter and reasoned that there was, therefore, a best speed at which to work. He queried what one actually measured in the described decremeter method and advised taking the decrement of a station when actually working and not when the key was held down.

Replying to the discussion, Major J. Erskine-Murray admitted that he did not clearly understand the theoretical basis of the decremeter. By its means one got some kind of a useful measure. Someone had to start. He agreed that there was a critical speed of rotation for the beacon stations, and that a very selective receiver was not practicable with a trailing aerial.

The Manufacture of the Mullard Valve.

The references to the design, output and production of the thermionic valve in the recent report of the Imperial Wireless Commission and especially the comparisons of valves contained in glass and silica containers respectively have aroused much interest in the manufacture of this important apparatus. Indeed, the wide use of the thermionic valve for both wireless telegraphy and telephony makes it necessary that close attention should be paid to its manufacture, as it presents problems which are just as interesting as those which have been found and overcome in more technical fields. As electrical engineers we are convinced by this time of the necessity of employing proper organisation and well thought out processes in manufacturing equipment of all kinds, and though we cannot perhaps claim that high efficiency of mass production which is seen, for instance, in motor-car and margarine manufacture, there is no doubt that definite economies can be obtained by careful attention to detail and a well thought out line of progress through the shops.

A Lamp Analogy.

That this has been done in at least one case is evident from a visit we recently paid to the works of the Mullard Radio Valve Company, Ltd., where the valves, to which such interesting reference was made in the report, are now being turned out in large quantities. While the company will doubtless be among the first to acknowledge the debt they owe to those pioneers who thought out the processes necessary for the production of the vacuum and gasfilled lamps on a large scale the special problems which have to be met in producing a valve, which will operate satisfactorily under ordinary working conditions and with relatively unskilled supervision, has meant that many steps have had to be taken along the lines we have just indicated.

Mullard Valves for Reception.

We may first deal with the small valves which are manufactured by the Mullard Valve Company for receiving purposes. These valves are made in a variety of patterns of which we illustrate examples (Figs. 1 and 2). Type R, which has an overall length, including pins, of 4½ in. and a bulb diameter of 2¼ in. works best with about 4 V on the filament, and 60 to 80 V between anode and filament. In the K type, which is rather more compact, about 3·5 V are required on the filament and 20 to 30 V between the anode and filament. This particular type of valve is suitable for use in high frequency amplifiers. The D type valve is a slightly soft valve designed for use in detecting or rectifying signals prior to low frequency magnification. It operates best at about 5 V on the filament and 20 to 30 V between the anode and filament. The essential parts of all valves of this kind are, of course, the glass bulb, the grid, the anode and their supports, the leading-in arrangements, and the metal cap.

Manufacturing Details.

The problems connected with the manufacture and assembly of the bulb and cap of the valve are not dissimilar to those met with in lamp manufacture and are therefore well known. We may, therefore, confine our description to dealing with the methods employed in manufacturing and mounting the more peculiarly wireless portions of the apparatus.

Referring particularly to the small type of valve, as is of course usual, the leading in wire is of platinum. To the outer end of this leading in wire is welded a copper wire by which external connections are made to the valve cap, while to the inner end is welded a nickel wire which is used for supporting the electrodes inside a closed stem. The valve electrodes are made from sheet nickel and molybdenum and tungsten wire. The former is stamped out to

Fig. 1.—View of the "R" Valve.

the correct size and is welded to one of the nickel supporting wires by means of a small electric welder. It is then shaped round to give it the desired cylindrical shape.

The Grid.

The grid to which the other nickel wire is connected is built up of molybdenum wire, which is coiled into a spiral. For the proper

production of both these parts, well designed jigs and tools are employed so that exact reproduction in every essential is secured. For instance, the molybdenum wire is wound on a special machine in the form of a spiral which subsequently passes into a closed tube for protection. Lengths can then be cut off as required. An automatic device is employed for cutting off uniform lengths of glass tubing to form the sealing stems for the valves. These lengths of glass are then fed by hand into a flanging machine which consists of two chucks which in turn grip the piece of tubing and bring it into the blow pipe flame where the flange is worked on to it. The four supporting wires for the electrodes are sealed into one end of this flange tube so as to form the stem.

Fig. 2.
The "K" Valve.

Filament Construction and Mounting.

After the grid and anode have been mounted on their supporting wires the filament is threaded down the centre of the grid and secured to the terminal wires by pinching. The necessary tension on the filament is maintained during working by placing a small flat spring between it and its support.

The grid, anode and filament, which are mounted together on their glass support, are then inserted in the bulb, which is either of a spherical or elongated cylindrical shape, being afterwards exhausted by a vacuum pump in a way similar to that used in lamp manufacture. During this exhaustion the valve is subjected to electrical tests so as to drive out the occluded gases from the metal electrodes and to indicate the state of the vacuum. This is effected by employing extremely high voltages which heat up the electrodes by electronic bombardment. The total occlusion of the gases is indicated by the disappearance of all the blue glow, and the valve is then sealed off from the pumps. In connection with this high voltage work which, of course, is a special feature of the valve manufacture great care is taken by means of automatic devices to prevent any danger of live high tension parts being touched by the operator. The valves themselves and the high tension terminals are protected by specially constructed cages, which can only be removed when the current is off.

Testing Arrangements.

Subsequent to exhaustion the valve is subjected to a short ageing run, and afterwards to careful testing. In these tests the filament current is adjusted until the required total emission is obtained when using a given anode voltage. The filament voltage and current are then read off by appropriate instruments, and the results must fall within certain predetermined limits, or the valve is rejected. The grid current is then measured by applying a voltage to the grid, which is negative with respect to the negative terminal of the filament. For hard vacuum receiving valves this current (or backlash) must not exceed 0·2 micro-ampere. The grid voltage is then reversed, and the value of the positive grid current is noted. This must not exceed 2 micro-amperes.

Transmitting Valves.

So far it will be gathered that the manufacture of these small receiving valves does not differ much from that usual in the preparation of incandescent lamps. Owing, however, to their larger size the construction of valves for transmission purposes necessitates the introduction of certain modifications. These transmitting valves are made in a variety of ranges from the smaller sizes where the anode dissipation is from 20 to 30 W with an anode voltage of 200 to 400 V and from 600 to 1 200 V respectively to those with an anode dissipation of 100 to 150 W and even up to 250 to 500 W, with corresponding increases in the anode voltage and filament current. It is interesting to note, in view of the remarks in the Wireless Commission's report, that, although the details we give below apply to valves made with glass bulbs, successful experiments have been successfully carried out using silica for this purpose with a great accession of strength and consequently life..

The Advantages of Silica.

The employment of silica not only reduces danger from breakage, but owing to the fact that the material can be brought nearer to the grid and filament a small container can be employed. The special construction used in the larger type of Mullard transmitting valves produces, we are informed, exceptionally long insulating paths between both the anode and grid and the filament. It also has the great additional advantage of making it possible for the valve filaments to be renewed by the makers, thus reducing the maintenance cost of valve installations. This is also dealt with in the report.

Constructional Details of Large Valves.

The filament in the case of these large valves is of loop form, and is mounted on two nickel strips which are fitted on to a special glass stem. This glass stem is of such a diameter that it will pass freely up the centre of the inner glass tube of the stem on which the grid is mounted without coming into contact with any of the grid supports or connections. The two are therefore insulated from each other not only by an air gap but by what are actually two sets of glass insulators. The grid is formed of a spiral of the molybdenum wire laced on to straight molybdenum supporting wires which themselves are carried by channel-shaped nickel strips held in place by friction on the inside of the glass tube of the grid stem. The flange end of the glass stem carrying the filament is ultimately sealed on to the outer end of the inner glass tube of the grid supporting stem. This enables the whole of this part of the apparatus to be kept completely outside the valve bulb proper, which bulb is sealed on to the flanged outer part of the grid stem. Similarly the tension spring which supports the loop-filament from the other end of the bulb is attached to a narrow glass tube which passes centrally up and is separated from the inner glass tube which supports the anode of the valve from the opposite end of the bulb. This arrangement enables the filaments to be replaced as mentioned above, for on

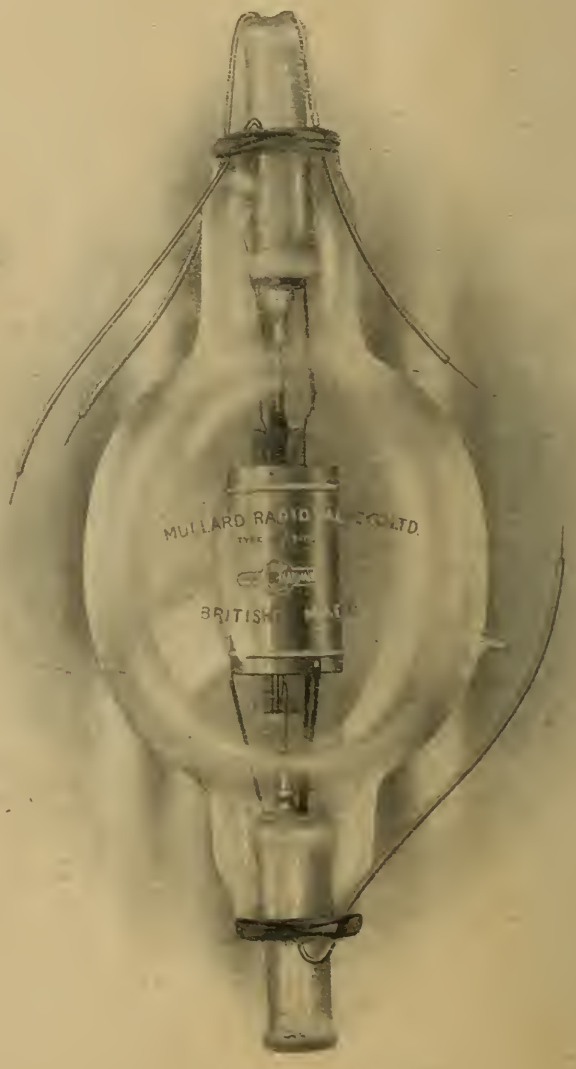


Fig. 3.—View of 0.500 Valve.

cutting through the tubes which project at the opposite ends of the valve the two small stems supporting the loop filament and its tensioning spring may be withdrawn from the valves and a new filament inserted in place, sealed in position, and the valve re-exhausted. An assembled valve of this type is shown in Fig. 3.

"Silica Valves."

In the case of the silica enclosed valves mentioned above the anodes are very much larger than those in the glass enclosed

valves. These anodes are built up of narrow molybdenum strip which is plaited into a hollow cylindrical form. Illustrations of these valves are given herewith, Figs. 4 and 5. The whole is a most interesting milestone in the development of valve manufacture.

In regard to the silica valves, it should be stated that these are made under an agreement with the Admiralty—who are joint owners

Fig. 4.—Silica Valve without Holder.

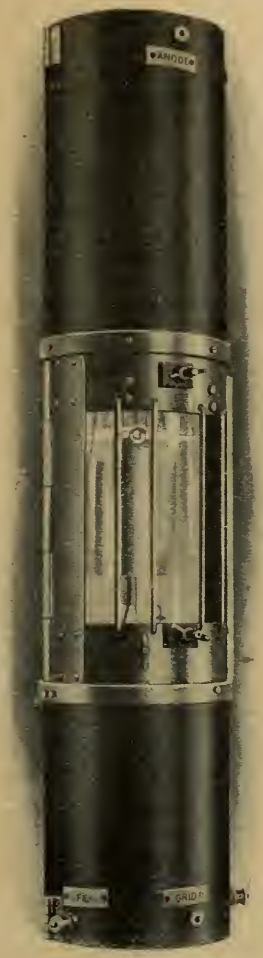


Fig. 5.—Silica Valve in Holder.

of the patents involved—most of the pioneer work in connection with the development of this type of valve having been carried out at H.M. Signal School, Portsmouth.

The large power output, and consequently aërial current, which can be obtained from a wireless transmitting installation of comparatively small dimensions by the employment of silica valves renders the employment of this type particularly advantageous on board ship. This is one of the reasons why H.M. Signal School, in conjunction with the Mullard Radio Valve Company, Ltd., has developed the silica valve to its present state. Silica valves of 2·5 kW and 4 kW rating are now being produced in considerable numbers and up to the present the whole of the output of the Mullard Radio Valve Company, Ltd., for this type of valve has been in fulfilment of Admiralty orders.

Warm Rivers or Warm Houses?

The discussion at Manchester on the two Papers by Messrs. Haden and Whysall on "The Utilisation of Waste Heat in Generating Stations" * was a model of what such discussions should be. The authors made their remarks commendably brief and pointed. Every speaker spoke well, and each contribution was relevant and rich in practical experience and suggestion, frequently enlivened with humour. Various points of view were presented. Altogether, Manchester again vindicated the value and necessity of these extra-metropolitan discussions and the delighted appreciation of the authors was no slight consolation to those who have to live in or near the city. The general attitude of the power-station engineers was one of distinctly qualified sympathy. The theoretical attractions were admitted, but the practical difficulties of commercial application were stressed. Altogether the meeting indicated a distinct tendency away from the super-station idea, an engineering reaction against centralisation not without its parallel in the political world.

* *See* The Electrician, Vol. CXXXVIII., p. 94, January 27, 1922.

Methods of Heat Distribution.

Mr. S. L. Pearce, who incidentally questioned some of Mr. Haden's figures, pointed out that in comparing energy conversions the efficiencies of transmission and application were involved. For a given amount of heat to the consumer, less coal would be destroyed at a modern super-station than at a gasworks. There were three methods of distributing heat, the first being to draw steam from a condensing engine or turbine after partial expansion, the station being considered primarily as a means of generating electricity rather than heat. Secondly, a special boiler-plant and a number of non-condensing sets giving exhaust steam for heating might be installed, the station being primarily a heating station with electricity as a bye-product, additional electrical load coming from a condensing station. In the third case, live steam might be supplied direct, as was the practice in American stations. No single method would satisfy all conditions or all localities. The first was suitable if the main station were in the centre of the heating load. The second was best for old stations where the capital cost had been written down. The main difficulties were the market for heat, the co-ordination of heating and lighting loads, the distribution of steam and the cost. There was no coincidence between the heating and lighting loads, and live steam had to be used at times—at Dickinson-street 25 per cent. of the time. Basement wayleaves had to be negotiated, and the costs of tunneling were considerable. A pre-war subway of 50 sq. ft. at Stuart Street cost £27 per yd. To-day a steam main subway 10 to 12 sq. ft. area would cost £30 per yd. Rates charged for steam should take account of varying load factors. A judicious combination of all methods of heating would be necessary in a commercial scheme.

Benefits of Central-heating Stations.

Mr. J. Frith said that offices, houses and works needing process steam formed the demand for heat, and a *liaison* should be formed between heating and electricity supplies to ensure the best service to the community as a whole. It was necessary to use the latent heat of steam, and the super-station idea was only tenable if the station were prepared to absorb surplus power from heat plants as well as to give power. The diminished consumption of domestic coal and the absence of smoke would benefit the whole community.

Mr. F. Biggin said that the use of a central-heat station was equivalent to concentrating boilers and heaters in one place, and would, by diminishing losses and labour involved, increase efficiency. In an actual case, a block of seventeen buildings on an area of 9½ acres saved £7 000 per annum by installing a combined heating, lighting and power plant. The same economies could be obtained on a larger scale.

Warming Rivers.

Mr. D. Brownlie emphasised the low efficiency of the average boiler plant, and considered that if that proportion of coal used in steam raising in the United Kingdom were employed in efficient plants 3 000 000 h.p. would be available. It would be better to give new plant to inefficient works rather than to erect it in super-stations. Power could not be generated in Great Britain in one particular way, and all methods had to be correlated. It was absurd to talk of objections to central heating, which had been used for forty years in the U.S.A. What English people needed was radiant heat, and homes should, therefore, be centrally heated throughout, with an open fire in the living-room and gas-cooking. The objection of condensation in steam distribution pipes could also be met. A modern air-insulated, lagged and buried pipe lasted twenty years and lost 0·04 lb. per sq. ft. per hour.

Co-ordination of Heat and Other Loads.

Mr. H. C. Lamb thought Mr. Brownlie ignored progress in the last twenty-five years. Coal consumption for power generation had been quartered, and if this progress could be maintained we should do well. He agreed with Mr. Haden about keeping open old stations. It was impossible to balance the heating and electrical loads. Manchester was one of the best areas for central heating. Yet out of a winter demand of 20 000 kW, 17 500 kW would have to come from a condensing station, using Mr. Haden's figure of 115 lb. per kW hour. The summer steam demand was only 10 per cent. of the winter demand, while the electricity figure was 85 per cent.

Heat Supply and Electricity Departments.

Mr. Nelson Haden suggested that if central heating developed, it should be connected with electrical rather than with any other branch of municipal activity. Electrical heating had its uses, but he did not think this would cause electrical engineers to be prejudiced against steam heating. Heating, electricity and gas making and refuse destruction might be carried on in one station, the chairman of the committee to say which source of heat was best for given conditions. Over five hundred American towns had central heating stations, all run by the electrical authorities.

The Home Idealised.

(*Continued from page* 291.)

"Tricity" Truisms.

On the stand of the British Electric Transformer Company is to be found a plethora of "Tricity" electrical apparatus, from which it is difficult to pick out points for special notice. But the newest, and presumably therefore the best, of the apparatus is the "Tricity" cooker for small families, which we illustrate herewith (Fig. 3). This is a combination cooker, the outstanding

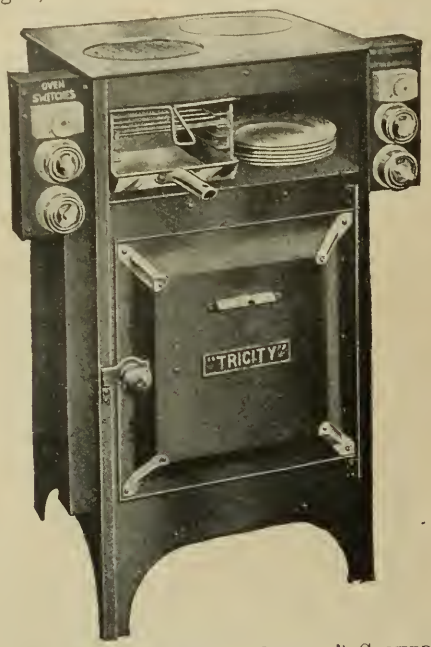


Fig. 3.—The Latest "Tricity" Cooker.

feature of which is its light loading compared with the work it will do. The loading of cooking apparatus is a question upon which a discussion can always be generated, and the "Tricity" view, in contradiction to some others, is that it is better to spend your money on the material, and especially the lagging of your oven, than in buying current all of which will not be economically used. The loading of this "Tricity" production is 3·3 kW, and it is claimed that it will do all the cooking operations necessary for a family of six. The oven has a loading of 1 400 W, 600 W in the top and 800 W in the bottom element. It consists of a sheet-steel body with double walls, between which is a plentiful supply of slag wool lagging. There are three heats on each of the elements. Even with this low loading it is claimed that a sufficiently high cooking temperature can be reached as quickly as with a cast-iron body owing to the efficient lagging. The top of the oven is of bright cast iron and is also lagged with slag wool. The internal dimensions of the oven are 14 in. by 14 in. by 12 in., and it can therefore take a joint and a sweet at one operation sufficiently large for the size of family mentioned. The elements are protected by trays and can easily be changed, being each held in place by three screws, to remove which is a simple operation. The elements themselves consist of nichrome wire wound on mica and are connected by means of bare wire carried on asbestos bridges to the control panel at the left-hand side of the oven as shown in the illustration. The switches are of the rotary type, and the fuses of the Kantark type which, it is claimed, have advantages of simplicity and easy changeability over any other on the market.

The cooker is completed by two hot-plates, one of the open type with a loading of 1 200 W and one of the closed-in type with a loading of 900 W, each with three heats. These hot-plates work in conjunction with a reflector plate. This, when placed under the element, allows boiling to be carried on on the top of the hot-plate, while, when placed over the element, the heat is thrown down, so that grilling can then be carried on in the space between the hot-plates. This space is also useful for many plates and dishes.

The British Electrical Transformer Company are also, it may be noted, advocates of control by thermometer, and one of these instruments is provided in the door of the oven. Further, it need only be added that the price of the complete equipment is £18. The boiling plate portion of this apparatus can be supplied separately, and, in addition, are to be found on the stand a wide range of irons, kettles, fires, grillers, ovens, boiling plates, pastry ovens, hot cupboards, and so forth, all eloquent of the "Tricity" idea.

How to Keep Your Bed Warm.

Another stand which absolutely teems—or should it be steams?—with electrical domestic appliances is that of the Dowsing Radiant Heat Company. Here are to be found electric boiling plates, cookers of various descriptions, hot cupboards, hotplates, irons, kettles, milk heaters, radiators, toasters, and urns, while for commercial use there are electric branders, belt trimming knives, glue pots, soldering irons and wax heaters, and for medical use there are all sorts of apparatus for giving radiant heat treatment and electric light baths. But the thing which attracted our notice was the stone bottle bed warmer. This is an interesting reversion to the days before the india-rubber hot water bottle was invented and the chilly went to bed accompanied by a pre-heated brick. These heaters are in appearance very similar to the stone hot water bottle sometimes used, and consist of a stoneware container surrounding an element. Pre-heating for about ten minutes or a quarter of an hour is necessary, and when the bottle is carefully wrapped in a flannel it will, it is claimed, keep itself and others warm for a considerable time. For the chilly, again, a small radiant bowl fire which is to be found on this stand may be recommended. It is of a pattern now well known in electrical circles, and from the excited comments which were being made by passers-by who suddenly came within its range it fulfils its purpose very well. It can be put anywhere.

Artistry in Illumination.

On the Metropolitan Vickers Electric Company's stand is to be found a good selection of their well-known Cosmos domestic electric apparatus, including a new pattern of 2 kW radiant fire designed on scientific principles both as regards reflection and radiation, and containing four elements which can be switched on in pairs. Anyone looking at this fire will agree that the element is easily accessible, and we understand that it can be removed by releasing two screws. But the more striking display on this stand is the artistic exhibition of lighting fittings which have been designed and made by Harcourts, one of Vickers, Ltd., associated firms. These fittings are produced in a number of styles such as 'Adams and Louis XV., but the actual designs have been prepared by artists working specially for the end in view, and their ideas have received special treatment, with results which are highly satis-

Fig. 4.—The Metropolitan-Vickers Stand at Olympia.

factory. We are informed that concentration is being specially made on the Adams period, but we noticed in addition candle fitting in the Baroque style, such as was largely used by Sir Alfred Gilbert and many others, and a bowl fitting of the Gothic school, which has the advantage of hiding the lamp entirely. The brackets are cunningly held from the back by means of a wall plate and hook so that no screws are visible, and as far as the fitting proper is concerned are unnecessary. The aim of the company is to apply art to everyday uses, and while the fittings are not cheap they indicate a desire to educate the public in art and to perpetuate the designs of the best periods and styles during these modern days. To those interested in beautifying their homes—and who is not?—this is a stand to linger on. Fortunately this is made more easy, as overcrowding has been avoided, and those responsible are to be congratulated on the general arrangement. How good this is is evident from Fig. 4.

Carron Cookers Collected.

On the CARRON COMPANY'S stand is to be found a display of electric cooking and heating appliances of this firm's well-known manufacture. Among these is the Carron 1922 model cooker, which is designed like a Globe-Wernicke bookcase to the extent that all the parts are separate, but can be easily pieced together to form a complete whole. An important point in this new design is that the oven is on the same level as the boiling table, being raised from the ground on a special stand, thus avoiding any necessity for stooping. The oven door is fitted with a special spring handle, and both it and the walls are suitably lagged in accordance with the usual Carron practice. It contains elements top and bottom, the former having a loading of 1 500 W, and the latter a loading of 1 000 W. There are three boiling plates of the usual Carron design, one 6 in. in diameter with a loading of 600 W, one 8 in. in diameter with a loading of 1 000 W, and one 10 in. in diameter, with a loading of 1 500 W. Over these hotplates is placed a plate rack—a useful addition, as all cooks know. In all the apparatus the element can be easily

FIG. 5.—THE 1922 CARRON COOKER.

exposed for replacement (though that is seldom necessary), and the wiring is also easily "get-at-able." This cooker is shown in Fig. 5.

Another new "Carron" is a hot-water circulator which is made in two sizes, with capacities of 30 and 60 gallons respectively, the loadings being 4 and 8 kW. The circulator proper is made of gun-metal, the body being screwed at each end to take the necessary piping. This body is suitably lagged, and the whole is enclosed in a sheet-iron case. It is very neat and compact, and can be tucked away in some corner without anxiety. The circulator can be fitted with a thermostat if desired, and once more the whole of the apparatus is easily accessible when the sheet-iron casing has been removed, and this is not difficult.

The Carron Company have long been known as manufacturers of artistic coal-grates of various designs, as well as producers of electrical appliances. Now the two activities are apparently being combined, for Carron dog-grates are shown fitted with electrical elements. The illusion is made the more complete by the use of two ruby lamps which give forth a pleasing and psychological glow. These "electrogrates" are made in any period, and for any loading up to a maximum of 6 kW with two heat regulation.

Stannos and the Home.

SIEMENS BROTHERS & COMPANY are showing a room wired for electric lighting, heating, &c., on the Stannos system and also a model in which the application of this system of wiring to housing

FIG. 6.—SIEMENS' STAND AT OLYMPIA.

schemes is demonstrated. This explanatory model shows a transformer installed in the nearest cottage to the main power cable. From the low tension side of this transformer a Stannos conductor is carried along the outside walls of each group of cottages and the supply tapped to each cottage through the main wall. Between each group of cottages the Stannos main is buried directly in the ground.

One of the leading advantages derived from introducing electric current into groups of cottages by this means is, it is claimed, reduction of cost (a not unimportant feature) as the system dispenses both with the necessity for opening the road and laying a main cable as well as opening trenches for laying the service wire into each of the cottages, the interiors of which can be wired on the Stannos system. We understand that in several housing schemes which at present are in progress this economical method of introducing electric supply is being adopted. A view on this stand is given in Fig. 6.

A Boon to Amateurs.

Amateur electricians, and professional ones too, for that matter, owe a debt of gratitude to the inventors of the wall plug variations which, in all their glory, are exhibited by the RAWLPLUG COMPANY. This simple and ingenious piece of apparatus is, as our readers probably know, invaluable in the home for such jobs as fixing shelves, bell pushes, bathroom fittings, hangers, coat hookers, wall plugs, flower-pot stands, etc. Examples of fixtures made by Rawlplugs are compared with horrible results of employing the old methods. These are enough to drive anybody who does not already use Rawlplugs to do so at the earliest possible moment.

RASHLEIGH PHIPPS & COMPANY have a large stand on which is shown one of the only methods of solving the lighting problem in the country house, that is by means of the Rashleigh Phipps standard plant, which is designed on simple and reliable lines to provide electric light at a low cost, and people with country houses might therefore do worse than use it.

The AUSTIN MOTOR COMPANY exhibit a range of their well-known Austin automatic electric lighting sets, including the 0·75 kW auto-plant, and the 2 kW auto-plant and auto-dynamo. The principal feature of all these sets is their entirely automatic character, though they can easily be made semi-automatic or even controlled by hand.

R. A. LISTER & COMPANY are showing a full range of their Liston-Bruston lighting plants, which are suitable for all sorts of installations, ranging from a cottage to a mansion. An automatic plant suitable for cottages and bungalows is also on view. No need now to be without the electric idea, even if you live in the country.

The SHERINGHAM DAYLIGHT DEVELOPMENT COMPANY are exhibiting their system of obtaining artificial daylight by means of an ordinary electric lamp in conjunction with a simple inexpensive piece of apparatus requiring no alteration of existing installations. Details of this system have already appeared in THE ELECTRICIAN, and it is claimed, with some truth, that the light is invaluable for avoiding eyestrain in the home, for fine needlework, colour embroidery, stamp collecting, and all hobbies where colour values are important.

(*To be continued.*)

Industrial Electrical Heating.

A lecture on the present position and future prospects of INDUSTRIAL ELECTRICAL HEATING was given at the University of Sheffield on Monday by Mr. J. G. Pearce, of the Metropolitan-Vickers Electrical Company, to the Sheffield Gas Consumers' Association. Sheffield is one of the largest consumers of gas for industrial purposes in the United Kingdom.

After indicating the influence on electrical heating development of the nickel-chromium resistance alloys, the lecturer considered the relative positions of gas and electricity for heating purposes, and stated that, for a given amount of heat required by a consumer, a modern super-power station used less fuel than was required in any other form of fuel conversion. The recent improvements which had been made in the manufacture of high-speed and high-capacity turbines, together with projected schemes for linking up power stations, would enable electrical energy to be procured at rates much more favourable than had hitherto been possible.

For precision heating, electricity was unapproached by any other heating agent—it was rapid, practically any desired temperature could be obtained over a very wide range, and temperature control could be obtained within extraordinarily fine limits. Electrical heating did not distort the material, and spoiled work was almost entirely eliminated. Heaters occupied a minimum of floor space and were less detrimental to workers than other forms of furnace. It was particularly important that those who were considering the installation of electrical heaters should not compare merely the cost of electrical energy with the cost of gas at the power station and gasworks respectively, as the efficiencies of distribution and application had to be considered. In electrical heating no heat was wasted through warming up the air used for combustion, and radiation losses could be cut down to a minimum.

Mr. Pearce then described a number of modern heating appliances, ranging from low-temperature applications, in the form of ovens, soldering pots and irons, cooking and heating equipment for works canteens, &c., up to the largest electrical furnaces of the resistance type, which had been developed for the heat treatment of gun forgings, &c., taking loads up to 2 800 kW and able to heat steel up to 150 tons; in such furnaces the resistance ribbon is inside the furnace and radiates heat directly on to the charge. The lecture was illustrated with lantern slides.

Changing Tungsten to Helium Gas.

An interesting experiment was described at the conference of the American Chemical Society at Chicago on Saturday, states the "Times" New York correspondent.

By exposing it to the temperature of 50 000 deg. F., Dr. Gerald Wendt and Mr. C. E. Iron, of the University of Chicago, succeeded in CHANGING TUNGSTEN TO HELIUM GAS. The feat of transmuting the metal in itself involved the generation of a temperature far exceeding anything hitherto achieved. To produce such a degree of heat the experimenters utilised an apparatus recently designed by Dr. C. P. Steinmetz for producing artificial lightning. It consists in charging an electrical condenser to 100 000 V and then suddenly releasing the charge.

Dr. Wendt and Mr. Iron, according to their report, discharged it into an extremely fine tungsten wire. It exploded with a deafening report, says Dr. Wendt, as if struck by lightning, producing a flash 200 times as bright as sunlight, with a momentary temperature of over 50 000 deg. After the flash he found atoms of tungsten decomposed into simpler ones, and the result was the change of metallic tungsten into gaseous helium. The experiment had its genesis in the fact, remarked by astronomers, that the number of materials composing the stars grows fewer as the temperature of the stars increases, till the hottest stars appear composed entirely of hydrogen and helium. Adopting the theory that this fact is due to the decomposition of other materials by the great heat, Dr. Wendt and Mr. Iron produced a temperature nearly equal to twice that of the hottest star, and found ordinary metals decomposed into simple gases, particularly helium.

Institute of Patentees.

At the second annual meeting of the INSTITUTE OF PATENTEES on Friday it was reported that there were 281 full members and 396 associate members. The technical committee had examined and reported on 245 inventions during the year. The Executive Committee found that a small proportion of the inventions submitted were really commercial propositions.

Mr. GODFREY CHEESMAN complained that too many British employers failed to give support to employees who made inventions. A man of brain and initiative was an asset to employers worth encouraging. Mr. G. H. Skinner advocated an Imperial patent for the whole Empire.

At the annual dinner of the Institute in the evening, Sir HARRY FOSTER presided, and among others present were Sir William Grey-Wilson, Sir Charles Bright, Lord Morris, and Major the Hon. Hugh Fletcher Moulton. LORD MORRIS, who responded to the toast of "Our Guests," urged that the laws should be amended to protect inventors. In Italy, the United States and Germany inventors were honoured, but in Great Britain the inventor had a hard road to travel.

A Wireless Dinner.

A wireless reunion, inaugurating what it is hoped will become an annual event, was held at the Trocadero Restaurant, London, last Saturday, when ADMIRAL OF THE FLEET SIR HENRY JACKSON took the chair at A WIRELESS DINNER. The company, numbering about 150, was composed entirely of those who had served during the War as wireless officers of one of the Fighting Services, or in an equivalent capacity, and included a large number of senior officers of the Services, the General Post Office, and the leading scientific and commercial interests.

After honouring the toast of "The King," the chairman proposed the health of Mr. Marconi in an interesting and reminiscent speech, outlining the growth of the youngest of the practical sciences from its very small beginnings to its establishment as the greatest medium for a system of world communications.

Mr. MARCONI, in reply, referred in moving terms to his early association with Admiral of the Fleet Sir Henry Jackson (or Capt. Jackson as he then was), who had passed from the *rôle* of Inspecting Officer to that of active collaborator, and to whose enthusiastic support the early adoption of wireless by the British Admiralty was largely due. He also paid a glowing tribute, based on personal inspection over various War fronts, to the efficiency of the British wireless organisation during the Great War, and to the skill and devotion displayed both by land and sea.

The Chairman, in complimenting the Organising Committee responsible for the arrangements, proposed the health of its Chairman, Colonel L. F. Blandy.

Colonel BLANDY, in reply, explained the origin of the idea of holding a reunion, and proposed that a Wireless Dinner Club should be formed, and an annual dinner arranged on the lines of the present dinner. He proposed that, in the first instance, qualification for membership should be the same as that which guided the committee in arranging the dinner this year, *i.e.*, that membership of the club should be confined to those who had done wireless work during the War as officers or in an equivalent capacity.

The proposal was welcomed, and everyone present at the dinner joined the newly-inaugurated Wireless Dinner Club, Admiral of the Fleet Sir Henry Jackson kindly consenting to be the first president.

Electric Lorries for Calcutta.

The question of refuse disposal in CALCUTTA has been for some time a source of trouble to the Corporation. There is a municipal railway for carrying the refuse out of the town, but some months ago the Corporation began experimenting with motor wagons for refuse removal. According to the "Municipal Journal," petrol-driven vehicles were introduced at first, but more recently the electrically-propelled lorry has been tried. At present there are ten petrol lorries and two electrics in service, each type having the same carying capacity, viz., 3½ tons. The provision of additional vehicles has recently been under consideration, and in connection with the proposal a report has been submitted in which it is pointed out that, excluding interest and depreciation, the running cost of an electric lorry is only about half that of a petrol lorry. In Bombay, where electric vehicles are employed, there has been very little trouble with batteries. The Calcutta Corporation has therefore decided to obtain tenders for eight more electric lorries, and to make provision for the cost in next year's estimates. By having the same number of each type of vehicle it is hoped to be able to obtain reliable figures of the relative working costs.

The British Industries Fair, Birmingham.

The BRITISH INDUSTRIES FAIR (Birmingham Section), which closed on Friday, was visited by 40 000 persons, including overseas buyers from all parts of the world. This is considered satisfactory, as the general public was not admitted this year. Mr. H. O. Worrall (the chairman of the council of the Fair) reported at the close that the amount of business transacted and the prospective business was more than last year, and that in regard to overseas trade especially there had been a notable increase. The improvement in business was specially marked in the small tool section, and satisfactory reports had been received in regard to hollow ware (aluminium of superior makes), electrical goods, general ironmongery and hardware. Mr. Worrall added that he was sufficiently optimistic to believe that the next few months would see a profound change in the position of British trade. Many exhibitors had booked stands for next year's Fair, and in some instances the space had been increased.

The Southampton Dispute.

After negotiations lasting over the week-end, the Parliamentary Committee of the SOUTHAMPTON Corporation recommended that the matter in dispute with the staff of the electricity works should be referred to the National Joint Board, and that the Corporation should agree to abide by the decision of the Board. On this understanding the E.P.E.A. and the E.T.U., the organisations representing the technical staff of the electricity undertaking, agreed temporarily to withdraw their notices, reserving themselves the right once more to present them should the Corporation fail to confirm the recommendation of their Parliamentary Committee.

We learn, however, that the proposed cut of 20 per cent. in salaries has now been withdrawn

Hull and Hessle Tram Extension.

A PUBLIC ENQUIRY was held last week at Hull by the Ministry of Transport into the application of Hull Corporation for a Light Railways Order to extend the electric tramway from the Pickering Park extension to Hessle. Mr. Alan D. Erskine was the presiding Commissioner, and with him were Mr. M. Kissane and Mr. Kenneth J. M. Teasdale.

Mr. W. B. CLODE appeared for the Corporation, and said there was considerable opposition, including the North-Eastern Railway Company, Hessle Urban Council, and others. The proposed line would be one and a half miles long. At present Hessle was served by the North-Eastern Railway and two motor-'bus proprietors, but they contended that passengers were not adequately served. A better service could be given without involving any charge upon the rates. It was not until city boundary extension was mentioned that opposition appeared. Mr. Bell claimed compensation for "injury and damage by competition," but Mr. Bell did not run his 'bus until application was made for the Order. Mr. McMaster's objection was based upon the assumption that a fixed tramway track was obsolete.

Mr. F. W. BRICKNELL, Hull City Engineer, thought there would soon be need for both trams and 'buses, and he described as ridiculous the suggestion that the trams would restore the congestion that formerly existed at Hessle.

Mr. E. S. RAYNER, manager and engineer of Hull Corporation tramway undertaking, said the running of a tramway to Hessle was a very sound financial proposition. A volume of traffic would be served which was not served by the railway. The capital cost would be £30 000, and he estimated that they would have to carry one million passengers per annum at an average fare of 2d. to make the undertaking pay.

The Hon. EVAN CHARTERIS, K.C. (for the North-Eastern Railway Company) said if the scheme was intended to be supplementary to the existing service, he submitted that it would be redundant and superfluous. If, on the other hand, the scheme was intended to substitute existing services, it raised an extremely serious question from a public point of view. It was proposed that the tramcars should do the journey in half an hour, but the railway journey only took ten minutes. The North-Eastern Railway paid one-tenth of the whole rates of the city. If, therefore, the application succeeded, the company would suffer by a depletion of traffic; if the scheme were carried out, and it became a loss, they would suffer as ratepayers.

Mr. F. G. THOMAS, K.C. (for Hessle Urban Council), said the local authority were unanimously of opinion that the tramway extension was not needed. Evidence was called to show that the public were satisfied with the 'buses.

The result will be announced in due course.

Telephone Overcharges.

In their report on the REGISTRATION OF TELEPHONE CALLS the London Telephone and Telegraph Advisory Committee state that a large number of communications have been received complaining of overcharges. This might be expected of a system under which each call is separately charged. The Committee cite eleven examples of a discrepancy between the number of calls noted by the Post Office and by private record. In one case there was difference in favour of the subscriber of 3 273 calls, and in another of 1 132. Up to the present the pure message rate has not been universally adopted. Conferences with officials of the Post Office have taken place with regard to the questions involved.

Besides directing attention to overcharges and to the need for establishing a satisfactory basis for adjusting differences, the Committee also raised other points of administration, such as the method of calculating the 5 per cent. reduction (2 000 calls or over) where a single subscriber had more than one line; the arbitrary manner in which demands are made for payment where charges are in dispute, &c. The Committee visited, by invitation, the Central Exchange in order to see the system in operation, and some particulars are given of what was observed. Every effort appears to be made to render the service as expeditious as possible and to improve organisation and installation. The meters are of a pattern used in the United States of America and elsewhere, and, though they may occasionally get out of order, they can scarcely be held responsible for the discrepancies. Stringent instructions are given to operators and great care is given to the question of correct registration. The Committee think that sufficient use is not made of the Department's slip entitled "How to avoid the risk of Overcharges." It was also pointed out that the Telephone Department undertake, if required, to train operators for subscribers and to send officers to advise with regard to the best methods of private registration, &c. The Committee, while satisfied that the Department is anxious to do everything to ensure accuracy, recommend that the Department be urged to continued efforts at improvement; but they also feel that some of those employed by subscribers to record calls lack technical knowledge and experience.

The "Mechanical World" ELECTRICAL POCKET BOOK, 1922, which is published by Emmott & Co. at 2s., hardly requires any introduction to our readers. There is now a lengthy section on power station construction and operation, while the section on switch gear and switchboards has been rewritten and extended so as to cover the latest developments in this important branch of the subject. A further example of modernity is the new section on electric hoists. The book is of a convenient size, and the type and illustrations are pleasingly clear.

E

Parliamentary Intelligence.

Wireless Receiving Apparatus.

In reply to Mr. HURD, who asked the Postmaster-General (House of Commons, March 7) if he were aware that the number of wireless telephone receiving sets in the United States had increased in one year from 50 000 to 600 000, and the entire country had been plotted into circuits with a central station so that every rural and urban home might obtain, at a cost below that of an ordinary gramophone, weather forecasts and business information as to prices and market conditions, as well as records of sermons, lectures, and entertainments; and whether he would endeavour to provide comparable facilities under the Post Office monopoly in this country, Mr. KELLAWAY said that he was aware that there had been a considerable increase in the number of private wireless installations in the United States. He understood, however, that, in consequence of the danger of interference with Government and commercial communications, the United States Government were considering the restriction of the use of wireless telephone for other purposes. Permission to use wireless receiving apparatus for experimental purposes was granted with comparative freedom in this country, the number of installations authorised being at present 7 500. The provision of facilities for broadcasting messages by wireless was under consideration.

Montevideo Tramways.

In reply to Colonel NEWMAN (House of Commons, March 7), Mr. HARMSWORTH said a strike for increased wages had stopped the working of the tramways of Montevideo for three weeks. The company was unable to pay the increased wages demanded by the men unless permission were granted to them by the Government to raise their tariff. A Bill to authorise this increase was for some time before Congress, but was not passed. It would come up again at the meeting of Congress on March 15. On Jan. 28 the Municipality assumed control of the tramway company. The British manager was invited to remain at his post, and the Municipality appointed an "interventor" to control gross receipts. Two accounts were now to be opened. One would provide for payment by the company of wages on the old scale, the other for the increased wages which the men demanded. These were to be paid by the Municipality from the company's gross receipts. The company had protested, and it was understood that they were now taking legal action against the Municipality. Uruguay was a member of the League of Nations.

Miners' Safety Lamps.

The Secretary for Mines (Mr. BRIDGEMAN), replying to Major KELLY in the House of Commons on Monday, stated that no fresh regulations governing the use underground of safety lamps were contemplated at the moment. He was awaiting recommendations in the matter from the Miners' Lamps Committee. As regards danger from choke-damp, he was advised that flame safety lamps or open lights (where used) gave sufficient warning to enable the miner to withdraw in safety. The electric safety lamp, however, could give no warning of the presence of inflammable or noxious gases, and the question what steps should be taken to provide safeguards in the general use of electric lamps by the workmen in a mine was now under consideration by the Miners' Lamps Committee.

Artificer Apprentices.

Replying to Mr. R. YOUNG in the House of Commons on March 8, Mr. AMERY stated that the details of the new scheme for training officers for engineering and electrical duties had not yet been approved, and no artificer apprentices, therefore, had so far been sent to Keyham, but when the scheme came into operation, probably in September next, it was the intention that a few artificer apprentices who showed sufficient promise (not exceeding one or two a year) should be chosen to undergo the course of training under the same conditions as the other officers.

Underground Railway Extension.

In the House of Commons on Monday, Mr. HILTON YOUNG, in reply to Mr. GILBERT, said the Treasury, on the recommendation of the Trade Facilities Advisory Committee, had agreed to guarantee a loan to be raised by the London Underground Railways for the purpose of extending and improving their Tube railways. Full details had not yet been completed, but he hoped to make a complete announcement very shortly.

Wireless at the Institution.

Those proceeding across Waterloo Bridge northward have a good view of the roof of the Institution, and the more observant have recently noticed the ERECTION OF A WIRELESS MAST, leading them to suppose that the Institution is celebrating its return to its own building by making arrangements for the reception of wireless messages. These suspicions are confirmed by the notification we have received that a permanent wireless aerial has now been installed for reception purposes. The details of this equipment are as follows:—

Span between strain insulators, 113 ft.; down lead from aerial to leading insulators outside, 63 ft.; down lead from leading-in insulator to floor of lecture theatre, 44 ft.; making a total down lead of 107 ft. The effective length of the aerial (down lead plus half the span) is, therefore, 163·5 ft., giving a natural wave length of approximately 200 metres.

Legal Intelligence.

Scottish Machinery Assessment Appeals.

An important judgment has been delivered by the Valuation Appeal Court (Lords Salvesen, Cullen and Hunter) in a series of appeals by fourteen firms of iron and steel makers in Lanarkshire against decisions of the Valuation Committees of the Middle and Lower Wards of the county. The Assessor undertook a revaluation of all the steel and iron works in the county, and the parties were at issue with the Assessor as to whether the contractors' principle should have been applied to certain plant and machinery, and as to whether the Assessor was entitled to apply that method in arriving at the annual value of the works as a whole. The appellants contended that the annual values for 1919-20 represented full valuations, and that the Assessor had failed to adduce any evidence to justify the increases he had made. The committees approved of the method adopted by the Assessor, but were of opinion that the percentages suggested were rather high. They were of opinion that, having regard to the whole circumstances, a reasonable abatement would be 30 per cent.; and the Court affirmed the decision of the committees.

In giving judgment, Lord Salvesen said the questions raised were of unusual importance, but he had no difficulty in rejecting the Assessor's contention that a building was not a building which was not enclosed by walls as well as by a roof. His Lordship also found it impossible to accept the Assessor's view that certain machinery was attached to the heritage, and he overruled the Assessor's objection to the exclusion from the heritable subjects of the rails laid across certain transverse walls in the foundations of one of the buildings for supporting bars of steel while undergoing cooling and also the plain floor plates and sleeper floors.

His Lordship said the Assessor had raised certain questions which turned upon the meaning of "first motive power." The first related to electricity, which was generated by means of steam-driven machinery. It was not disputed that steam-driven machinery was rateable, as well as the boilers. But the Assessor claimed that the dynamos actuated by the steam-driven machinery should also be included as heritable, apparently on the ground that the electric current so produced was used to operate machines in appellants' works. In his Lordship's view, the Assessor's view was negatived by the Guardbridge Paper Company case of last year, where their Lordships held that the boilers, the steam engines and the main shafting all fell within the definition of plant or machinery for producing or transmitting first motive power, but that when that power was transmitted by secondary shafting to the manufacturing machines it ceased to be first motive power. His Lordship thought this view governed the other matters raised by the Assessor.

Dealing with the main subject of the appeal, his Lordship took one case (the Dalzell Steel & Iron Works) in which the yearly rent or value was £105 236, against £27 000 in 1919-20. The result was undoubtedly startling, and appellants were right in their contention that there was a heavy onus upon the Assessor to justify so revolutionary a change. After an exhaustive analysis of the facts, their Lordships decided that the 30 per cent. abatement allowed by the committees should stand, though Lord Salvesen was of opinion that the allowance should have been 50 per cent.

The Lodge Tuned Wireless Patent.

The Royal Commission on Awards to Inventors continued on Monday last the hearing of the claims of Marconi's Wireless Telegraph Company and the Lodge-Muirhead Wireless and General Telegraphy Syndicate for an award in respect of the infringement by the Admiralty of Sir Oliver Lodge's Patent No. 11 575 of 1897.

Mr. C. F. Wilkins (director and manager of Muirhead & Company) and Mr. J. S. Vincent Pletts (consulting engineer to Marconi's Wireless Telegraph Company) gave evidence, the former dealing with the prices of and the royalties on apparatus supplied by the Lodge Muirhead Syndicate, and the latter with specific sets supplied to the Admiralty, and for which, it was stated, the Admiralty had paid or agreed to pay at rates corresponding to those now claimed.

The Attorney-General (Sir Ernest Pollock, K.C.) opened the case for the Admiralty, and said if the Marconi agreement with the Admiralty were cleared of its other liabilities, one arrived at a figure of £11 per kW for the whole period from 1903 to 1911. Taking the wattage of the whole of the sets, they had to deal with a figure of 6 846 kW-years, and by dividing that into £75 000, the result was £11 per kW per annum. Those who made that agreement, taking a just estimate of the very important user that would be made, were prepared to accept that sum. But when they came to the period of the war, it was said they were entitled to make those enormous claims on the Crown. It was true that a patentee had a statutory right to claim compensation from the Crown, as he could in the case of private persons, but the Crown was given the right, as against him, that he could not stop by injunction the use of the invention by the Crown, provided compensation were paid.

The Chairman said the Commission had already given it as their opinion, in their report, that the Crown, having availed itself of the statutory licence, compensation should be such as would be given in the case of a willing licensor and licensee.

The Attorney-General said that the Commission would be ready to disregard the Marconi Company's table, in which the selling price of £805 per kW had been arrived at by selling to foreign Governments, which he did not think had any possibility of providing themselves with the necessary sets. Nearly all the relevant figures in the company's tables had been made use of for enhancing the proposed royalty. In one item (No. 1 003) the price was given as £300, but it had to be admitted that where there were a large number of sales the price was £165.

The Attorney-General had not concluded his speech when the Commission adjourned until Monday next.

Hamilton v. Marconi's Wireless Telegraph Company.

In this case plaintiff appealed to the Court of Appeal (Lords Justices Bankes, Warrington and Scrutton) on Monday and Tuesday against an order of the Lord Chief Justice staying all proceedings in the action.

Mr. Hamilton, who appeared in person in support of his appeal, said the Lord Chief Justice had refused to allow the action to be tried in his court before the jury were sworn.

Mr. Hogg, K.C. (for defendants), said that was on a preliminary objection. He (counsel) objected to the action being tried before the jury upon the ground that the action was to rescind the agreement of May, 1920, made between Mr. Hamilton and the defendant, and that that agreement had been the subject of an action in the Chancery Division, in which defendants had sued Mr. Hamilton to restrain him from referring to the agreement or certain other documents in breach of his covenant, and that there had been an undertaking given by Mr. Hamilton (who was then represented by Mr. Upjohn, K.C.) to the court under which Mr. Hamilton undertook that he would not refer to the contents of the agreement or publish it, or repeat any part of it to anybody. His (counsel's) objection was that as long as that undertaking stood it would be contempt of court to break it, and that Mr. Hamilton's right course must be to get rid of the undertaking before he sought to open an action in which he was attacking the agreement itself.

In the result their Lordships held the order of the Lord Chief Justice was too wide, and made an order staying the proceedings in the present action for one month to enable Mr. Hamilton to bring a fresh action in the Chancery Division, if he thought fit, for the purpose of getting relief from his undertaking and for rescission of the agreement. A special order as to costs was made.

Collision with Unlighted Tramcar.

At York County Court recently, Robt. Whitehead, a taxicab proprietor, was awarded £100 damages against York Corporation on account of a collision with a tramcar. Plaintiff's case was that on the night of Nov. 11 one of his drivers was going round a sharp curve into Holgate-road and crashed into a stationary tramcar without lights. The trolley pole had become detached, and the head had fallen, disconnecting the overhead wire and extinguishing all the car lights. It was submitted that the Corporation were liable through the negligence of their servants in not taking steps to ensure the safety of people lawfully using the highway.

For the defence it was argued that if plaintiff's servant was driving so fast that he could not pull up it was not fair to mulct the Corporation in damages. Not ten seconds had elapsed before the car was plunged in darkness and the collision, and the Corporation's servants had not had time to do anything.

His Honour (Judge McCarthy) said the first duty of defendants' servants was to go to the corner and warn the traffic. He accepted plaintiff's story that there was time. He thought defendants were liable, and gave judgment for plaintiff accordingly.

Miller v. Lanarkshire Tramways Company.

Sheriff Shennan has awarded £60 to William Miller, miner, as damages for injuries sustained through being knocked down by one of defendants' tramcars. Miller, who was marching with a band, was struck from behind and knocked down. His Lordship found negligence by the tramway driver in trying to pass the band at the wrong moment.

Trade Improving.

The pessimism which has been expressed on the publication of the export and import figures for February seems a little unjustified, for though, compared with January, both imports and exports have declined, it must be remembered that February is the shortest month in the year, and this year had two working days less than January. This difference largely discounts the reduction recorded, even when the continual fall of prices is taken into consideration. This fall in prices is an important factor in any comparison that is made with the figures of the corresponding month last year, and to make such comparison except on the basis of quantities is altogether misleading. On this latter basis the figures are, in certain respect, very satisfactory. The export of coal has risen from 1 729 148 tons in February last year to 4 014 334 tons in February of this year. Iron and steel scrap has risen from 289 tons to 4 754 tons, a figure in excess of that obtained in February, 1920, when the boom was still in being. The export of copper is slightly in excess of that of the corresponding month of last year, though it is below the figure reached in February, 1920. Machinery, on the other hand, is still slightly below that of February, 1921, the figures being 34 884 tons as compared with 41 917 tons. In the staple industries, in which electrical engineers are not directly interested, but which are indirectly of great importance to them, far greater consignments of their products were sent abroad last month than in 1921. The outlook therefore gives rise to no pessimism, and if labour troubles could be composed the development should be correspondingly satisfactory during the coming months.

Electricity Supply.

Blackpool Electricity Works are expected to realise a surplus of £10 000 on the current year's working.

The Galway electricity plant has been destroyed by fire, damage to the extent of £15 000 having been caused.

Mr. J. H. Clothier, electrical engineer to St. Anne's Council, reports that during January the department connected fifty-six new lighting and thirty-four power consumers.

Teignmouth Urban Council have accepted the offer of the newly-formed Electric Lighting Company for public lighting for five years, at £4 per 100 c.p. lamp per annum and £6 per 250 c.p. lamp.

Waterloo-with-Seaforth Council are pressing Liverpool Corporation for the same terms for the supply of electricity as they are charging in Liverpool, Bootle, and other districts within the extended area of supply.

Mr. T. McLeod, the Sheriff, has been appointed chairman of the newly appointed Electricity Committee of Hull Corporation. Mr. Pearlman, who took a prominent part in the impeachment of the old committee, has accepted the position of deputy-chairman.

It is reported that there is every likelihood of an amalgamation between the Wirral Railway and the London and North-Western Railway. According to the "Liverpool Courier," the scheme for electrification proposed by the Wirral Railway in 1900, when they were empowered to raise £300 000 for the purpose, will very possibly follow the taking over of the line by L. and N.W. Railway.

Burnley Paper Works Company have applied to the Corporation for a supply of electricity. Special terms have been quoted for 300 h.p. during a 24-hours' day, and the engineer will lay the mains should these be accepted. A revised supply agreement has been made with J. Hargreaves, Ltd., of Bank Hall Colliery. The price per unit has been increased from 0·8d. to 1·02d., and a coal clause has been inserted in the agreement.

Belfast Ministry of Commerce has appointed the following to be Electricity Commissioners for Northern Ireland under the Electricity (Supply) Acts, 1882 to 1919:—Mr. Cecil Litchfield (chairman), permanent secretary, Ministry of Commerce; Mr. Walter Abbott; Mr. G. H. Edmiston Parr. Mr. F. W. Parkinson has been appointed electricity consultant and adviser to the Commissioners and the Ministry of Commerce.

The deputation from Glasgow Corporation, which recently visited London for the purpose of inspecting the lighting arrangements, has issued its report. After describing the methods employed in the City of London, it is pointed out that little or nothing has been done in the way of improvement on the system adopted in 1914, though that was good. In the City of Westminster experiments are made with gasfilled electric lamps in refractor bowls, but their method of use did not give the best results from the appliances installed. In many of the smaller London boroughs experiments are also being made with gasfilled lamps for public lighting. In Glasgow nearly 500 miles of streets have to be dealt with. Liverpool approximates to the position at Glasgow so far as street lighting is concerned, but it has no stair lighting, and the stair lighting forms a big part of Glasgow's lighting responsibilities. The deputation note with satisfaction that Glasgow lighting, taken as a whole, is equal to any lighting seen in the United Kingdom, except some of the main London thoroughfares, where the traffic is heavy.

New Schemes and Mains Extensions.

The scheme to supply Mumbles with electricity has been deferred for three months.

Warrington Corporation has received sanction to borrow the money required for the erection of a sub-station at Latchford Without.

Southport electrical engineer (Mr. E. Moxon) has been authorised to alter the supply to two local companies from single-phase to three-phase. An additional transformer is to be obtained from the Brush Electrical Engineering Company at a cost of £360.

Torquay Corporation are seeking leave to introduce a Bill for powers to acquire the Newton Abbot undertaking of the Urban Electric Supply Company, to extend the Corporation's area of electricity supply to Newton Abbot and the adjoining rural district, &c.

Accrington Town Council are about to supply the residents of Oswaldtwistle with current on terms 5 per cent. higher than the charges made in the borough to cover the additional cost incurred. Steps are now being taken to obtain the necessary statutory authority.

Alteration of Charges.

Fulham Council propose to reduce the charge for electricity from 7d. to 6d. per unit.

Walthamstow Urban Council have reduced the charge for electricity from 8d. to 7½d. per unit.

Hampstead Borough Council are reducing the price of electricity to private consumers from 8d. to 7d. per unit.

Canterbury Town Council have reduced the charge for current for power by ½d. per unit, as from April 1 next.

Electricity charges at Long Eaton have been reduced from 8d. to 7d. for lighting and from 3d. to 2½d. for power.

The price of electricity at Hebden Bridge is to be reduced by 1d. per unit for power and ½d. per unit for lighting.

Stockport Town Council have increased the minimum charge to consumers of electricity to £2 10s. per annum.

Tonbridge Urban Council have reduced the price of electricity for lighting by 1d. per unit for six months from April.

The price of electricity for lighting in Plymouth is to be reduced by a halfpenny a unit from the March meter readings.

Leicester Electricity Committee recommend a reduction in the charge for power from 133⅓ per cent. to 100 per cent. over pre-war rates.

Heywood Corporation have reduced the charges for lighting from 70 to 50 per cent. and for power from 80 to 60 per cent. above pre-war rates.

Sheffield Town Council have agreed to make a standard charge of 2d. per unit for all buildings and institutions in the city supported by the rates.

Lynn Town Council have agreed, as from the March meter readings, to reduce by ½d. per unit the charges for lighting and to cancel the last increase of 5 per cent. made to power consumers.

As from April 1, the charges for electricity at Weymouth will be reduced as follows:—Lighting, from 10d. to 9d., with discount; power, from 3½d. to 3d., with discount; public lighting, from 5·3d. to 4·9d.

Hammersmith Borough Council have made a reduction in the charges for electricity for lighting and power from the March meter readings. In future a minimum yearly charge of £1 per consumer will be made.

Poplar Council Electricity Committee recommend that from the meter readings in March the present charges for electricity of 85 per cent. above pre-war rates for power and public lighting and 70 per cent. for private and domestic supplies be reduced to an all-round charge of 50 per cent. above pre-war rates.

Sunderland Corporation have reduced its charges for electricity by 18⅓ per cent. to h.t. and 11½ per cent. to certain l.t. consumers, and by 5½ per cent. to the tramways. The chairman of the Electricity Committee has given an undertaking to consider a reduction to ordinary domestic consumers after the end of the financial year.

Glasgow Electricity Committee have decided to reduce the charges for electricity as follows:—Lighting: maximum demand from 6d. to 5d. and from 2d. to 1½d. for rebate rate. Domestic consumers, churches and schools: from 5½d. to 4½d. Power: maximum demand from 2¾d. to 2¼d., and for rebate rate from 1¾d. to 1½d. and from 1½d. to 1¼d. These reductions vary from 17 per cent. to 25 per cent. on present rates, and will amount to £217 000. They will take effect as from the May meter readings.

As from the March meter readings the following charges for electricity at Stepney will become effective:—(*a*) The secondary charges for lighting purposes under scales A, C and F, and the charge under scale G, to be 1½d. per unit; (*b*) the charge for power and heating under scale B to be 1½d. per unit; (*c*) the charges for electricity supplied and meter rent for lighting to be 33⅓ per cent., instead of 50 per cent. above pre-war charges; and (*d*) for power, heating, and private bulk supplies 25 per cent. instead of 50 per cent.

Dublin Electricity Committee recommend the following alterations in the electricity charges, as for the March meter readings:—(a) Abolition of the 10 per cent. addition to accounts, where in force; (b) reduction of the fixed rates (for theatres and other special consumers) by approximately 1d. per unit; (c) reduction of the special charges for large consumers by approximately 10 per cent., this being in addition to the 10 per cent. already mentioned; (d) increase of the allowance for combined lighting and heating from ¼d. to ½d. per unit; (e) the fixing of the maximum price at 9d. for all general consumers. With regard to power charges, there will be a reduction of ¼d. per unit in almost all cases, and the Committee also recommend substantial reductions in the meter rents, &c. The reductions represent a decrease in total revenue of £30 000 for the twelve months, apart from a reduction in street lighting of £3 000.

Institution Notes.

At a meeting of the West of Scotland and Ayrshire branches of the Association of Mining Electrical Engineers, held in Glasgow, on Saturday, a paper on the Clyde Valley Electrical Power Company's system was read by Mr. A. E. M'Coll.

A meeting of the Electrical Society of Glasgow will be held in Reid's Tea Rooms, 34, Gordon-street, Glasgow, on Tuesday next, at 7.30 p.m., when a Paper on "Organisation" will be read by Mr. Percy J. Sims, manager for Scotland, General Electric Company.

A special general meeting of the members and associates of the Institution of Electrical Engineers will be held at the Institution Building, Savoy-place, London, on the 23rd inst., at 5.45 p.m., for the purpose of passing formal resolutions authorising the Council to borrow from the Alliance Assurance Company the sums of £16 340 and £7 500 by way of mortgages on the Institution Building at Savoy-place and on the freehold and leasehold property of the Institution in Tothill-street, Westminster, respectively, in substitution for the present mortgages to the company, upon which the same amount is now due. Subsequently a further meeting confined to corporate members will be held to consider and adopt bye-laws for the Chartered Institution.

Electric Traction.

For the nine months ended Dec. 31 there was a loss of £17 000 on the East Ham Municipal Tramways.

The Beach Committee of Bournemouth Corporation again recommend the provision of two electric runabouts, as they would be cheaper and more convenient than petrol vehicles on the front.

The petition of Wandsworth Borough Council against the Bill promoted by the L.C.C. to introduce trackless trolley 'buses at Lewisham was disallowed by the Court of Referees at the House of Commons last week.

The net amount taken on the St. Anne's tramways for the year to the end of January last was £45 666, against £47 481 for the previous year. A sum of £24 581 was paid to Blackpool Corporation in respect of the service in their borough.

At the International Railway Congress, which is to be opened in Rome on April 18, under the presidency of M. Tondelier, of the Belgian State Railways, a large number of subjects relating to the improvement and development of railways will be discussed. The work of the Congress will be divided into five sections. Section II. includes electric traction, and in Section V. various aspects of light railway working will be dealt with. Various excursions have been arranged, and on Saturday, April 22, the delegates will visit the steel, hydro-electric, and carbide of calcium works at Terni.

A deficiency of £18 000 on the L.C.C. Tramways account was carried to the accounts for 1920-21, but counsel has advised that the Council had no power to raise in the rates levied in the year moneys to meet an estimated future deficiency on tramways. The district auditor, supported by the Minister of Health, maintained that the deficiency should have been transferred forthwith to the special county account, and it has, therefore, been decided to adopt this course, but the Highways Committee remain of opinion that their former practice was, from the point of view of accountancy, correct.

The Joint Industrial Council for the Tramways Industry decided last week to revise the 1919 agreement. Under the new arrangement, which will take effect from the first full pay period after April 17, the average duty schedule will be forty-eight hours for a week of six days. No schedule will be less than forty-four hours, nor more than fifty-two. On the question of spread-overs, each authority is to deal with the matter in conference with the local representatives of the trade union. With regard to "spare men," when a man is called out he is to be paid for a minimum of four hours for the first call and two hours for each succeeding call in the day. Holidays have been fixed at eight days annually, with pay, after twelve months' continuous service, Christmas Day to be worked when required, and double ordinary week-day rates paid for time actually worked. The new overtime rates are time and a quarter for the first two hours, and time and a half afterwards. The agreement will be terminable upon three months' notice from either side.

Personal and Appointments.

Capt. F. H. Masters, O.B.E., T.D., has been gazetted Major in the Territorial Army Reserve.

Dover Town Council has appointed Mr. D. Powell junior charge engineer at the electricity works.

Sir Arthur Whitten Brown (who made the memorable Atlantic flight) has been appointed consulting engineer to the Instone Air Line.

A new lectureship in the Faculty of Engineering in the utilisation of water power has been instituted at University College, London, and Mr. Theodore Stevens has been appointed.

Mr. F. R. Anderton has been elected Chairman of the London County Council for the ensuing year. Mr. H. C. Gooch is vice-chairman, and Miss Nettie Adler deputy-chairman of the Council.

Business Items, &c.

As from the 20th inst. the address of Holder-Harriden, Ltd. will be Noble House, 35-37, Noble-street, London, E.C. 2.

From to-day (Friday) the address of the Enterprise Manufacturing Company will be Electric House, Grape-street, Shaftesbury-avenue, London, W.C. 2. Telephone: Gerrard 3 018 and 3 019.

In connection with the liquidation of the Wilson-Wolf Engineering Company, Pooley & Austin announce that under the reconstruction scheme they have been re-appointed the sole London agents for the new firm, and will continue to supply fractional horse-power motors from stock in London or direct from the works as hitherto. They hope to have the complete original programme, which embraces all sizes for both a.c. and d.c. from 1-30 h.p. up to ½ h.p., in production within the next few months.

The Spearing Boiler Company, Ltd., and Tinkers, Ltd., Daisyfield Boiler Works, Hyde, near Manchester, have come to an arrangement under which the Spearing Boiler Company acquire the controlling interest in Messrs. Tinker's. The Spearing water-tube boiler will in future be made at the works of Tinkers, Ltd., where it is proposed to carry out large extensions to cope with the rapidly growing demand for the boiler. Mr. Spearing will join the board of Tinker's, Ltd., as chairman, and Mr. Frank Tinker will continue to act as managing director.

Narrandera (N.S.W.) Council have taken over the electricity works from Wise Brothers, who have supplied electricity in the town under a contract for the last seven years.

Telegraph and Wireless Notes.

The director of the Military Wireless Service has informed the Academy of Science that the transmitting energy of the Eiffel Tower Wireless Station will shortly be made much more powerful.

During the violent gales which swept over Southern England and the English Channel on Tuesday night and Wednesday last week wireless was the only method of communication with the Continent, and was not interrupted. The steamboat and air services were suspended, and telegraph and telephone communications were reduced to very small dimensions.

In connection with the proposal of the President of the United States to issue regulations regarding amateur wireless telegraphy, General Squiers, head of the Army Communications, states that within a few hours he had received formal protests from the Governments of Australia and New Zealand against the activities of a Californian amateur, who, in broadcasting the dulcet notes of a concert held in Santa Catalina, had brought the official communications of these Governments to a standstill for many hours.

Plans for the distribution of all the ex-German cables have been presented to the Ambassadors of Great Britain, France, Italy, and Japan by Mr. Fletcher, the U.S.A. Secretary of State, in his capacity as chairman of the International Conference upon Communications. The proposal has not yet been made public, and it is understood that its acceptance depends largely upon the attitude of France, as apparently it is acceptable to the other members of the Conference. It is understood that Italy will be allotted the Liberia-Brazil cable, and will be allowed a sufficient cash grant to lay a branch line connecting it up with Genoa. Japan is not taking part in the discussions, as she will accept any agreed division of the cables.

Obituary.

The death is announced of Mr. Percy Foulds, who was in business as an electrical engineer and contractor, at Heaton Moor, Stockport.

The death has occurred, at Port Glasgow, at the age of 73, of Mr. Matthew Blackwood, one of the pioneers in West Scotland of X-ray and electrical treatment. Mr. Blackwood was the founder, and latterly principal partner, of Blackwood and Co., saw millers.

We regret to announce the death of Dr. Augustus D. Waller, F.R.S., M.D., Director of the Physiological Laboratory, University of London. Deceased, who was a great authority on electro-physiology, was the inventor of an electro-cardiograph. He conducted many researches, and he was the author of several publications on physiology. Dr. Waller was born in Paris, and was 68 years of age.

The death is announced, at the age of fifty-two, of Mr. J. J. Walklate, General Controller and Town Clerk of Auckland, New Zealand. He went out to New Zealand to take charge of the City of Auckland Electric Tramways, Ltd., a concern that was later absorbed by the City of Auckland Corporation. Mr. Walklate was associated with the early development of electric street traction, having been engaged under Mr. Alfred Dickinson, of London and Birmingham, in the construction of the Darlaston and Walsall Tramway, claimed to be the first overhead electric tramway in this country. Later he was resident engineer for the Douglas and Laxey Electric Tramway, the Kidderminster and District Tramways, and the Potteries Electric Traction Company. He was a Staffordshire man.

Standard Starters.

At the last meeting of the Institution of Electrical Engineers valuable Papers on "Motor Starters" were read, and the opportunity was taken by Mr. C. H. Wordingham to present for discussion six draft British standard specifications for motor starters. These were submitted to members for criticism, and some useful points were raised. It was decided to adjourn the discussion of the specifications until Thursday, March 23. It is hoped that as many as possible of those interested in the manufacture, use and export of motor starters will make a point of attending and giving their views on these specifications in order to assist the committee to complete them on a satisfactory basis for all concerned.

German Engineers in Australia.

The Chief Victorian Electricity Commissioner (Sir John Monash) has issued a statement regarding the refusal of the Australian Federal Government to permit German experts to enter Australia and supervise the erection of the coal briquetting plant, which has been ordered from a firm at Halle (Germany), at a cost of about £100 000, for the Morwell Coalfield. The Electricity Commission have satisfied themselves that the undertaking cannot be launched without such guidance, in the absence of which there would be danger to the workmen and the plant. Sir John Monash adds that it is high time the public of Australia realised that the growth of native industries depends far more upon the acquisition from abroad of expert and scientific knowledge and experience than upon tariffs.

Since the above statement was issued, the Commonwealth Government has given permission for six German engineers to enter Australia and supervise the erection of the plant, as proposed by the Commissioners.

The annual meeting of the Batti-Wallah's Society will take place on Monday, March 20, at 2.30 p.m., at the Holborn Restaurant, and will be preceded by the abandoned (revived?) monthly lunch at one o'clock.

Companies' Meetings, Reports, &c.

County of London Electric.

After dealing with the report and accounts (Electrician, March 10) at the annual meeting of the County of London Electric Supply Company on Tuesday, Sir Harry Renwick (chairman and managing director), who presided, speaking of the general progress of the company, said that the units sold during the year were 51 220 079, an increase of 1 666 856 over 1920. The applications received for new business amounted to the equivalent of an additional 6 098 kW. The company was now rapidly approaching a total of 100 000 kW, and the total number of consumers supplied directly or indirectly was now well over 43 000. A further stage had been reached regarding the proposed station at Barking, the Commissioners having at last issued their draft consent for the company to proceed with the work. Their new Act had materially strengthened the company's position, and would be of great assistance in raising of funds and in disposing of certain difficulties in carrying out the actual works at Barking. Referring to the Electricity Bill, the chairman said there was much in it that was useful, and should assist in the development of the electric supply industry, particularly in the provinces. The clauses dealing with finance would no doubt be the subject of much discussion and, possibly, amendment. The clause dealing with the erection of railway generating stations would, however, give rise to direct opposition, and certainly as the clause stood drastic amendments were needed. The clause, so far as it permitted the erection of separate generating stations, was obviously an anomaly in a Bill the principal aim of which was centralisation and pooling of supplies. He was confident that the Government and the Electricity Commissioners realised the great work that private enterprise had performed hitherto in developing electricity supply, and that recent events had taught them that the wheels of trade could only be set going, and the industries of the country developed, by encouraging private enterprise. The Electricity Commissioners were admittedly rendering a great service to the community. The task they had entered upon of reorganising the electricity supply of the country presented enormous difficulties, and all who had the real interests of the industry at heart would give Sir John Snell and his colleagues their most loyal support. He, the chairman, had taken a personal interest in the Trade Facilities Act, and had been actively engaged in securing for electric supply companies participation in the benefits and advantages given under that Act. At the present moment the Advisory Committee had before them applications for assistance from electric supply companies to the extent of several millions, and some of those applications put forward by himself on behalf of the provincial undertakings had already been granted.

Telegraph Construction and Maintenance.

In the course of his speech at the annual meeting of the Telegraph Construction and Maintenance Company last week, Mr. Colin F. Campbell, who presided (in the absence of the chairman, who is in Africa), said that the heavy fall in the price of raw materials which had taken place in 1920 had continued in a lesser degree throughout 1921, but none of the raw materials with which they were most concerned had yet reached the pre-war figures. It might be argued that this fall was all to their advantage, which in a sense was true, but in a company such as theirs considerable stocks had always to be maintained, with the consequence that if prices continued to fall from one level to another, confidence in the stability of prices was apt to be shaken. They were fortunate last year in being able to keep their works and ships fairly well occupied, and they had little doubt that when trade revived they should be able to secure a fair share of the business to be done. Turning to the report and balance-sheet, the Chairman said the net profit was £120 880, an increase of £10 693 on 1920. The capital was still at £896 400. Debts owing by the company and reserves for insurance and contingencies (£1 528 331) were lower by £354 220 than last year. The reserve fund was £160 000, and it was being built up at the rate of £20 000 a year. The balance at credit of the profit and loss (£213 858) was £11 241 better than last year. On the other side of the balance-sheet, property, including stocks, amounted to £1 149 208. This was £402 770 down, mostly the result of the fall in prices of materials, which still continued.

The company's output of submarine cable was less than in 1920, due to the coal strike, which for some time restricted supplies of wire, and their turnover was also down, both from the same cause and from the general fall in prices. The good result of the year's working was due to appreciation of investments. During the war and since, every year had shown a fall in the value of the company's securities, averaging about £50 000 a year, which had to be allowed for before arriving at their net profits. That absorbed all the dividends or interest on the investments, and in some years considerably more. The beginning of 1921 seemed to have been the low-water mark with gilt-edged securities, and by Dec. 31 last there was a general rise, which had helped very much with this year's accounts. Out of the profit of £120 880 they proposed to pay £89 640 in dividends, adding £20 000 to reserve and £10 000 to the pension fund, which would leave £1 240 to increase the carry forward.

Underground Electric Railways.

Presiding at the annual meeting of the Underground Electric Railways Company of London last week, Lord Ashfield (the chairman of the company) said that the year 1921 had been a successful one for the operating companies, especially if compared with those which preceded it, and in particular with 1920. The present year would show a substantial fall in expenditure, as within the last few months there had been a decided drop in various items. Tyres had dropped 23 per cent., coal 41 per cent., and petrol 10 per cent. If expenditure was falling, so also was the traffic. The first seven weeks of 1921, compared with the same period of last year, showed that passengers had fallen by about 4 650 000 and traffic receipts by about £189 000. The fall of nearly 10 per cent. in receipts was explained by the continuing depression in trade and industry, by the lowering of the fares on omnibuses and tramways, and by the widespread lack of money to spend upon anything but the necessities of livelihood. Referring to the proposals made on behalf of the London Electric and the City and South London Railways to the Advisory Committee under the Trade Facilities Act of last year, Lord Ashfield said these proposals aimed at securing from the Government a guarantee as to principal and interest upon a capital sum not exceeding £5 000 000, which was to be expended upon the reconstruction to a larger size and re-equipment of the City and South London line, the construction of connecting lines at Camden Town with the Hampstead section of the London Electric Railway, and the extension of the latter railway from Golders Green to Edgware. He could not disclose the terms, as they were still under discussion, but he assured the shareholders that, taken over the series of years to be covered by the proposals, they should not be disadvantageous to the railway companies. The problem, which rested with the boards of the companies to decide, was whether the possible additional cost of the works carried out at once was offset by the reduced interest cost of the capital attributable to the Government guarantee, for the final cost to the companies was a combination of these two factors. There was no question that the works themselves were essential parts of a complete scheme of traffic facilities for London and were much overdue.

Mersey Railway.

Addressing the shareholders at the annual meeting of the Mersey Railway Company, Mr. James Falconer (the chairman) said that it was a special satisfaction to the board to be able to report that the company had at last reached the stage of being able to pay in full the interest on all its debenture stocks. The debenture holders would, he hoped, recognise that the board, so far as the debentures were concerned, had carried out the programme laid down in 1900, when it was resolved to adopt electric traction, and the scheme of arrangement was entered into. On the other hand, the shareholders must recognise the sacrifices made by the holders of the contingent debentures in reducing the interest upon their stocks and making its payment contingent upon the profits of each separate year, without which the scheme could not have been carried out. The result now reached had been arrived at by a continuous process of development, accomplished in the face of many difficulties. The development began in 1903 with the adoption of electric traction, and was maintained down to 1913, when they were within sight of being able to pay their interests in full. In 1902 the surplus of receipts over working costs was only £3 715. In 1913 the corresponding figure was £58 345, an increase of £54 630. In 1914 came the war and Government control, and the financial progress of the company was arrested for seven years. The installation of automatic signalling was now completed, and had been in operation for several months. It had proved itself to be of importance in increasing the capacity of the train service and maintaining its punctuality, and the company was advised that it provided an additional safeguard against the risk of accidents. Continuing, the Chairman said he thought they had placed the company upon its feet financially, and had established what had been authoritatively described as a world's record for the benefits to be derived from electrical working. The accounts of the company were dealt with in our issue of March 3.

British Mannesmann Tube.

Presiding at the annual meeting of the British Mannesmann Tube Company last week, Mr. R. S. Guinness, the deputy-chairman, said that the offer made by Baldwins, Ltd., to their shareholders had been accepted to the extent of upwards of 91 per cent. of the issued capital, but the reconstituted board had only been in charge of operations for a small part of the year under review. The stocks had been written down heavily to bring them into line with market values at June 30, 1921. An adverse balance on profit and loss account would have resulted, but the amount they were able to bring to the credit of revenue through the adjustment of excess profits duty had counteracted the abnormal depreciation of stocks. In their profits there was a decrease of some £95 000, due largely to the heavy depreciation he had referred to. During the first half of the year operations had been very successful, but in the second half the company had suffered very much from depression in trade, with the consequent cutting of selling prices. They had, however, been able to keep their works in operation, although output showed a considerable falling away. The board were doing everything possible to bring down expenses and so reduce the cost of production. Orders, however, were both scarce and keenly competed for, and it was difficult to see any signs of encouragement at present. The whole question with regard to writing off allowances on capital expenditure had been finally arranged with the Inland Revenue.

Charing Cross, West End and City Electricity Supply.

Addressing the shareholders at the annual meeting of the Charing Cross, West End and City Electricity Supply Company last week, Mr. W. F. Fladgate (chairman of the company), said that against the difficulties of the last year it was satisfactory to record that on the combined undertakings there had been an addition of over 90 000 lamps connected and an increase in sales of over half a million units, and the cost of generation had been materially reduced since the delivery of the new plant.

After dealing with the accounts, an abstract of which we gave in our last issue, the Chairman referred to the corporation tax. He said that up to the present the company, being a public utility company, was exempt from this tax, but after December it became operative upon them. Having regard to the fact that they were subject to a fixed rate of charge, it appeared extremely unfair that electricity companies should be saddled with the tax, and they were taking joint steps to endeavour to get a further exemption.

Harrow Electric Light and Power.

Mr. J. N. Stuart presided at the annual meeting of the Harrow Electric Light and Power Company. The balance to the credit of the net revenue account, including the sum of £662 brought forward from 1920, and after deducting debenture interest and the interim dividend on the preference shares, was £3 674, which the directors recommended should be dealt with as follows: in payment of the final dividend on the preference shares, £375; in payment of a dividend on the ordinary shares at the rate of 7 per cent. per annum, £2 333, leaving a balance to be carried forward of £965. The chairman said there had been an addition of about 200 new consumers during the year, a record number, and an increase in the sales of electricity of 87 000 units above the last or any previous year, while the revenue had increased £3 180 above that of 1920. The gross profit was £9 530, against £7 765, or 8½ per cent. on the capital expenditure. During the year they had substituted for the old steam-driven plant three rotary converters, driven off the bulk supply obtained from the North Metropolitan Company. The new plant purchased cost £7 500, but this had been met out of the sums put aside for depreciation in previous years, to which £5 000 was added during the current year. A further generating set was on order, to be in readiness for next winter's load, and the heavy work of strengthening their mains was continuing to be carried out. During the past few months there had been a few short interruptions of the supply, due to old bitumen cables laid many years ago breaking down. The company had for some time past been gradually replacing these cables with new paper-insulated and steel-armoured cable, which had proved to be more durable in Harrow soil.

London and Suburban Traction.

In moving the adoption of the report and accounts at the annual meeting of the London and Suburban Traction Company last week, Lord Ashfield, who presided, said that the directors were able to recommend a dividend on the five per cent. cumulative preference shares for the first time since 1917 at the rate of 3½ per cent. in respect of arrears, being the balance of 2½ per cent. for 1917 and 1 per cent. on account of 1918. This improved position of the company was due to the increased net earnings of the tramway and omnibus companies in which they were interested. The traffic receipts of the tramways increased from £1 566 000 in 1920 to £1 722 000 in 1921. The operating expenses were only slightly higher, with the result that the operating balance of the three companies was £350 000, compared with £214 000. The passengers carried were 190 000 000 in 1921, being nearly 17 000 000 less than in the previous year. This falling off was largely due to the general trade depression and the prolonged coal strike. The fact that, notwithstanding the fall in traffic, the net earnings showed a substantial improvement was attributable to the increase in fares which took place in 1920, and the considerable economies which had been effected in general working. The decrease in wages which took place towards the latter part of the year, the introduction of labour-saving and power-saving devices, and generally improved methods of working had not only counteracted the loss in traffic, but had increased the net income of the companies.

Oxford Electric.

Presiding over the meeting of the Oxford Electric Company on Friday, the chairman (Sir Henry Mance) congratulated the shareholders on the company's increased revenue. They were maintaining the dividend at 5 per cent. and placing £3 000 to reserve, against £2 000 last year. The long-continued coal strike cost the company, one way and another, £4 000 to £5 000. Up to the present no steps had been taken to form an electrical area in their part of England. They occupied an isolated position, and he did not think there was any probability of their being approached by the Electricity Commissioners for a considerable time, but any suggestions made to them in the future would receive the directors' careful consideration. If the Commissioners should desire, in the course of a few years, to supply them with electricity at a cheaper rate than the company could generate it themselves, they would naturally wish to become their customers, but if this were not to be they would have to take timely precautions to provide themselves with generating plant to meet the increasing demand. He took it that the company would always remain the distributing agency, and so, as the demand increased, they would have to go on extending their mains.

Electrical Distribution of Yorkshire.

Presiding at the annual meeting of the Electrical Distribution of Yorkshire (Ltd.) last week, the chairman, Mr. R. W. Wickham, said that during the year over £40 000 had been expended in capital extensions, and in order to cover their commitments to bankers, and to provide for further extensions, it was proposed to issue about 50 000 shares of £1 each, being the balance of the authorised nominal capital, and, as they had close business relations with the Yorkshire Electric Power Company, it was proposed to extend the privilege of taking an interest in the distribution company to shareholders of the power company. This was the tenth year in succession for which a dividend of 6 per cent., free of tax, had been paid. The increase in the rate of income tax had, in effect, meant an increase in the rate of dividends, but the board had carefully reviewed the position established by the company, and intended, unless the unexpected happened, to recommend a higher rate of dividend next year. An abstract of the accounts was given in The Electrician of March 3.

The American Telephone & Telegraph Company announce a quarterly dividend of 2¼ dollars.

The Mirrless Watson Company recommend a dividend of 10 per cent. and a bonus of 2½ per cent., less tax.

The Shawinigan Water & Power Company have declared a dividend of 1¾ per cent. for the quarter ending March 31.

The directors of Stothert & Pitt announce an interim dividend of 1s. per share, tax free, on the ordinary shares.

The Midland Electric Corporation for Power Distribution announce a dividend of 6 per cent., making 10 per cent. for the year 1921.

The Mississippi River Power Company have declared a dividend of 1½ per cent. on the preferred stock, payable to holders of stock on the 17th inst.

A meeting of the Argentine Tramways & Power Company is to be held on the 22nd inst. to consider a scheme for the reorganisation of the capital of the company.

The Brazilian Traction, Light and Power Company have declared a quarterly dividend of 1½ per cent. on the cumulative preference shares to holders of record on March 15.

The Manilla Electric Corporation announce a quarterly dividend of 1½ per cent. ($1.50 per share) on the common stock, payable in New York to stockholders of record on the 20th inst.

The directors of the Direct Spanish Telegraph Company recommend dividends for 1921 of 10 per cent. on the preference shares, less tax, and 10 per cent. on the ordinary shares, tax free.

Uxbridge and District Electric Supply Company recommend a dividend of 8 per cent. on the ordinary shares for the year, against 4 per cent. last year. The sum of £10 000 is placed to depreciation and £393 carried forward.

The following companies will be struck off the Register of Joint Stock Companies unless cause to the contrary is shown before June 10:—Bright's Light & Power, Drycells, Electric Floor Machine Company, London & Provincial Electric Company.

British Insulated and Helsby Cables announce a further dividend on the ordinary shares of 6¼ per cent. and a bonus of 5 per cent., making 15 per cent for 1921. The sum of £35 000 has been placed to reserve for depreciation, leaving £362 000 to be carried forward.

The National Trust Company, 18, King-street East, Toronto, as trustee for the 5 per cent. first mortgage thirty-year gold bonds of the Electrical Development of Ontario, is prepared to receive up to April 11 offers for the sale of the bonds to an extent to absorb $78 205.

The report for 1921 of the Commonwealth Edison Company shows gross income of $9 527 330, less deductions $1 326 503, leaving $8 200 827. Interest on funded debt amounted to $2 834 042, leaving $5 366 785. Dividends paid absorbed $4 307 126, leaving $1 059 659 to be carried forward.

The accounts of the Mackay Companies for the year to Feb. 1st show income from investments $4309 252. Dividends paid absorbed $4 180 340. Operating expenses, including Federal income-tax, transfer agents, salaries, etc., amounted to $82 771, leaving $46 141 to be carried forward.

The net profit for 1921 of the Guernsey Railway, after allowing for depreciation, renewals, income-tax, and various other charges, was £2 255. After providing for the preference dividend, the directors recommend a dividend of 7½ on the ordinary shares, leaving £602 to be carried forward.

The directors of the Canadian General Electric Company, in Toronto, have declared a quarterly dividend on the common stock of 2 per cent. for the three months ending the 31st inst., being at the rate of 8 per cent. per annum, and a dividend on the preference stock of 3½ per cent. for the six months ending the 31st inst., being at the rate of 7 per cent. per annum.

Thos. W. Ward have decided not to pay an interim dividend on the ordinary shares for the half-year ended December. The directors state that various matters affecting taxation accounts remain to be settled, and having regard to the depression in trade they consider this course to be in the best interests of the company. Quarterly dividends at the rate of 5 per cent. per annum on first and second preference and employees' shares will be paid on the 31st inst.

The directors of Stewarts & Lloyds, after setting aside £70 000 for depreciation and providing for income and corporation taxes, recommend, subject to audit, dividends for the half-year on the 6 per cent. preference shares and 10 per cent. preferred ordinary shares, both less tax, on the deferred shares (fully paid) 2s., and a bonus of 6d. per share for the year, both free of tax, and on the deferred shares, fully paid from Sept. 30, 1921, 1s. 6d. and bonus of 4½d., both free of tax. The sum of £230 000 has been placed to reserve, £10 000 to employees' benefit reserve, leaving £180 000 to be carried forward.

The accounts of Davis & Timmins for 1921 show a loss of £12 850, due to depreciation in the value of stock. A claim for repayment of excess profits duty in regard to this depreciation has been made to the Inland Revenue authorities, but no amount in respect of the claim has been taken credit for in the present accounts. The balance

brought in was £53 535. Deducting loss, interim dividend on preference shares and on ordinary shares at 6 per cent. per annum for the half-year to June 30, and after placing £15 585 to income tax account in respect of 1920, there remains £21 891. The directors propose to pay a balance dividend at 10 per cent. per annum on the ordinary shares for the half-year to Dec. 31, making 8 per cent. for the year, free of tax, carrying forward, subject to taxation, £17 741.

The net profit of FERGUSON PAILIN for the year ended Nov. 30 was £19 638, making, with £7 937 brought in, £27 575. The directors recommend a further dividend of 4½ per cent. on the preference shares, making 7 per cent. for the year, and a further dividend of 9½ per cent. on the ordinary shares, making 13 per cent. for the year. The sum of £2 000 has been placed to reserve and £15 264 carried forward, subject to excess profits duty for two years to Nov. 30, 1920, and corporation tax for two years to Nov. 30, 1921.

The accounts of BRUCE, PEEBLES AND CO. for 1921 show a profit, including balance brought in, of £119 616. The sum of £82 221 has been placed to reserve, leaving £37 395 to be carried forward. The directors recommend a dividend of 7½ per cent. per annum on the preference shares for the half-year to December 31st, less tax, with a further dividend of 2½ per cent. for the year, less tax, making the full dividend of 10 per cent., and a dividend on the ordinary shares for the year of 10 per cent., plus bonus of 5 per cent., less tax, leaving £7 919 to be carried forward.

Negotiations are taking place for the sale of the TORONTO POWER COMPANY to the Hydro-Electric Power Commission of Ontario. There has been competition between the company and the Commission. The shareholders of the Toronto Street Railway Company (who at present control the Power Company), realising the effect of the competition upon the company's revenues, have approved the proposed agreement. If the Power Company debenture-holders also acquiesce they will, in the event of the sale being completed, exchange their existing guarantee for that of the Commission, coupled with an unconditional guarantee from the Government of Ontario.

Electrical Imports and Exports.

IMPORTS.—The following are official values of electrical machinery, apparatus, and material imported into this country (*a*) during February, 1922, and (*b*) the aggregate figures from Jan. 1 to Feb. 28, with increase or decrease compared with corresponding periods of 1921 :—

Electrical machinery, (*a*) £198 163 (increase £134 101), (*b*) £245 034 (increase £69 971); telegraph and telephone cables, submarine, nil: other than submarine, (*a*) £2 600 (decrease £7 069), (*b*) £6 097) (decrease £19 423); telegraph and telephone apparatus, (*a*) £8 629 (decrease £17 248), (*b*) £25 824 (decrease £28 869); other electrical wires and cables, rubber insulated, (*a*) £3 566 (decrease £41), (*b*) £8 173 (increase £2 088); with other insulations, (*a*) £4 707 (decrease £5 560), (*b*) £8 240 (decrease £11 387); carbons, (*a*) £2 485 (decrease £7 833), (*b*) £5 133 (decrease £23 293); glow lamps, (*a*) £22 127 (increase £474), (*b*) £41 163 (decrease £209); arc lamps and electric searchlights, (*a*) nil (decrease £829), (*b*) nil (decrease £4 731); parts of arc lamps and searchlights (other than carbons), (*a*) £571 (decrease £3 032), (*b*) £1 138 (increase £2 623); batteries, (*a*) £3 365 (decrease £8 494), (*b*) £7 015 (decrease £22 608); electrical instruments, commercial and scientific, and electricity meters, (*a*) £4 810 (decrease £20 886), (*b*) £10 643 (decrease £31 382); switchboards, (*a*) £20 (decrease £932), (*b*) £965 decrease £205); other electrical goods and apparatus, (*a*) £36 561 (decrease £56 343), (*b*) £86 761 (decrease £116 084). Total of electrical machinery, apparatus, and material (other than uninsulated wire), (*a*) £287 605 (increase £6 308), (*b*) £446 186 (decrease £188 755).

EXPORTS.—The exports of electrical machinery, apparatus, and material (*a*) during February, 1922, and (*b*) from Jan. 1 to Feb. 28, with increase or decrease compared with corresponding periods of 1921, were as follows :—

Electrical machinery, (*a*) £384 015 (decrease £8 511), (*b*) £951 279 (increase £113 621); including railway and tramway motors, (*a*) £15 178 (increase £2 259), (*b*) £31 056 (decrease £15 250); other generators and motors, (*a*) £177 240 (decrease £58 393), (*b*) £521 739 (increase £42 709); and electrical machinery unenumerated, (*a*) £191 597 (increase £47 623), (*b*) £398 484 (increase £86 062); telegraph and telephone cables, submarine, (*a*) £61 084 (decrease £45 667), (*b*) £64 478 (decrease £135 772); other than submarine, (*a*) £34 234 (decrease £117 917), (*b*) £115 897 (decrease £233 736); telegraph and telephone apparatus, (*a*) £139 732 (decrease £10 971), (*b*) £360 803 (increase £68 247); other electrical wires and cables, rubber insulated, (*a*) £40 926 (decrease £102 854), (*b*) £97 046 (decrease £232 041); with other insulations, (*a*) £114 983 (decrease £60 432), (*b*) £238 949 (decrease £143 409); carbons, (*a*) £2 363 (decrease £9 788), (*b*) £9 106 (decrease £21 820); glow lamps, (*a*) £29 583 (decrease £16 192), (*b*) £58 593 (decrease £30 047); arc lamps and searchlights, (*a*) £141 (decrease £994), (*b*) £1 092 (decrease £1 338); parts of arc lamps and searchlights other than carbons), (*a*) £244 (decrease £1 042), (*b*) £781 (decrease £1 169); batteries, (*a*) £24 999 (decrease £48 951), (*b*) £58 593 (decrease £30 047); electrical instruments, commercial and scientific, and electricity meters, (*a*) £35 728 (increase £4 755), (*b*) £72 194 (decrease £7 900); swtichboards, (*a*) £24 389 (increase £14 883), (*b*) £110 364 (increase £78 450); other electrical goods and apparatus, (*a*) £100 356 (decrease £119 988), (*b*) £223 276 (decrease £245 627). Total of electrical machinery, material, and apparatus, other than uninsulated wire, (*a*) £992 778 (decrease £523 549), (*b*) £2 362 251 (decrease £894 106).

Tenders Invited and Accepted.

UNITED KINGDOM.

LONDONDERRY CORPORATION. March 14.—1 000 kW rotary converter equipment with switchgear, panels, &c. Specification from the City Electrical Engineer.

BELFAST GUARDIANS. March 21.—Wiring and fitting fever hospital. Specification from the Clerk at the Workhouse.

BRIGHTON GUARDIANS. March 21.—Electrical fittings. Particulars from the Clerk, Guardians' Office, Prince's-street.

PORTSMOUTH GUARDIANS. March 22.—Three months' supply of electrical fittings. Particulars from the Clerk, Mr. H. C. Morrell, Guardians' Offices, St. Michael's-road.

DUBLIN GUARDIANS. March 28.—Electric lift at Brook-street Infirmary. Specification from the Clerk, Brook-street, Kennington-road, London, S.E.

COMMISSIONERS OF H.M. WORKS, &c. April 12.—Electrical engineering labour-in-daywork in Leeds district.

EDINBURGH CORPORATION. April 15.—Converting plant for lighting and traction and d.c. switchgear for Portobello station. Specification, &c., from Sir A. B. W. Kennedy, 17, Victoria-street, Westminster, S.W. 1.

BATLEY CO-OPERATIVE SOCIETY.—Electric light installation. Specification from the Secretary.

SOUTH AFRICA.

DURBAN ELECTRICAL DEPARTMENT. Postponed from Jan. 18 to April 19.—*Supply of 372 consumers' W-hour meters, including 37 d.c. meters; 275 single-phase, 50-cycle, induction-type meters; and 60 three-phase, 50-cycle, induction-type a.c. meters for unbalanced loads.

MUNICIPAL COUNCIL OF JOHANNESBURG. April 12.—*Supply and delivery of six (or more) h.t. metal cubicles suitable for 3 000-3 300 V two phase, 50 cycles, 200 A normal working load, and for, alternatively, similar equipment for 500 A. (Contract 887.) Fifteen miles 0 000 S.W.G. (0·4 in. diameter) round section hard-drawn trolley wire of a conductivity not less than 98 per cent. Mathieson's standard on stout wooden drums, each containing half-mile of wire. The drums are to have a hole 3 in. in diameter through centre for mounting on bar for rolling off. Tenders are to be based on electrolytic copper at £69 per 2 240 lb.

WIMBLEDON Corporation have accepted the tender of the English Electric Company for h.t. switchgear for Raynes Park sub-station, £859 10s.

STOCKTON-ON-TEES Corporation have accepted the tender of British Insulated & Helsby Cables, Ltd., for e.h.t., l.t. and pilot cables, £2 968 14s.

BIRKENHEAD Corporation have accepted the tenders for the Pirelli General Cable Works for 4-core cable, £1 007 15s.; and the Macintosh Cable Company for single cable, £1 183 10s.

KENSINGTON (London) Borough Council have accepted the tender of Rawlings Bros. (lowest tender received) for wiring and fitting the Town Hall. Four tenders were received, the highest being £1 473 5s.

WALLASEY Corporation have accepted the tenders of United Water Softeners, Ltd., for water-treating plant for the electricity department, £1 368; and Metropolitan-Vickers Electrical Company for switchgear, £2 600 10s.

HAMMERSMITH Borough Council have accepted the tender of the Hackbridge Cable Company for 1 000yds. of 7/22 twin cable for the Wormholt Housing Estate at £88 10s. Eight tenders were received, the highest being £111.

TODMORDEN Corporation have accepted the tenders of General Electric Company for switchgear and cubicle, £555; New Switchgear Company for sheet steel cubicle, £191; and Brush Enginering Company for two transformers, £1 080 19s.

STEPNEY Borough Council have accepted the following tenders :—Maclennan & Company, for 1 000 rolls 1 in. white tape, at £97 10s. (three tenders were submitted, the highest being £113 15s.); W. T. Henley's Telegraph Works Company, for 500 gallons of resin oil, at £162 10s.; A. Reyrolle & Company, for meters, at £166.

BLACKPOOL Tramways Committee have accepted the tender of the General Electric Company for the supply of one 1 000 kW rotary converter, and that of the English Electric Company for two 300 kW rotary converters, as well as the tender of Higginbottom & Mannock for the supply of one 25-ton overhead electric travelling crane.

LEEDS Corporation have accepted the following tenders :—Tramways Supplies, Ltd., one mile of trolley wire; J. W. Hinchliffe, 45 H.P. motor; English Electric Company, ten partial electric equipments for tramcars; British Thomson-Houston Company & Ferguson, Pailin, Ltd., switchgear; F. W. Brackett & Company, circulating water screens, £1 020; Enfield Ediswan Cable Works, cables, £12 434; W. T. Henley's Telegraph Works Company, cables, £10 975.

MANCHESTER Corporation have accepted the following tenders :—Hall Bros., wiring Embden-street, Bangor-street, and Every-street schools; Bruce Peebles & Company, 1 500 kW motor converter; Ferguson, Pailin, Ltd., l.t. switchgear; British Insulated & Helsby Cables, Ltd., and Pirelli General Cable Works, Ltd., cable; Holt & Willett, one ton electric hoist for Barton power station; Metropolitan-Vickers Electrical Company, induction motor generator; J. V. Pyatt, wiring ninety houses.

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* *Particulars from the Department of Overseas Trade.*

Foreign Notes.

An important electric power station has just been opened at Motala, in Central Sweden, with a capacity of 21 000 kW.

It is reported that the Uruguayan Government has received an offer from an Austrian bank to supply TRAMWAY ELECTRIFICATION MATERIAL IN EXCHANGE FOR WOOL.

In consequence of the prolonged drought in Northern Italy, which caused a shortage of hydro-electric power, many manufacturers are reported to be using brown coal for generating electricity.

A 5 000 c.p. light on a tower 75ft high has been installed at Cuatro Vientos Aerodrome, near Madrid. It will flash the Morse code for H T I when the arrival of aeroplanes by night is expected.

The business of the Cie. des Forge et Acieries Electriques Paul Girod has been amalgamated with that of the Société d'Electrochimie et d'Electrometallurgie, of Paris, and in consequence the capital of the latter company has been increased to 36 400 000 frs.

Interesting tests were recently carried out by the Southern Californian Edison Company in connection with the proposal to convert their two twenty-four-mile Big Creek transmission lines from 150 000 to 220 000V. Only about twenty-seven miles of line were tested, and although limited in duration, the "Electrical World" reports that the results of the tests show that only a relatively simple modification of the lines will be needed to meet the new conditions. The original insulation consisted of nine 10in. cap and pin suspension units, but it has been concluded that eleven units will be required at the higher voltage. In the experiments shield rings were installed at the bottom of all strings and 280 kV applied, and one flashover occurred under rainy conditions. As only one bank of high voltage transformers was available, it was not possible to transmit power, the lines being merely energised.

Owing to the cheap power available and the transport facilities available on the Rhine, both Alsace and Lorraine are becoming popular as industrial centres. Many French and foreign firms propose to erect new metallurgical and engineering works. The reorganisation of electricity supply is being carried out in all the districts, so that the surplus electrical energy of one may be utilised by the other. The Société Electrique de Sidérurgie Lorraine, with a capital of eight million francs, has been formed by the principal metallurgical companies. A 65 000 V transmission system will supply Mont St. Martin, Micheville, Algrange, the Moselle Valley above Thionville as far as the Orne Valley, Auboué, Landres, Réhon, Longwy and Mont. St. Martin. It will be connected with the State system along the north-eastern frontier and with the La Houve system, which is being constructed by the Société Alsacienne et Lorraine d'Electricité (Salec).

Catalogues, Price Lists, &c.

The A.C.E.C. (Atéliers de Constructions Electriques de Charleroi) have issued their March stock list of motors and dynamos.

An up-to-date price list giving particulars and illustrations of the "Helios" electric kettles and other table devices has just been published by the manufacturers, Wm. Soutter & Sons.

A new catalogue (List W3) of wireless apparatus for reception and transmission has been received from H W. Sullivan. The booklet, which consists of sixty-four pages, is well produced and fully illustrated.

Pamphlet F2 694, recently issued by the General Electric Company, contains details and illustrations of English alabaster bowls of various designs for semi-indirect lighting. This firm are also circulating Leaflet No. L2 715, giving revised prices of Wittom primary cells and parts appearing in L (2) section of their 1920 catalogue.

Apart from their large sale of miners' electric safety lamps and accumulators, Oldham & Son, Ltd., carry on an extensive business in accumulators for motor-bus and coach lighting, and their accumulators for this purpose have now been exclusively adopted by many of the most prominent motor vehicle builders and proprietors for starting, lighting and ignition purposes. Full particulars of the various types of accumulator manufactured by the firm are contained in an illustrated booklet (Price List No. 124) lately published.

A new and third British edition of the Michell Bearing Book has recently been brought out. The booklet was first published in 1916 for the purpose of explaining, in simple language, how the oil film in a bearing can be made to carry the highest possible load with the least frictional resistance. It is not a trade catalogue, but rather a short introduction to the modern science of lubrication, illustrated by practical examples. Supplements to this publication, dealing more specifically with particular applications of the principles described, can also be obtained on application to the firm.

The Record Electrical Company inform us that they are now manufacturing a complete series of Cirscale instruments, the standard sizes being 2¾in., 4in., 6in., 8in., and 16in. dials, and the scale length in each case more than twice the dial diameter. Apart from the increased scale length, the "Cirscale" is, they claim, in all respects superior to the usual bi-polar type, the magnetic system which is astatic rendering the instrument indispensable where strong magnetic fields are present, the error being less than 1-12 that of the ordinary moving coil instrument. The revised prices are only a little in excess of the ordinary moving coil type. The company have also developed a miniature Cirscale instrument for use in confined spaces, such as motor-cars, airships, submarines, &c.

COMMERCIAL INTELLIGENCE.

County Court Judgments.

[Note.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

COX ELECTRIC ENGINEERING COMPANY, 21, Third-avenue, Bordesley Green, electrical engineers. £14 11s. 6d. Jan. 12.

DE COSTER & COMPANY, LTD., registered office, 102, Boundary-lane, St. John's Wood, electrical engineers. £30 14s. 1d. Jan. 11.

MALLINSON, H. E., care of Ipswich Corporation, Ipswich, electrical engineer. £34 18s. 8d. Jan. 11.

NORVALL, G., & COMPANY, 242, Goswell-road, E.C., electrical engineers. £57 2s. 5d. Oct. 3.

STEEL, GEORGE, & COMPANY, Sprowston-road, Forest Gate, electrical engineers. £18 18s. 7d. Jan. 11.

TILLOTSON, Mr. S., 52, Kennington Park-road, S.E., electrical contractor. £22 16s. 5d. Jan. 13.

VENN BROTHERS, 39, Turnham Green-terrace, Chiswick, electrical engineers. £19 11s. 9d. Jan. 10.

Deed of Arrangement.

JOWETT, Charles Eric (trading as C. E. JOWETT & COMPANY), Lowther-arcade, Harrogate, electrical engineer. Filed March 10. Trustee, C. H. Baker, 1, Albion-street, Leeds. Liabilities unsecured, £750; assets, less secured claims, £294.

Mortgages and Charges on Limited Companies.

[Note.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

CORDOBA LIGHT, POWER & TRACTION COMPANY, LTD., London, E.C. Registered Feb. 25. Trust deed dated Feb. 10, 1922 (supplemental to trust deed registered March 13, 1909), securing £572 602 debenture stock, making with the sum of £427 398 debenture stock outstanding under trust deed registered March 13, 1909, £1 000 000; general charge (with special provisions in regard to certain shares held by company). *£429 500. Jan. 3, 1922.

HENDERSON & THORNTON, LTD., London, W.C., electrical apparatus dealers, &c. Registered March 4, £500 debentures; general charge.

INSULATING PRODUCTS, LTD., East Boldon. Registered Feb. 27, £8 000 debentures, to Branch Nominees, Ltd., 15, Bishopsgate, E.C.; general charge. *——. Jan. 2, 1922.

KEMP (H. S.) & COMPANY, LTD., London, W.C., electrical engineers. Registered March 2, £300 debentures, to Belco, Ltd., Windsor House, Kingsway, electrical engineers; general charge.

Satisfaction.

HEXHAM & DISTRICT ELECTRIC SUPPLY COMPANY, LTD. Satisfaction registered March 7, £10 000, registered Feb. 17, 1921.

Private Meetings.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

DUROLITE MANUFACTURING COMPANY, LTD. (in voluntary liquidation), Hardinge-lane, Penge. A meeting of creditors was held last week. The liquidator said that the liabilities to unsecured creditors amounted to £2 774, while there were partly-secured creditors for £891, the security held being valued at £25. The assets consisted of cash in hand £17, furniture £135, and there were 3 000 ordinary shares in a company called Clydo, Ltd., but it was uncertain what the shares would realise, and the liquidator said that it would be safe to assume for the time being that the assets were somewhere between £300 and £400. It was said that the Clydo Company had been run in conjunction with the Durolite Company, and the patents of the Clydo machines, which consisted of an illuminating sign, were believed

to be of very considerable value. In the result it was decided that the liquidation should be left in the hands of Mr. H. C. Merrett with a committee of inspection.

NOYES, STOCKWELL & COMPANY, LTD., Lennox House, Norfolk-street, Strand, London, W.C. A meeting of creditors held recently confirmed the voluntary liquidation of the company, with Mr. A. W. Heale as liquidator. Total liabilities were reported as £8 876, and net assets £647. The liabilities included £1 500 due to English trade creditors, while £4 125 was owing to the General Ordnance Company, Ltd., of New York. The bank were partly-secured creditors, as also were a guarantee corporation, who held tractors as part security. The company was formed in January, 1920, with a nominal capital of £5 000, and it took over certain concessions, which were paid for by the issue of shares. It was believed that the company had never been very successful, and latterly had traded at a heavy loss.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Company Winding-up Voluntarily.

PORTPATRICK ELECTRIC SUPPLY COMPANY (THE), LTD. James Purves appointed liquidator. Meeting of creditors at the Dunskey Estates Office, Portpatrick, on March 24, 1922, at 12 noon.

Bankruptcy Information.

HALLETT, Graham Moore, 7, King-st., Frome, co. Somerset, electrical engineer. Receiving order, March 7. Debtor's petition. First meeting, March 22, 12 noon, 26, Baldwin-street, Bristol. Public examination, March 28, 11.45 a.m., County Court Offices, Frome.

WILLIAMS, Aneurin Tudor, and BEVAN, William John, trading as the ELECTRICAL & GENERAL ENGINEERING COMPANY, 49, Commercial-street, Aberdare, electrical engineers. First meeting, March 22, 11.30 a.m., 34, Park-place, Cardiff. Public examination, April 21, 10.30 a.m., Temperance Hall, Aberdare.

Notices of Dividends.

WATKINSON, Matthew, WATKINSON, Harold, and WATKINSON, Arthur (trading as WATT & CO.), 22 and 24, Palmer-road, Sheffield, electrical and mechanical engineers. Amount per £, 6s. 2d., first and final. Payable, March 20, Parkin & Company, 36, Bank-street, Sheffield.

WORTHINGTON, Vincent Broughton, Ellesmere-yard, Walkden, co. Lancaster, electrical and mechanical engineer. Amount per £, 5¾d., first and final. Payable, March 20, Official Receiver's Offices, Byrom-street, Manchester.

Notices of Intended Dividends.

DAVIS, William Aaron, 14, Basinghall-street, Leeds, electrical engineer. Last day for receiving proofs, March 29. Trustee, H. C. Bowling, 24, Bond-street, Leeds.

OWEN, Joseph (trading as J. OWEN & SONS), 186, Westcombe-hill, and 3, The Grove, Greenwich, electrical engineer. Last day for receiving proofs, April 3. Trustee, Official Receiver, 29, Russell-square, W.C. 1.

RAWSTHORNE, Thomas, 67B, Paradise-street, West Bromwich, co. Stafford, electrical engineer. Last day for receiving proofs, March 25. Trustee, E. E. Deane, Ruskin Chambers, 191, Corporation-street Birmingham.

Application for Discharge.

KERSHAW, Arthur, and WOOD, Charles Herbert, carrying on business in partnership together at 9, Bradford-road, Dewsbury, under the style of KERSHAW & WOOD, electrical engineers, &c. Hearing, April 5, at 11 a.m., County Court House, Dewsbury.

Partnership Dissolved.

GOSLING, Albert Newland, and ARNALL, Jabez Christopher, electrical and mechanical engineers, 1, Thomas-street, Smethwick, co. Stafford, under the style of J. C. ARNALL & COMPANY, by mutual consent, as from March 8, 1922.

Bankruptcy Proceedings.

GOSS, Frederick Charles, 64, Gloucester-road, Bishopston, late 71, North-road, Bishopston, and 32, Windsor-road, St. Andrew's Park, Bishopston, electrical engineer. The receiving order in this matter was made on Feb. 28, on debtor's own petition. The statement of affairs shows liabilities of £1 291, while the net assets are estimated to realise £268, or a deficiency of £1 022. Debtor attributes his failure to slump in trade, depreciation in value of stock, expenses in connection with agency for automatic lighting plant, and expenses in connection with the illness of his wife. He commenced business in May, 1919, as an electrical engineer in partnership with another. In October, 1919, the partnership was dissolved, debtor taking over the assets and liabilities. Subsequently debtor traded on his own account, and for the first two years the business was fairly successful, but during the last year, by reason of the slump in trade and falling prices, he traded at a loss. On Feb. 8 a meeting of creditors was held, when it was resolved that efforts should be made to realise sufficient from the assets to provide a composition of 4s. in the £, but as the creditors were not unanimous, the petition was filed. Debtor became aware of his position in August last.

INCE, Arthur Courtenay (trading as the NEWCASTLE ELECTRICAL ENGINEERING COMPANY, formerly the TYNE ELECTRICAL INDUSTRIES, in co-partnership with another person), 21, Fenkle-street, Newcastle-on-Tyne, electrical contractor. At his public examination last week debtor stated that he was born in Barbados, West Indies, and came to England in July, 1915, to enlist. He was in the Army until November, 1919, and then had between £500 and £600. He commenced the Newcastle Electrical Engineering Company in October, 1920, with another man. In May, 1921, this man left the business, and on Aug. 16, 1921, debtor was joined by another man. At that time the business was in difficulties. The name was changed to the Tyne Electrical Industries, and debtor took over responsibility for the debts of the old firm. Debtor attributed his failure to bad trade and losses on trading. He stated further that he had very little experience of business in this country and had to depend upon others.

MAIDMENT, Percy Charles, builder and electrician, 13, Beauchamp-place, S.W. The first meeting of creditors under a receiving order made against this debtor was held at the London Bankruptcy Court before Mr. Vyvyan, Official Receiver. The debtor, in a preliminary examination, had stated that he began business as a builder and electrical engineer in partnership in 1916 at 164, Sloane-street, S.W. A few months later, owing to disagreements, the partnership was dissolved, the debtor paying his partner £4 250 and assuming the liabilities. To enable him to pay out his partner he borrowed £3 600 from bankers, £1 000 from his father, and £600 from a brother. He continued the business at a loss until March, 1921, and then sold it for £4 500, out of which he repaid his loans. He afterwards took premises at 13, Beauchamp-place, and started a similar business, which he carried on until Jan. 26, when the Sheriff took possession and sold his effects. The debtor, who said he had done a good business in electrical apparatus, attributed his failure to the general depression in trade. He estimated his liabilities at £1 658, against assets £157. The case was left with the Official Receiver for administration in bankruptcy.

PUGH, Herbert John (trading as H. J. PUGH & COMPANY), electrical engineer, 38, Broadway-parade, Crouch End, N. This debtor, who failed in December last, attended at the London Bankruptcy Court last week for public examination on a statement of affairs showing unsecured debts of £470 and no assets of value. Debtor said that he began business at 1, Hornsey-rise, in May, 1914, removing to 37, Broadway-parade, Crouch End, in the following November. He was joined soon afterwards by a partner, who retired in the middle of 1916, and he had since traded alone. He took additional premises at 38, Broadway-parade in October, 1917, and twelve months later gave up No. 37. In February, 1921, he took premises at 76, Fore-street, Edmonton, to which he transferred £100 of his stock, but the business there was unsuccessful, and two months later he closed it and disposed of the remaining stock from a stall in Club-row, E. His failure was due to bad trade and the stoppage of his business during the execution of repairs to the premises. The examination was concluded.

Prices of Metals, Chemicals, &c.

TUESDAY, MARCH 14.

		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£64 10 0	£2 5 0	—
Electro Wirebars ..	,,	£68 0 0	£1 10 0	—
H.C wire, basis	per lb.	0s. $10\frac{5}{16}$d.	$\frac{3}{16}$d.	—
Sheet	,,	0s. $10\frac{11}{16}$d.	1d.	—
Phosphor Bronze Wire (Telephone) Phosphor-bronze wire, basis	,,	1s. $2\frac{5}{16}$d.	$\frac{3}{16}$d.	—
Brass 60/40—				
Rod, basis	,,	0s. 7¼d.	—	—
Sheet, basis	,,	0s. 9¾d.	—	—
Wire, basis.....	,,	0s. 10¼d.	—	—
Pig Iron—				
Cleveland Warrants .	per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 SWG	,,	£19 0 0	—	—
Lead Pig—				
English	,,	£22 5 0	—	—
Foreign or Colonial ..	,,	£20 17 6	£0 2 6	—
Tin—				
Ingot	,,	£143 12 6	—	£1 7 6
Wire, basis	per lb.	2s. 0d.	—	—
Aluminium Ingots	per ton	£120 0 0	—	—
Spelter	per ton	£25 12 6	£0 10 0	—
Mercury	per bottle	£11 0 0	—	£1 0 0

Salammoniac.—Per cwt. 65s.-60s.
Sulphur (Flowers).—Ton £10 10s.
,, (Roll-Brimstone).—Per ton £10 10s.
Sodium Bichromate.—Per lb. 5¾d.
Sodium Chlorate.—Per lb. 3½d.
Sulphuric Acid (Pyrites, 168°).—Per ton £9 17s. 6d.
Copper Sulphate.—Per ton £27
Boric Acid (Crystals).—Per ton £60
Rubber.—Para fine, 11d.; plantation 1st latex, 8d

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

New Companies.

General Electro-Motives.

General Electro-Motives, Ltd. (180 239). Private company. Reg. March 10. Capital, £5,000 in £1 shares. To acquire the benefit of an agreement between Electromobile, Ltd., and J. A. Popplewell and F. E. Popplewell, and to carry on the business of electrical, mechanical, and general engineers, &c. Life directors: J. A. Popplewell and F. E. Popplewell. Registered office: 62, Hunslet-road, Leeds.

Olso-Light.

Olso-Light Company, Ltd. (180 211). Private company. Reg. March 9. Capital, £6 000 in £1 shares. Manufacturers, importers, and shippers of and dealers in merchandise, including electric lighting and heating requisites, &c. First directors: J. O'Malley-Davies (chairman and managing director) and C. B. Liddell. Registered office: 47, Victoria-street, S.W. 1.

Radio-Constructa, Ltd.

Radio-Constructa, Ltd. (180 126). Private company. Registered March 6. Capital, £500 in £1 shares. To adopt an agreement with G. H. Moody and to manufacture and deal in wireless telegraphic and telephonic apparatus and appliances and electrical apparatus and accessories, &c. First directors: H. D. Butler and G. H. Moody. Solicitor: W. I. Thomas, 32, Chancery-lane, W.C.

Unwin-Soar Agency.

Unwin-Soar Agency, Ltd. (180 191). Private company. Reg. March 8. Capital, £2 500 in £1 shares. Mechanical and electrical engineers, iron and steel workers, &c. Life directors: F. Unwin and M. Soar, Housley Park. Registered office: Orchard-chambers, Church-street, Sheffield.

Webb & Wilson.

Webb & Wilson, Ltd. (180 257). Private company. Reg. March 10. Capital, £1 000 in £1 shares. Constructional, mechanical, electrical, heating, lighting, and ventilating engineers and consultants, &c. First directors: G. L. Wilson and H. E. Webb. Secretary, G. F. Broadway. Registered office: 523, High-road, Tottenham, N. 17.

Growth of U.S. Industrial Power Load.

The rapid growth of the industrial power load in the United States is proved by some figures given in a recent issue of the "Electrical World." On Jan. 1, 1915, the number of stationary motors in use was 575 000, with a connected load of 6 100 000 h.p.; but by January, 1920, the figure for motors had doubled, and the load was 12 900 000 h.p. By January, 1925, it is anticipated that the load will be 20 800 000 h.p. The units sold indicate that only 34·5 per cent. was for lighting in 1915 and 28·4 in 1919, but the power figures (including the street railway load) were 51·1 and 57·2 per cent. respectively. The use of the electric steel furnace is also extending rapidly. In 1915 only forty-one steel works employed them, when only 62 000 tons of electric steel were produced. The capacity of the electric power plants installed in steel works was 25 000 kW and the electrical energy used was 45 000 000 units, but in 1919 there were 287 steel works, which produced 566 084 tons, the plants installed having a capacity of 240 000 kW and the electrical energy consumed was 260 000 000 units. In 1921 it is estimated that there were 336 steel works employing electric furnaces and the capacity of the generating plants was 320 000 kW.

Openings for Trade in the Netherlands.

The "Handelsbelangen" of Feb. 15 and 22 gives particulars of the following contracts for which tenders are likely to be invited in the near future:—The Limburgsche Groene Kruis (Rijksweg Z.Z. 7, Sittard) intend building a modern hospital on the road Sittard-Heerlen, with accommodation for 250 patients. Estimate, Gld.1 250 000. Building will probably begin this summer. The granting of the concession for the electrification and extension of the Gooische Stoomtram (director, F. M. Augustijn, Watergraafsmeer) may be expected this year. The line Amsterdam-Hilversum will be the first to be electrified, and a power station and annex buildings will be constructed. The Zeeuwsch Vlaamsche Tramweg Mij, of Axel (Z), intend to lay a new tramline, with stations, sheds, &c., in Zealand. The plans will probably be drawn up by Ingenieursburean W. E. Kramer and H. Polano, Noordeinde 18A, The Hague.

Electricity in Farming.

An interesting example of the use of electricity in farming is given in the "Industrial Australian." Mr. J. C. Fredericksen, of Rous Mill, Richmond River, N.S.W., has constructed a dam on a small creek near his farm, and has erected a Pelton water wheel, giving 17 h.p. with the water applied as at present through a 3-in. nozzle. This drives a d.c. dynamo of about 5 kW, which supplies current for lighting and for fans and radiators in five homes on the farm and in the dairies, &c., while it also supplies power to a 5 h.p. motor operating milking machine, separator, lathe, grindstone, chaff-cutting, corn-shelling and bushnut-shelling machines. A sawmill for heavy work is driven directly by the Pelton wheel, the electrical plant being temporarily disconnected. A novel feature of the electrical installation is that no battery is used, the speed of the generator being regulated by means of wires extending from the farm to the Pelton wheel, a quarter of a mile away, and attached to the valves controlling the water supply to the wheel.

Arrangements for the Week.

FRIDAY, March 17th (to-day).

Institution of Mechanical Engineers.

6 p.m. At Storey's Gate, London, S.W. Paper on "British and American Locomotive Design and Practice," by Mr. P. C. Dewhurst.

Institution of Electrical Engineers
London Students' Section.

7 p.m. At Savoy-place, London, W.C. Paper on "The Electron Theory," by Mr. C. C. H. Wade.

British Electrical Development Association.

7.30 p.m. At the Chartered Institute of Patent Agents, Staple Inn-buildings, London, W.C. Salesmanship Conference. No. 5, "Salesmanship in Relation to Showroom Displays and Demonstrations." Speaker: Mr. A. C. Bostel.

Junior Institution of Engineers.

8 p.m. At Caxton Hall, London, S.W. Lecturette on "Power Factor Improvement," by Mr. G. H. Ayres.

SATURDAY, March 18th.

Royal Institution.

3 p.m. At Albemarle-street, London, W. Lecture on "Radio-activity," by Sir Ernest Rutherford, F.R.S. (Lecture III.)

MONDAY, March 20th.

Institution of Electrical Engineers.
(Liverpool Sub-Centre.)

7 p.m. At the University, Brownlow-street, Liverpool. Paper on "The Interconnection of A.C. Power Stations," by Messrs. L. J. Romero and J. B. Palmer.

Institution of Mechanical Engineers.
(Graduates' Section.)

7 p.m. At Storey's Gate, London, S.W. Paper on "Hydro-Electric Course at the University of Grenoble," by Capt. H. Whittaker.

Institution of Electrical Engineers.
Informal Meeting.

7 p.m. At Savoy-place, London, W.C. Discussion on "The Importance of Studying Finance in Connection with Electricity Undertakings," to be opened by Mr. A. Wright.

Institution of Civil Engineers.

7.30 p.m. At the Hotel Metropole, Leeds. Paper on "Modern Methods of Water Purification," by Mr. N. K. Holmes.

Royal Society of Arts.

8 p.m. At John-street, London, W.C. Lecture on "The Constituents of Essential Oils," by Mr. G. Radcliffe.

TUESDAY, March 21st.

Institution of Civil Engineers.

6 p.m. At Great George-street, London, S.W. Paper on "All-Electric Automatic Power Signalling on the Metropolitan Railway," by Mr. W. Willox.

Institution of Electrical Engineers.
North-Western Centre. Informal Meeting.

7 p.m. At the Engineers' Club, Manchester. Paper on "Specifications and Estimates," by Mr. J. Frith.

Röntgen Society.

8.15 p.m. At the Institution of Electrical Engineers, Savoy-place, London, W.C. Silvanus Thompson Memorial Lecture delivered by Sir Oliver J. Lodge, F.R.S.

WEDNESDAY, March 22nd.

Industrial League and Council.

7.30 p.m. At Caxton Hall, London, S.W. Lecture on "Some Common Fallacies on Trade and Industry," by the Right Hon. G. N. Barnes, C.H., M.P.

THURSDAY, March 23rd.

Electrical Power Engineers' Association.
Derby and District Section.

6.45 p.m. At the "Flying Horse" Hotel, Poultry, Nottingham. Paper on "Power Station Efficiency," by Mr. J. N. Waite.

National Liberal Club. Political and Economic Circle.

8 p.m. At Whitehall-place, London, S.W. Lecture on "Revolution by Consent," by Mr. J. A. Hobson.

FRIDAY, March 24th.

Electrical Power Engineers' Association.

7 p.m. At the Institution of Electrical Engineers, Savoy-place, London, W.C. Lecture on "Electric Control of Large Amounts of Power," by Dr. C. C. Garrard.

Edinburgh Electrical Society.

8 p.m. At the Philosophical Institute, 4, Queen-street, Edinburgh. Paper on "Magnets," by Mr. J. M'Ewan Brown.

Royal Institution.

9 p.m. At Albemarle-street, London, W. Discourse on "Auxiliary International Languages," by Prof. F. G. Donnan, F.R.S.

It is announced that Sir Evelyn Cecil, chairman of the Telephone Select Committee, has completed the draft of the report on the telephone service. Recommendations are to be made the effect of which, if adopted, would be to reduce expenditure on the service without impairing its efficiency. By this means it is believed that it will be possible to lower telephone rates by 10 per cent.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Complete Specifications.

146 474 Cameron, W. J. Incandescent electric lamps. (14/2/16.)
146 520 Western Electric Co., Ltd. Telegraphic ciphering and deciphering mechanism. (13/9/18.)
146 529 Radio Corporation of America. Receivers of electrical oscillations. (18/6/14.)
146 881 Western Electric Co., Ltd. Wireless signalling apparatus. (1/12/15.)
147 428 Ges. für Drahtlöse Telegraphie. Arc transmitters for wireless telegraphy and telephony. (3/7/14.)
147 436 Ges. für Drahtlöse Telegraphie. Wireless transmitters. (6/12/13.)
147 610 Western Electric Co., Ltd. Telephone systems. (20/2/19.)
147 849 Ges. für Drahtlöse Telegraphie. Generation of electric oscillations. (29/9/17.)
148 221 Allgemeine Elektricitats Ges. Choking coil with variable inductance or transformer for doubling frequency. (10/7/14.)
149 330 Nolle, J. A. van der. Absorbents for use in galvanic batteries. (19/7/19.)
157 909 Kruger, F. High ohmic resistance. (27/11/19.)
169 285 Automatic Telephone Manufacturing Co. Ltd., Savin, J., & Mercer, R. (partly communicated by Automatic Electric Co.). Telephone systems. (23/6/20.)
169 295 Sanders, H. C. Electrical quick make-and-break switches. (26/6/20.)
169 297 British Thomson-Houston Co., Ltd. (General Electric Co.). Electrical regenerative control apparatus and systems. (28/6/20.)
169 305 Parsons, I. H., & Ball, A. E. J. Apparatus for the reception of electro-magnetic waves. (2/7/20.)
169 324 Wade, H. (Concordia Elektrizitats Akt.-Ges.). Portable electric hand lamps. (13/7/20.)
169 330 Della Veneria, Z. R. Electric switches. (16/7/20.)
169 340 Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). Electric switches. (21/7/20.)
169 359 Booker, H. Bromide electric printing boxes. (23/10/20.)
169 361 Silbermann, F. Electric letter-forming apparatus for advertising and the like. (10/8/20.)
169 377 Atkinson, C. L. Rotary electric distributors for internal combustion engines. (6/9/20.)
169 395 Armstrong, A. W. Sparking-plugs (2/11/20.)

APPLICATIONS FOR PATENTS

December 10, 1921.

33 198 Cockerill. Electrical flooder and tell-tale for carburettors of internal combustion engines.
33 218 Pollard. Boards for charging torch accumulators.
33 221 Large. Electric kettle, &c.
33 239 Magneta Time Co. & Webber. Intermittently operating electrically actuated devices.

December 12, 1921.

33 284 Waterhouse. Combination couplings for electric condensers.
33 288 Richards. Electrolytic rectifiers.
33 306 Oates. Commutators for generators and motors.
33 309 Latimer. Dimming electric hand lights for cars, &c.
33 349 French-Brewster. Driving means for electric mechanical pocket lamps.
33 353 Prince. Means for obtaining telephonic modulation of high frequency oscillations.
33 369 Cole. Interrupter for metal vapour apparatus ignited by h.t. impulses. (11/12/20. Austria.)
33 372 Johnston. Electric clocks.
33 386 Pfiffner. High tension condensers. (5/1/21, Germany.)

December 13, 1921.

33 419 Ellis. Aerials for wireless signalling.
33 420 Bosch (R.), Akt. Ges. Magneto-electric devices. (13/12/20, Germany.)
33 422 Hancock & Russell. Switches.
33 424 Collingham & Owen. Electric lighting plants for motor vehicles, &c.
33 434 Jacob. Device for locking lamps to sockets
33 435 Railing, Garrard, & McColl. Switches.
33 442 Hopkins. Electric resistances.
33 445 Paul. Numbering machine for telephone calls.
33 466 Della Riccia. Auto transformer. (14/12/20, Germany.)
33 470 Kahn. Automatic cut-outs or interrupters. (13/12/20, Germany.)
33 473 Chambers. Electro-magnetic wave receiving and amplifying systems.
33 476 Powell & Miles. Electric clocks, time recorders, &c.
33 490 Westinghouse Lamp Co. High Temperature electric furnaces. (13/12/20, U.S.)
33 533 Renaudin. Insulator for high pressure electric lines. (15/12/20, France.)
33 534 Hoffman Mfg. Co. & Barden. Electrical measuring of sounds or mechanical vibrations.
33 536 Reid. Cleaning plates of accumulators, &c.
33 549 Pollock. Thermionic valve relay.

December 14, 1921.

33 550 Onward. Valves for controlling supply of current to anode of valve of continuous wave transmitter.
33 551 Wheeler. Automatic metering of telephone calls.
33 556 Bosch (R.), Akt. Ges. Slip rings for generators. (20/12/20, Germany.)
33 559 Anderson & Huntsworth. Telephone call counting, registering, &c., apparatus.
33 561 Davies & Son (Derby) & Dawson. Means for unlocking magnetically locked lamps.
33 567 British United Shoe Machinery Co. Electric heating of tools of edge setting machines.
33 569 Mynne Model electric motor.
33 580 Hill. Connections for electric cables, &c.
33 591 Hanson Traction motors.
33 619 Darsey. Prevention of removal of lamps from sockets.
33 634 Hall. Coin collecting means for telephones.
33 635 Hall. Meter registers and control devices for telephones.
33 647 Westinghouse Electric & Mfg. Co. Motor-control systems. (14/12/20, U.S.)
33 648 Metropolitan-Vickers Electrical Co. Flexible couplings.
33 649 B. T.-H. Co. Incandescent lamps. (18/1/21, U.S.)
33 651 Marsollier. Electrical connecting devices and lampholders.
33 657 Metropolitan-Vickers Electrical Co. & Fletcher. Armatures of electrical machines.
33 663 Marshall. Electrical device for destroying rats.

December 15, 1921.

33 701 Electric Construction Co. & Close. Safety vents for electric motor cases, switch boxes, &c.
33 706 Williams. Marking conductors of multi-conductor cables, &c.
33 717 Amberton. Electric resistances.
33 744 Langdon-Davies & Soames. Bringing into and out of circuit an inductive resistance or choke.
33 747 ...er & McGregor. Electric drive for talking machines.
33 762 Planer. Localisation of faults in cables, &c. (3/12/21, Germany.)
33 779 Clark. Electric fuses.
33 785 Metropolitan-Vickers Electrical Co. Fusible devices for protecting electric circuits. (21/1/21, U.S.)
33 792 Morgan & Saynor. Electrical adapters, plugs, &c.
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33 807 Pratley & Lovell. Electric couplings.
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33 819 Schaufelberger. Electric heater. (20/12/20, Switzerland.)
33 820 Barsby. Electric motor.

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33 966 Tennant. Wireless receiving apparatus.

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34 550 Akt. Ges. Brown, Boverie et Cie. Mercury-vapour pumps for high vacua. (8/1/21, Switzerland.)
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34 909 Gill-Knight. Electro-atmospheric multiple unit control for electric railways.
34 934 Creedy. Windings for a.c. machines.
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34 940 Didies. Accumulators.
34 944 B. T.-H. Co. (G. E. Co.). Circuit breakers.
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34 986 Palmer. Telephone transmitters, &c.

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35 000 Fellows. Holders for incandescent lamps.
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35 037 Siemens & Humphries. Automatic, &c., telephone exchange systems.
35 045 Krupp (F.) Akt. Ges. Overload switches formators started by starting resistance. (3/1/22, Germany.)
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35 058 Soc. Francaise Radio-Telegraphique. Wireless telegraph receivers. (30/3/21, France.)
35 078 Pfiffner. Earthing choking coils or voltage transformers for high voltages. (5/1/21, Germany.)
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35 087 Quarzlampen-Ges. Irradiation lamps for medical purposes. (30/12/20, Germany.)
35 088 Huth (E. F.), Ges. & Schwarz. Electric transmission of messages along conductors. (30/12/20, Germany.)
35 089 Blathy. System of pole charging for polyphase induction motors. (8/6/20, Hungary.)

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35 098 Blathy. System of pole changing for polyphase induction motors. (9/4/21, Hungary.)
35 101 Forges et Ateliers de Constructions Electric de Jeumont. Alternating current motor groups. (26/1/21, France.)
35 128 Monson. Electric treatment of liquids.
35 156 Quarzlampen Ges. Mercury vapour apparatus. (31/12/20, Germany.)

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18 A. Kirk & R. C. Milliken. Cleats and cleat cases for electric conductors, &c.
44 J. H. Collings, C. W. Saunders & M. J. Railing. Electric bell, &c., indicators.
65 B. T.-H. Co. (G. E. Co.). Motor controllers.
71 A. R. Taylor. Instrument for measuring capacity and inductance.
86 C. J. Evans. Intermittently operating circuit closing devices.
131 P. Alexander & C. W. C. Beckman. Electrical apparatus.
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146 W. W. Burnham. Switches.
168 Brush Electrical Engineering Co. Propulsion of torpedoes, &c.
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200 J. B. Tucker. Electric make and break connections.
202 E. Pollock. High-frequency telephony, telegraphy, &c.

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207 F. E. Pernot & L. J. Rich. Phase adjustment of electrical systems.
228 A. P. Addison & J. W. A. Waller. Electrical apparatus.
267 B. T.-H. Co. & A. P. Young. Magneto-electric machines.
273 W. B. Sayers. Dynamo electric machines.
297 E. C. R. Marks (Goodman Manufacturing Co.). Controlling devices for electric locomotives.
308 E. de Vries. Combined phonograph and electric lamp.

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337 H. W. Cox. Electric apparatus for separating or classifying finely divided materials.
350 C. B. Buchanan & C. C. Johnson. Current collectors.
356 C. F. Shanks. Electro-magnetic clutches.
362 W. Gee. Fuse-carrier for distribution boards.
374 F. C. Raphael. Electric fittings and means for fixing same.
385 E. W. Lancaster. Anti-vibration devices for electric lamps, &c.
395 E. C. R. Marks (Fabbr. Apparecchi F. E. R. T.). Thermo-electric lamp.
397 R. Herzog & C. Lorenz Akt. Ges. Wireless telegraph and telephone apparatus. (2/7/21, Germany.)
407 G. P. Symons. Heating element for radiators, cookers, &c.
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424 Naamlooze Vennsotschap Philips' Gloeilampenfabr. Electric discharge tubes. (16/8/21, Holland.)
425 Naamlooze Vennsotschap Philips' Gloeilampenfabr. Electric discharge tubes. (5/11/21, Holland.)
426 Naamlooze Vennsotschap Philips' Gloeilampenfabr. Electric resistances. (14/1/21, Holland.)
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482 G. H. Boot. Trolley wheels for current collectors.
486 Scintilla. Electric starters for engines. (15/1/21, Switzerland.)
488 Siemens-Schuckertwerke. Electro-magnets. (16/2/21, Germany.)
496 Automatic Telephone Manufacturing Co. Telephone systems. (3/5/21, U.S.)
500 A. van T. Day. High-frequency electric signalling. (17/7/16, U.S.)

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516 P. C. Hanks. Drive for dynamos or magnetos.
518 G. Wilkinson. Automatic valves or switches.
522 J. P. Annacker & S. Fildes. Electric tumbler switches.
523 A. R. Angus. Devices to utilise forces due to variations in electrical energies.
526 J. Wilson. Electric lamps.
530 S. J. Vaughton. Clocks for operating switches, &c.
567 Elektrizitätswerk Lonza. Improving electrolytic mercuric oxide. (8/1/21, Switzerland.)

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604 H. V. Owen, M. J. Railing & F. G. Quance. Electric junction boxes, &c.
613 W. Buckley & A. Mansell. Suspension of electric lamps.
625 A. Willmott. Electric switch.
630 Callender's Cable & Construction Co. & G. S. Boothroyd. Electrically bending metallic sheathed cables, &c., in junction boxes.
631 Callender's Cable & Construction Co. & G. S. Boothroyd. Electrically bending metallic sheathed wires or cables.
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654 Western Electric Co. Electric coils.
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662 J. Stone & Co. & C. E. Adams. Electro-magnetic switches for train lighting installations.
663 D. A. Evans & H. Hodgson. Cooling or ventilating of enclosed electric motors.
667 S. D. White. Locking device for electric lamps.

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703 A. M. Taylor. Joints for underground h.t. cables.
709 Whittaker Bros. (Accrington) & W. Whittaker. Electric wringers and mangles.
711 H. F. Carey. Electrical automatic omnibus signs.
719 Hague & McKenzie & A. Hague. Electric kettles, &c.
750 P. G. A. H. Voigt. Attachment to low-frequency amplifiers.
764 L. Bussereau. Contact maker for l.t. ignition circuit.
765 Soc. Anon le Carbone. Brushes of agglomerated graphite for electrical machines. (7/4/21, France.)
781 Astra Dynamo Co., F. U. Y. Weldon & C. T. Freeman. Means for dimming light from electric lamps.
783 B. T.-H. Co. (G. E. Co.). Protective devices for electric circuits.
800 S. Dallaway. Electrically illuminated scenic displays for advertising, &c.
808 H. W. F. Ireland & H. Lucas. Electric machines.
814 S. G. Cowper-Coles. Telephone receiver cases.
815 S. O. Cowper-Coles. Electrolytic apparatus for production of seamless articles.
821 M. Meinhardt & E. Viz. Production of thermo-induction currents.
826 Newton Bros. (Derby). Direct current machines.

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858 R. Bosch Akt. Ges. Electric generators. (14/2/21, Germany.)
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912 Metropolitan-Vickers Electrical Co. & W. T. Gray. Couplers for conductors of electric railway vehicles.
913 Metropolitan-Vickers Electrical Co. & N. E. North. Switches.
916 A. W. Sharman. Apparatus for controlling and regulating electric currents.
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939 T. N. Whitehead. Means of enabling l.t. current to flow across surfaces of two conductors in contact.

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Notes of the Week.

More Criticism.

Sir Harry Renwick's announcement, to which we referred last week, that the County of London Electric Supply Company are prepared to support the Electricity Supply Bill has caused much perturbation in certain quarters. It has inspired the financial contemporary, to whose fulminations we have already called attention, to issue in parallel columns Sir Harry's statements on this subject in 1921 and 1922, and to inquire acidly the reason of his change of heart. Surely the very nadir of criticism! For 1922 is not 1921, and if the electrical industry has learnt nothing else in a short twelve months, it has at last realised that the best, if not the only, way out of the present sloughs of uncertainty and depression is by mutual help and not by internecine strife. Moreover, the 1922 Bill is not the 1921 Bill, and the differences are more than sufficient to explain and justify Sir Harry's change of opinion. We wish, therefore, that more would follow his example and reconsider their views. This reconsideration is, perhaps, most necessary among the smaller, privately-owned undertakings, who have suffered much in the past and have the most to gain from any change.

Our Electrical Bourbons.

One of the points made by Sir Harry Renwick's critic is that the most conspicuous case of failure of the Commissioners' policy is to be found in London, "where the deadlock in the situation has arisen from the refusal of the companies to subscribe capital for a scheme under the control of a joint authority." We know; and we blame the companies for that state of things rather than the Commissioners. They argue, we think mistakenly, that if the purchase clause were extended, they could develop on more economical lines if left to themselves than if included in a Joint Authority, and that some such treatment is their due for the obstacles that have been placed in their way in the past. But this is parochialism at its worst. It leaves out of consideration the lessons of modern electrical experience, it ignores the fact that the London electricity problem, overwhelming as it is, can best be dealt with as a whole, and it forgets that development by sections is the cause of much of the present trouble.

Local Authority Propaganda for the Bill.

We are glad, however, to see that the London County Council, through the Special Committee on Electricity, and the London Conference of Local Authorities have both issued reasoned statements in support of the Bill. This will, we hope, have beneficial results, and it should certainly tend to remove the misunderstandings and doubts in the public mind which have been sedulously propagated by not wholly disinterested persons. On Tuesday, too, the County Council passed a resolution welcoming the introduction of the Bill, and urging upon the Government that in the public interest it should take every step in its power to ensure the passing of the measure in the present session of Parliament. The Conference of Local Authorities, which represent all shades of political opinion, have gone further and have forwarded a statement to members of the House of Lords, in which it is pointed out that Joint Authority schemes contemplate a development of electricity supply in the interests of authorised undertakers, consumers and the general public, but that in order to secure proper results the provisions of the new Bill are essential. It is to be hoped that their lordships will give due weight to the considered opinion of these elected authorities, and that they will not stand in the way of industrial and social progress by rejecting or mangling such a useful measure as the present Bill.

Standard Starters.

From many points of view the discussion of the British Engineering Standards Association starter specifications at a recent meeting of the Institution of Electrical Engineers

missed fire, and it is, therefore, fortunate that the discussion was adjourned. For the subject is most important, and, perhaps, more than other problems dealt with by standardisation, may be divided clearly into two principal sections: What to do and how to do it. With starters, the second of these sections is the simpler. Given a standard rating, which would enable purchasers to make a fair comparison between types of starter, there remains the necessities of good workmanship and attention to detail which are common to all properly designed and manufactured apparatus. To take an example under the heading of " Joints," it is stated that no soldering shall be used on the connections between units, and that all joints must be mechanically secure. That is a point upon which agreement will be instant among all well-conducted manufacturers, and is, therefore, in a very different category from the controversy which arises when the vexed question of rating is mentioned.

Compromise, Not Revolution.

That this is a vexed question can also be shown by example. In the specification for contactor starters, the maximum currents which shall pass both on the first steps and on each of the subsequent steps is stated. For 10 H.P. starters the maximum current permissible is two and a half times full load current on the first step and three times full load current on the subsequent steps. Yet many municipal electricity supply departments in this country object to such high currents, and it would be interesting to know whether they will accept the change. To do so would only mean the alteration of regulations. On the other hand, as Mr. J. T. Mould pointed out in the discussion, each starter maker has his own standard (for rating among other things), which he may be forgiven for thinking quite as good as those of the B.E.S.A., with the sole exception that they are employed particularly rather than generally. The work of the B.E.S.A. has, therefore, been one of co-ordination rather than erection, and of compromise rather than revolution. As yet the specifications are in a draft stage and are, therefore, in a form inviting and convenient for discussion. It is the duty of those interested to play their part in welding them into a final form. This, as Mr. Wordingham pointed out, may be a matter of years, but if it is well done it will be none the worse for that.

An Impudent Claim.

As we have often pointed out, of all the forms of taxation the Corporation Profits Tax is the most pernicious and inequitable in its incidence, for, though it is nominally levied on companies, its burden really falls on the ordinary shareholders, one class being thus singled out for special taxation. But, bad as it is when fairly and equitably assessed, it is worse when claims such as that made upon the Central Electric Supply Company become common. This is, in fact, a clever, though a most unwarranted, attempt to extend the operation of the tax. Public utility companies are exempt from the tax until December 31 next, provided that their charges to the public are limited by statute. The Act which established the Central Company has no such express limitation, but as the Company does not give a retail supply to the public, but only a bulk supply to the St. James' and Pall Mall, the Westminster and Chelsea Supply Companies, whose charges are limited, we cannot see the justice of the claim. The companies are, we are glad to see, resisting the demand, as it really amounts to the taxation of something which is definitely exempted by statute.

160 000 kVA Turbo-Alternators!

America has long been recognised as the home of everything that is gargantuan, from oratory and skyscrapers to the production of motor cars, but according to information given in the " Times Engineering Supplement," the palm for turbo-alternators will now have to be conceded to Germany. For Prof. Reichel has designed a real superstation to contain six 160 000 kVA units! Such a station would have a possible annual output of 2 000 million kilowatt hours, and five of them would be able to supply the whole country. As regards details, the proposed station will contain 100 steam boilers, each with a heating surface of 10 750 sq. ft., producing steam at a pressure of 285 lb. per sq. in. and a temperature of 350 deg. C. The quantity of cooling water needed would be from 1 200 to 1 400 cu. ft. a second. The annual coal consumption would be some $2\frac{1}{4}$ million metric tons, and in close connection with the boiler house there would be a coal store capable of holding 100 000 tons, sufficient for two weeks. The coal would be transported to the power station in trains composed of thirty forty-ton trucks, which would be constantly working between the station and the coal mines. The ash would be removed in tipping cars by battery locomotives. In the boiler house, which would measure about 490 ft. by 590 ft., the boilers would be arranged in ten rows of ten each.

Generator Details.

The total weight of the generator of a 160 000 kVA unit would be about 600 tons, of which 222 tons would go to the rotor and the remainder to the stator. The weight would thus be about $8\frac{1}{2}$ lb. per kVA. The diameter of the rotor would be nearly 9 ft. and its length over 13 ft., while the outer diameter of the stator would be over 18 ft. The two bearings would be $28\frac{1}{2}$ ft. The turbine is designed as a double-flow machine, with steam admission in the centre and exhaust at both ends. We shall be interested to learn the future developments of this scheme. It seems to be advancing rather fast on a road of which some electrical engineers are a little fearful.

Newcastle-upon-Tyne Company's Results.

We regret to notice that the operations of the progressive and well-managed Newcastle-upon-Tyne Electric Supply Company have been so affected by the coal strike and by the industrial depression on the North-East Coast that the ordinary dividend has had to be passed. For the past four years the distribution has been at the rate of eight per cent., and it is unfortunate that an excellent record should be broken. When, however, it is remembered that the interest charges on additional debenture capital required for extensions absorbed £48 500 more than in the previous year, and that there was a drop of nearly £48 000 in revenue from the sale of current the position will be understood. We are convinced that the set-back is merely temporary, and that the company and its associates will recover rapidly as soon as trade begins to revive once more. The company is the largest supply authority in the kingdom, and it has been obliged to make heavy issues of debenture stocks to provide for extension work in hand and for the general expansion of business. This additional capital has not yet become remunerative, but as soon as the tide of industrial prosperity turns, as assuredly it will, the company will reap the reward of its foresight and bold enterprise. Within the last few days the company has sustained a more personal loss in the death of its present vice-chairman and former chairman, Dr. J. T. Merz. Dr.

Merz was, in fact, one of the founders of the company, and its undoubted success was largely due to his careful direction.

B. and K. Progress.

We have often contended that the policy adopted years ago by the Brompton and Kensington Electricity Supply Company ought to be more widely followed, if only on account of the fact that it has been justified by results. What that policy is need not be stated here, and we may confine ourselves to saying that in 1921 the company connected more consumers than in any previous twelve months, excepting only 1919 and 1920, that they sold more current per lamp installed than in the previous year, and that the gross receipts showed an increase of 7½ per cent. over the record of 1920. This continued progress is due mainly to conversion of the larger houses in the area into flats and maisonettes, to the growing use of labour-saving devices, and to the low charges imposed. There will be those that contend that the B. and K. Company are very lucky, but then luck has been defined as the child of hard work and enterprise. Incidentally, it is interesting to learn that saturation is still far off even in this well-developed area.

A Great Railway Amalgamation.

The announcement that a provisional agreement for fusion has been reached between the extended London and North Western and the Midland Railway Companies will be interesting to electrical engineers from several points of view. After the end of the present year this combination will result in the elimination of competition for goods and passenger traffic in a wide area of the country, and will erect a gigantic organisation whose operations, we hope, will be neither too oppressive nor too slow moving to affect adversely the development of the country's trade. The effect of this fusion on the progress of electric traction in this area will also be watched with interest. The present London and North Western Railway has already two systems in operation on different parts of its line, while the Midland, as we showed a little earlier in the year, has made some interesting experiments with single-phase working, which were intended to lead to more fruitful results.

Its Effect on the Electrical Staff.

More important than these, however, is the effect the reorganisation is likely to have on the staff of the two systems, and especially on those concerned with carrying out the electrical work. We have already called attention to the retrograde step taken by the extended London and North Western Railway in practically placing their electrical department under the orders of the chief mechanical engineer. Is this policy to be extended in this further amalgamation, or is an opportunity to be taken of repairing a mistake and once again establishing a separate electrical engineers' department under the leadership of a man responsible solely to the directors? We sincerely hope the latter.

The Great Stoppage.

We are afraid that the debate, which took place in the House of Commons on Monday, on the lock-out of the members of the Amalgamated Engineers Union by the Engineering Employers' Federation has not brought peace much nearer. We scarcely expected it would. For these debates are too often conducted in an atmosphere of unreality and acrimony, and are seized by doctrinaires and interested persons as an opportunity for putting forward all sorts of impossible ideas and arguments, which, if they do nothing worse, generally serve to cloud the issue. Nevertheless, some important points were made to which attention may be drawn, for their consideration has effected what the debate itself failed to achieve—a meeting together between the Joint Labour Council and Sir Allan Smith, with what we hope will be satisfactory results.

A Breach of Faith?

Mr. Clynes derided the employers' contention that to carry on their business they must be the authority to decide when overtime shall and shall not be worked—and all that decision implies. He found in the employers' action a breach of faith, but as Mr. Gould pointed out, the condition which the trade unions wished to enforce would interfere with the management, and was therefore contrary to the terms arranged. Industry was paralysed by present conditions, and the lock-out had only anticipated by a few weeks what would inevitably have come about for other reasons. Comparisons of pre-war and existing costs in the shipbuilding trade, and examples of the opposition that the employers have to face in reducing production costs in order to increase trade, which he gave, combine to form a dark picture of both the present and future chances of industrial recovery, and indicate the extraordinary ignorance to their own interests which exists among the workers. This is shown particularly in their indifference to the ballots, with the results that harmful decisions are come to by a small minority of the trade union membership. One speaker on the Labour side seemed to think that when 21 per cent. of the total membership had voted, a good showing had been made. The proper organisation of the ballots and the careful explanation to the voters of the issues are both matters which Trades Union leaders would do well to deal with without delay.

Mr. Hopkinson on the Situation.

Mr. Austin Hopkinson's criticism was that the members of the Engineering Employers' Federation were not at present exercising managerial functions, the Federation doing that for them. But even if that be so it is surely better for these functions to be exercised by a body which is working in the employer's interests rather than by a Trade Union, or by shop stewards, whose policy, through ignorance, is antagonistic. This point was stressed by Sir Allan Smith, who pointed out that to give the men what they wanted would be to introduce a right of veto which would prevent employers in practice from managing their own factories, whatever it might do in theory, and that it was only on the abrogation of the demand for that right that employers would consent to negotiate. This attitude was not taken up in any spirit of opposition to the Trade Unions, whom the Employers' Federation wished to see in the strongest possible position. This is the olive branch to which we have already made reference.

The Industrial Court Difficulty.

But the most important part of the debate was the position disclosed by Dr. Macnamara, as a result of appeals made by a number of speakers to set up an enquiry under the Industrial Courts Act. This is a weapon which, as Mr. Clynes pointed out, has been forged for such an occasion as this, but it is a weapon which the Government is very reluctant to use until it is, as often as not, too late. Dr. Macnamara said he had done his best to bring the parties together, but that he could not set up the Court until the ballots now being taken were completed; in the hope apparently that they would be favourable to peace and that the

Court would then be unnecessary. Nevertheless, he urged both parties of their own motion to come together and compose their differences. It is, having in view all the circumstances, an extraordinary attitude to take up—and not a little puzzling.

The Results of it All.

Meanwhile, the dispute goes on, and every day matters go from bad to worse. Mr. Gould tells us that trade can never recover under present conditions, but with a lock-out in progress it cannot recover under any conditions. We are face to face with overpowering foreign competition. A lock-out will not help us to resist that. A lock-out will mean increased unemployment, not only among those who work with their hands, but among those who work with their brains. It will mean decreased expenditure on research at a time when every available sum should be spent on increasing our knowledge of the materials with which we work. It will mean the stamping out of that spark of reviving trade which we have been long expecting at a time when it is just appearing amidst the smoke. It is not much credit to either side that a stoppage of work and production has occurred at such a time.

The North-West Midlands Inquiry.

The scheme for the reorganisation of electricity supply in the North-West Midlands District, which was recently investigated by the Electricity Commissioners, is one of the best and most complete that we have seen, both from the administrative and technical points of view. The report of the proceedings at the inquiry gave us the impression that it was put forward purely in the interests of the municipal undertakers, but we are pleased to find that this is far from being the case, and that the scheme, which was backed by all the supply authorities in the district, gives equitable representation to both companies and local authorities.

Representation on the Authority.

Each undertaker will be entitled to appoint one member on the proposed Joint Electricity Authority for each £200 000 of gross revenue per year, and the representation is so graduated that five members are given for a gross revenue not exceeding £200 000, with an additional member for each £100 000 in excess of this amount. One vote will be allowed for each £20 000 of gross revenue. On this basis The Midland Electric Corporation for Power Distribution will have a larger representation and voting power than any of the local authorities, and the small supply companies operating at Church Stretton and Market Drayton will also be represented on the Joint Authority.

Very little exception can be taken to any of the administrative provisions, as they seem to be designed with a view to the mutual co-operation and assistance of the whole of the undertakers rather than to secure any special advantage for any class. This has always been our opinion, as we believe that until the causes of friction between the municipal and company undertakers have been removed no satisfactory progress can be made.

Powers of Authority.

The Electricity Authority may exercise any of its powers and duties through any undertaker, and it may act in an advisory capacity in respect of the generation, transmission, and distribution of all electrical energy in the district. In regard to areas not at present supplied with electricity, the Authority is to provide for this as the demand arises and it is economically possible to do so, by recommending the Commissioners to extend the area of supply of existing distributors or by the creation of new authorised distributors. This is a very sensible way of dealing with a subject which has been greatly misrepresented by interested parties.

Financial Clauses.

The clauses relating to finance are mainly based on the powers to be conferred by the new Electricity (Supply) Bill, and will enable authorised undertakers, local authorities, and consumers to render financial assistance to the Joint Authority. The provisions governing the application of revenue are very full, and we are pleased to see that the charges for electricity supply are to be regulated with a view to securing that receipts shall meet expenses, and that in fixing prices regard is to be had to the annual load factor, the quantity taken, and the cost of transmission. With a policy carried out on these lines there will be little risk of a deficit on the year's working and, therefore, there will be no need to fall back on the rates. This point needs emphasising because certain unfriendly critics have so misrepresented the facts that the public have very erroneous views on the subject of Joint Authorities.

Technical Details.

The technical side of the scheme seems to have been prepared with as much care as the administrative. The proposed system of supply is the standard three-phase, with a periodicity of 50 cycles. Generation is to be at 6 000 to 6 600 V, main transmission at 30 000 to 33 000 V, and secondary transmission at 6 600 to 11 000 V. The generating stations at Ocker Hill, Stafford, Hanley, Walsall (Birchills), West Bromwich, and Wolverhampton, are to be transferred to the Authority, but later it is contemplated to acquire the stations at Shrewsbury, Leek and Market Drayton. None of the existing generating stations is to be shut down immediately, but after certain interlinking transmission cables are laid and economic conditions warrant it, all the d.c. stations and plant, and, when conditions justify it, the most uneconomical of the existing alternating current plant will also be shut down.

New Generating Stations.

The erection of three new capital stations (at Rugeley, Ironbridge, and near Stone) is contemplated, and the sites have been chosen because of the transport facilities, availability of cooling water and coal supplies, and their proximity to the heaviest load centres. For the first five years the capital expenditure will be £2 913 000, and this figure includes the erection of the first section of the Rugeley Station, about 38 000 kW of plant at the existing stations, the first section of the transmission mains, together with the estimated cost of transformer plant and the purchase price of the two other station sites. The ultimate capacity of the three new stations would be 260 000 kW, viz., 80 000 kW at Rugeley, 150 000 kW at Ironbridge, and 30 000 kW at Stone. Provision is also made for the supply of energy for electric traction and power to the Railway Companies when required, and for the supply in bulk to the two tramway generating stations at Stoke.

Conservative Estimates.

Though no figures are given, it is clear that if existing undertakers were required to meet their obligations in their own areas, without regard to other districts, it would be necessary to erect several new stations, and the aggregate capital expenditure would be much greater than that of the Joint Authority, which, it is calculated, will be able to save 100 000 tons of coal per annum in the first stage. The maximum load on the local station feeders five years hence will be 76 105 kW, the units required per annum

will be 191 068 500, and, after debiting all charges and supplying the authorised undertakers at an average of 1·15d. per unit, there will be a balance of £22 107 for the creation of a reserve fund. If anything like this result can be achieved there can be no question of a deficit to be met out of the rates, while the present distributors will gain a decided advantage.

The estimates appear to err on the side of caution, and we are not surprised to learn that there was no opposition to the main principles of the scheme. There was, however, a claim for representation of large consumers on the Authority, and frankly we think it would be a good thing for both parties if this were conceded. Walsall also put forward a scheme of its own, but as this would cover only a small part of the Electricity District it cannot be treated as a serious attempt to find a solution of the problem set by the Electricity Commissioners.

A Brighter Institution.

Events at a recent meeting of the Institution of Electrical Engineers point to the necessity for a change in the procedure followed at these gatherings. On the occasion in question three Papers were down to be read, and their exposition was to be followed by a general discussion. The first of these Papers was short and generally explanatory. It took but a few minutes to read. The second dealt in an exhaustive manner with the high technicalities of the design of certain electrical apparatus, and was long and involved. Its author therefore wisely refrained from attempting to read it, even in abstract, and contented himself by giving a short illustrated lecture on the ideas with which he had dealt at length in the Paper. This was interesting enough, but would have been better if the speaker's elocution had been of a higher quality. The third Paper had already been read and discussed at one of the Territorial Centres, and had been published in the "Journal." Nevertheless, the author took up a considerable amount of time giving another illustrated lecture on its subject in which slide followed slide so rapidly that mental indigestion set in.

A Feast and its Results.

The result of this feast of good things was that it was seven o'clock (one hour after the opening of the meeting) before the discussion, which is after all the main object of these gatherings, could be started; and by that time the meagre audience were obviously becoming exhausted. An appeal from the chair that speakers should be brief had a further withering effect on the eloquence of those taking part, and finally the meeting came to the usual, but rather disappointing, full close at a late hour.

Change in Procedure Necessary.

We have given the history of this affair at full length because in exaggerated form it is what too often occurs at these Thursday evening meetings, and because its effect on those present and on the work of the Institution is so unsatisfactory that it is worth while making an examination to discover whether matters cannot be improved. For interesting discussions are, we fear, the exception rather than the rule. It appears to us, indeed we know it to our cost, that the chief thing wrong with the Institution meetings is bad elocution. Elocution, we are aware, is not a subject of instruction at technical colleges, but where speaker after speaker rises and mutters in tones which can just be caught by those near him, or reads rapidly from manuscript in an almost inaudible voice, we heartily wish it were. There are, we admit, speakers who can speak, but they are very few. This, obviously, is a matter in which the Council can do little or nothing; but members themselves ought to take it in hand, and remember that an argument is doubly cogent when it can be heard.

Publication in Advance.

The Council might, however, consider whether the time has not arrived when Papers for discussion should be published in the "Journal" sufficiently far ahead of the meeting for their contents to be available for any member who wishes to study them. It would not then be necessary for the Papers, or even abstracts of them, to be read at the meeting, and the discussion could be begun at once. If this plan is considered too iconoclastic, it might be modified by permitting the author ten minutes in which to explain any points in his Paper which were not clear or had been modified by the lapse of time since publication. But this concession should be granted sparingly, as such points could be as well, or better, dealt with in the reply. The speakers in the discussion should be required to speak extempore or from notes, and should not be permitted to read Papers. A rigid time limit should not be imposed, but irrelevancy and the discussion of points not dealt with in the Paper should be severely checked. If more speakers than could comfortably be dealt with in one evening desired to take part in the discussion a second evening should be allocated. And the meetings should not be too long. For it must not be forgotten the prime object of the meetings is instruction, and that learners soon get tired.

The Disadvantages of Stage Management.

It is generally known that with a laudable desire to improve the interest of the meetings a certain amount of stage management is in force. That is, members who are interested in the particular subject to be discussed are asked to take part, and human nature being what it is, doubtless consent even when they have nothing particular to say. The result is a welter of speakers, a pointless discussion, and not a little disappointment because some of those who have been requested to speak have not been given an opportunity of doing so. It is organisation *in excelsis* with the usual results.

Some Suggestions.

We have tried to make these criticisms constructive as well as destructive, for attending as we do practically every meeting that is held, we feel a miasmic atmosphere gradually creeping over the proceedings at Savoy Place. We realise that some stage management of the meetings is necessary, but we also feel that it is being conducted on the wrong lines. The Papers Committee must have no lack of choice of Papers, and this year they have done wisely in making the subjects discussed at the meetings cover as wide a range as possible. They could do more in this way by grouping Papers on related questions and having them discussed together. This would allow more time for discussion. It is also a matter for consideration whether fewer Papers should not be publicly discussed, giving more time for the discussion of those that do receive that treatment.

But whatever methods are adopted for bringing about a brighter Institution the success of those methods must lie with the members themselves, and especially with those members who take part in the discussions. When the informal meetings were started it was stated that they would be a useful school for the younger members. It is our experience that it is time some of the members who take part in the formal meetings attended that school not to speak but to listen and learn.

Regenerative Braking and Single-Phase Commutator Motors*

By B. NORDEFELDT.

(Concluded from page 314.)

Arrangements for Rotating the Phase of the Excitation.

For producing phase displacement between the armature and excitation voltages different methods may be employed. Those hitherto employed have been either to use a special exciter of the commutator type, the field of which is fed with single-phase current from the transformer, or to create an auxiliary phase by means of a two-phase asynchronous motor driven by one phase only, or by means of a phase converter of the commutator type. The use

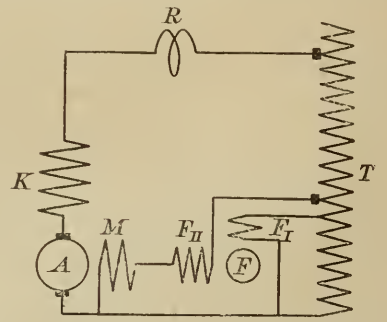


Fig 8.—Excitation by Phase Convertor.

of an asynchronous motor is a very simple method, especially as the motor can also be utilised mechanically on the locomotive. A diagram of such an arrangement is shown in Fig. 8, where the asynchronous machine F has a short-circuited rotor and two stator windings F_I and F_{II}. The transformer voltage is introduced on F_I, and the quarter-phase field produced in rotation induces a voltage in F_{II} which leads that of F in phase. These two voltages combine to give an excitation voltage of suitable phase.

Commutator machines may also be used as phase converters, although asynchronous machines would be better. On a locomotive constructed for the experiments on the French Midi Railway by the Compagnie du Nord et de l'Est de Jeumont (where the phase of the excitation was rotated fully 90 deg., and the phase of the transformer voltage was regulated accordingly) compensated repulsion motors were employed both for braking and for driving ventilators and compressors.

As already stated, a separately excited single-phase generator can also be employed. This however involves a considerable addition to the weight unless, as has been proposed by the A.E.G., one of the motors in a two or more motor locomotive is used as exciter, and the other as the main generator or generators. Fig. 9, which is reproduced substantially from an article by L. Monath in the "Elektrotechnik und Maschinenbau," 1919, No. 41, shows the arrangement. The speed characteristics of such a connection differ rather widely from those already described, due to the fact that the excitation decreases proportionally with the speed. The required characteristics are most easily obtained by replacing n by $\frac{n^2}{n_1}$ where n_1 is the normal speed in the above expressions. Samples of such curves are given in Fig. 10. The angle a is here assumed constant and equal to 30 deg., but the excitation of the

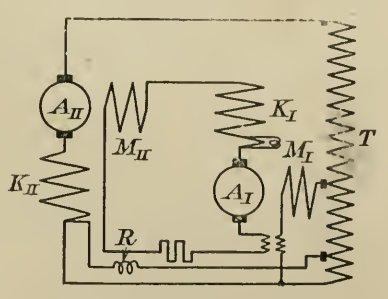


Fig. 9.—Separate Excitation.

exciter is increased for each step in the same proportion as the transformer voltage is reduced. This is necessary to avoid too large fluctuations in the current and braking torque. The curve for cos φ is here drawn only for the highest voltage step.

A comparison with Fig. 6 shows what much more pointed current curves and how much more rapid a decrease of braking torque with the speed are produced by this arrangement. It is obvious, therefore, that this method cannot be employed for braking to rest, as this would necessitate too many voltage steps in both the main and excitation circuits.

If, however, the main purpose of the braking is to prevent a certain speed being exceeded on long down grades, the fact that the braking torque increases rapidly with the speed may be an advantage.

Control of the Braking Action.

The question of controlling the generators during the braking period, which has been touched on in the preceding paragraphs, will now be treated more fully in comparison with the direct-current system such as is used on the Chicago, Milwaukee and St. Paul Railway.

When the direct-current machine is running as a series motor, it adapts its speed automatically to the excitation, or its excitation to its speed. If it is reconnected as a generator with separate and controllable excitation, the latter must be regulated very exactly with respect to the prevailing speed to avoid a rush of current. As it cannot be supposed that a motorman will know the speed of the train exactly, the problem has been solved by placing the excitation winding permanently in series with the armature, but successively impressing a voltage thereon from outside which keeps the exciting current constant or slightly increases it, although the armature current will gradually change its direction. The armature of the exciter is then traversed by the sum of the exciting and armature currents of the main machine

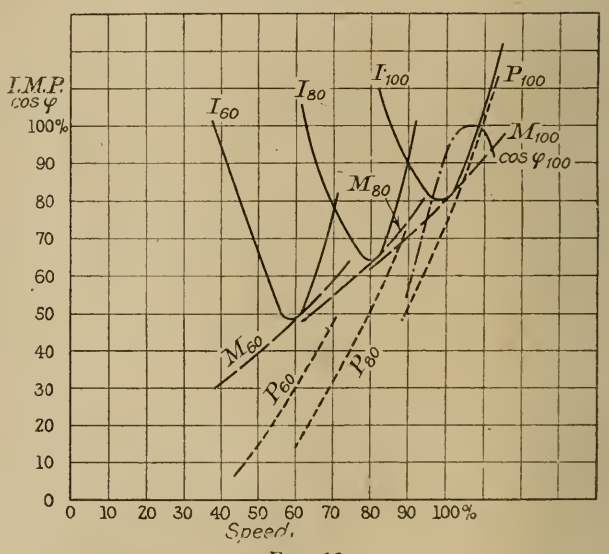


Fig. 10.

and must be designed accordingly. Even this arrangement has, however, not proved sufficient to prevent dangerous rushes of current, as a recent accident on the Chicago, Milwaukee and St. Paul Railway showed. To avoid such rushes, the motorman was prohibited from using the regenerative braking on freight trains at speeds below fifteen or above twenty miles per hour. The speed was slightly in excess of the latter value when the braking was begun, with the result that the cut-out came into action, and as the air brake also failed, nearly the whole train was wrecked.

Current Rushes on S.P. Systems.

A connection of the kind just described cannot be regarded as practically possible on the single-phase system, at least, not if a separate machine is employed for rotating the phase of the excitation. For the reason that the exciting power is mainly reactive power, the machine delivering it will be rather large for its own current and cannot be increased to carry the vector sum of this current and the armature current, which sum approaches the algebraic sum for small values of a. There is, however, no need for such a connection in the single-phase system, as the start of the braking operation can be made sufficiently smooth without it. If, for instance, an a value of 30 deg. and an excitation independent of the speed are chosen (Fig. 6), it is obvious that not even connecting the generator to the full transformer voltage

*Abstract of an article in the "Teknish Tidskrift."

at full excitation will give an undue rush of current if the speed is between 1·4 and 0·35 times normal. (These two limits correspond to 30 per cent. excess current, which is a very moderate value.) If a full braking torque cannot be avoided for mechanical reasons, the controller may therefore be shifted directly from the off position to a position corresponding to full voltage on both the excitation and the armature circuits. A transition step with, for instance, 3/4 voltage on both circuits will, however, give smoother braking, as the torque will be only half normal during that period. A really dangerous rush of current will never occur.

Single-Phase Gives Smoother Braking.

It is thus found that the passing from motor to generator action is not more, but rather less difficult in the single-phase than in direct-current systems. Moreover, the former, as already stated, has the advantage of permitting the braking down to low speeds, which would be very difficult in the continuous-current system, and therefore, probably, has not been practised. Even with the single-phase system, mechanical braking at the moment of stopping can, of course, not be avoided, but the main advantage lies in the possibility of running at widely variable speed on the same controller position without unduly loading the machine. This advantage is, however, characteristic only of the system with direct excitation from the transformer or with a phase converter; with the A.E.G. system such large variations of the speed cannot be permitted.

Further, it should be noted that the latter system cannot be employed in locomotives having only one motor, while in two-motor locomotives the motors are not uniformly, and therefore not completely, utilised. It has been proposed to interchange their functions occasionally, but this would make the apparatus still more complicated.

Heating Conditions in Regenerative Braking.

In connection with the last-mentioned question it may be asked whether the use of regenerative braking increases the cost of the motor equipment owing to heating. This question involves many factors and must therefore be examined. Traction motors of substantial size are now almost always provided with forced cooling, which brings the time-constant down to a rather low value. The larger the motor, the greater care must be paid to the cooling, whence the time-constant can be regarded as about equal for large and small motors, or about 10 to 20 minutes. This means that 90 per cent. of the final temperature is reached in 25 to 45 minutes. As it is often necessary to run the motors at full load during such periods, they must generally be dimensioned for nearly continuous full load, whether they are utilised for regenerative braking or not. Under such circumstances braking does not necessitate more expensive motors.

Increase in Weight.

The additional devices on a locomotive necessitated by the regenerative braking are: In the Oerlikon system, a rather large reactance coil and some small controlling apparatus: in the system with a special exciter or phase converter, this machine, together with a small reactance coil and some controlling apparatus; and in the A.E.G. system, a small reactance coil and some rather complicated apparatus. The reactance coil in the Oerlikon system must be dimensioned for more kVA than the transformer, but, it is stated, that by reason of its low voltage and high space factor its weight can be reduced to less than 4 per cent. of the total weight of the locomotive. In systems having phase converter, the latter will be greater the smaller the reactance coil. The total weight will always be greater than in the Oerlikon system, but, on the other hand, the advantages of a better power economy and more efficient braking are obtained.

The Commutation Problem.

An important matter in the operation of single-phase machines is the question of commutation. As is known, there is induced in the coil short-circuited by the brush—besides the usual reactance voltage caused by the commutation, which voltage, from the viewpoint of the line frequency, is in phase with and in the opposite direction to the current—a transformer voltage induced by the main field of the machine. This latter voltage, in a motor, is 90 deg. behind the former in phase, but in a generator is behind the field, which leads the current by the variable angle $(90°-\beta-\gamma)$. During generator operation, the correct phase of the commutating field cannot thus be obtained by shunting the winding by an ohmic resistance, as in motor operation, but other methods must be tried.

The most obvious of these, which, however, gives the correct phase to the commutating field only at a certain speed, is to impress on the commutating winding a voltage proportional to and in phase with the armature voltage. A method of this kind has been employed in the A.E.G. system and is illustrated in Fig. 9. The current component generated by the said voltage lags practically 90 deg. behind the machine voltage, and this is the case also with the corresponding field, while the main field is in phase with the machine voltage. The field component added in this way has thus the correct phase, but its strength varies in direct proportion to the speed of the machine, instead of inversely, as it ought.

A field component which is constant, independently of the speed, is an improvement hereof and can be obtained by connecting an ohmic resistance to the terminals of the magnet winding in series with a current transformer, both of sufficient size to substantially determine the phase of the secondary current of the latter, which current is introduced into the commutating winding. It is also possible, by special means, to provide a field component which varies inversely as the speed of the machine.

The commutation problem can, therefore, be regarded as solved in regenerative braking, although it will not be so simple as in motor action.

Review.

Electrical Rates. By G. P. Watkins, Ph.D. (New York: D. Van Nostrand Company). Pp. 228. $3.

While what is called a "multipart tariff" is very generally approved, the basis of the fixed charge in such a tariff is the subject of much discussion and difference of opinion. It is generally considered that ultimately load factor should govern the charge, but other considerations have to be taken into account such as (*a*) the capital cost of the services required by, and the special charges directly due, to a particular consumer, and (*b*) the proportion of the cost of the distributing network properly chargeable to the supply.

The items included in (*a*) termed "consumer cost," by Dr. Watkins, can be readily calculated and are of considerable importance in the case of a small consumer; those under (*b*) are not so easily ascertainable, but are nevertheless of vital importance in these days of high costs of mains. The author analyses the effect of this item of cost, and proposes that it should be dealt with in the "rate schedule" by means of discounts based on "density factor." While the solution may not be satisfactory, there is no doubt that "density factor" (or units sold per yard of frontage) as well as "consumer cost" have an important bearing on cost of supply, and may under certain conditions entirely swamp the effect of "load factor" in an allocation of costs.

It is not to be thought that "density factor" is brought into account in all American tariffs, or rate schedules; on the contrary, this is a new suggestion on the part of the author of this book, but one that undoubtedly deserves careful consideration.

The book is a careful survey of the whole question of fixing the price, or rather prices, at which electricity can be sold by an Electricity Supply Undertaking, written from the standpoint of an economist. Though the book is naturally based on American practice, the author having been statistician to the New York Public Service Commission, it is full of interest, and while from the nature of the subject it is not light reading, it is ably written and is evidently the result of a great deal of thought and experience. Dr. Watkins claims to be a non-technical man, but his grasp of a complicated subject is complete, and the book will repay careful study by Supply Engineers in this country.

We naturally turn to see how American practice differs from British, and, though it is not directly connected with tariffs in England, it is interesting to note that "The substantial displacement of other types (of lamp) by tungstens has already, in 1919, become an accomplished fact." Surely in most towns in Britain it was an accomplished fact in 1914; probably the reason that the change over in the States was slower, is that a great many if not most of the American Supply Undertakings provide lamps free of charge.

Apparently the difficulties in the States in framing a "rate schedule," are very similar to, if not identical with, those on this side of the water, and the author discusses the "minimum charge," "consumer cost," "Wright system," "Hopkinson system," in addition to the "density factor" mentioned above. "load factor," and all the other problems that are so familiar to the Electricity Supply Manager, but which are so difficult to deal with satisfactorily in a tariff of charges.

The author's suggestions for a model rate schedule are full of interest, but it would be quite as complicated as any tariff in force in English undertakings.

The terminology employed in the book is very precise, and appears to be based on definitions published by the National Electric Light Association, as the result of the work of their Rate Research Committee. The B.E.D.A. might undertake similar work in England; at present anyone writing on this subject is in great difficulty owing to the absence of accepted terms.

For the benefit of the Britishers who read this review, it may be mentioned that the book is written in excellent English, with an entire absence of "Americanese" (which, after all, is no worse than our "journalese"), and that the amount of "new" spelling is negligible.

W. A. Vignoles.

Electric Motor Starters.*

By J. ANDERSON.

The author deals with the development of an electric motor starter from first principles, defining what is meant by starting, accelerating, and using torques, and referring to the lack of data regarding starting conditions. Having given a means of estimating the accelerating time or torque, the author considers the application of these facts to step-by-step starters.

To obtain a clear idea of the action of a step-by-step starter, acceleration may be conveniently classified as natural regular acceleration, natural irregular acceleration, forced regular acceleration, or forced irregular acceleration. When rotation commences, the speed rises until the back E.M.F. cuts down the current to an amount which gives rise to a torque just sufficient to overcome the running friction or load at that speed. When the starter arm is moved to the next notch to cut out resistance there is a

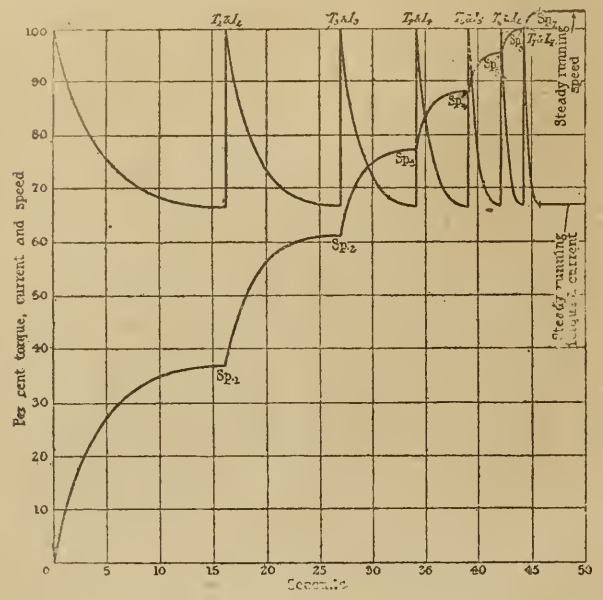


FIG. 1.—TORQUE/TIME AND SPEED/TIME CURVES FOR 7-NOTCH STARTER PASSING 100 PER CENT. CURRENT ON LAST NOTCH WITH MOTOR HAVING 66·6 PER CENT. LOAD. STORED ENERGY: 1 000 FT.-LB./B.H.P. MOTOR RESISTANCE: 8·8 PER CENT.

current-rush, the peak of which is determined by the ratio of the first resistance to the second, and which gradually dies away as the speed and back E.M.F. rise until balance is restored and the current corresponding to the running torque at the new speed is flowing.

If this is repeated on the third and subsequent notches and all the peaks and valleys are equal, the acceleration is called "natural regular."

Fig. 1 is drawn for a load of 66·6 per cent., the stored energy being 1 000 ft.-lb. per B.H.P., the motor resistance 8·8 per cent., ratio of resistance from notch to notch 1·5, and the current on the first notch and on subsequent peaks being 100 per cent.

Data for Correct Accelerating Time.

It is drawn for the correct accelerating time on each notch and these times are in proportion to the ratio of the resistances.

It is essential to know the motor resistance, that is, the resistance of field and armature for a series motor, and of armature only for a shunt motor. Armature resistance includes brush gear, commutator and connections. The starter maker, in the absence of this data, has to underestimate the motor resistance, and this frequently means the addition of another notch or two on the starter, with correspondingly increased selling price. There is no correct number of notches for a given horse power because, in general, the greater the number of notches the better the starter.

Fig. 2 shows a good example of natural irregular acceleration; it is drawn for a centrifugal pump load starting at 7½ per cent. and ending at 100 per cent.

A great deal has been written on the relative merits of current relays and pressure relays. In Fig. 3 the relays on notches 2, 3, and 4 must be set for 32·48, 69·18 and 87·03 per cent. pressure respectively to realise that diagram on full load. It would seem that there is no advantage in a pressure setting versus a current setting; on the contrary the relays must be more difficult to standardise, wind and adjust.

* Abstract of a Paper read before the Institution of Electrical Engineers.

Determination of Accelerating Torque.

Reverting to Fig. 1, it is necessary to indicate how the accelerating torque over the period is determined. If the running torque is 66 per cent. the excess torque in the time available for acceleration is represented by the area of the peaks. The average over the period works out at one-quarter of the excess of the peak over the valley, giving in this case 8·5 per cent.

It has been found that, as a working basis, the breaking capacity required from notch to notch is given by the maximum current at the maximum pressure. The law connecting amperes and volts for a given quick break switch and a given breaking distance in air is of the order of

$$\frac{(\text{Amperes})_2}{(\text{Amperes})_1} \propto \left[\frac{(\text{Volts})_1}{(\text{Volts})_2}\right]^{1\cdot5}$$

At the "off" position, two conditions have to be considered; first, making and breaking on the first notch, with the motor "stalled"; and second, breaking to "off" position when the starter arm is allowed to fly back from the full "on" position. In the first case, the power to be broken is the current on the first notch at line pressure. This is an onerous condition, particularly as the circuit is inductive, and no ordinary starter should be subjected to it. In the second case, practically no load is broken.

Form and Rating of Resistance Elements.

The next stage is to determine the form of the resistance elements, the method of support and cooling, and how the taps are to be taken off, &c. Then comes the real difficulty, that is, rating the element. Rating falls into two main divisions, continuous and intermittent. Continuous rating need scarcely be considered in the case of a pure starter, as it affects speed regulation only. But some starting conditions require a rating that is practically continuous.

The continuous rating of an element offers a fairly difficult

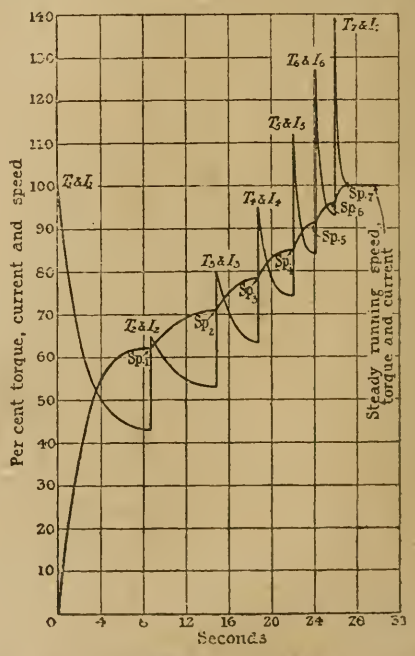


FIG. 2.—TORQUE/TIME AND SPEED/TIME CURVES FOR 7-NOTCH STARTER, PASSING 100 PER CENT. CURRENT ON FIRST NOTCH, WITH MOTOR HAVING CENTRIFUGAL-PUMP LOAD STARTING AT 7½ PER CENT. AND RISING TO 100 PER CENT. STORED ENERGY: 1 000 FT.-LB./B.H.P. MOTOR RESISTANCE: 8·8 PER CENT.

problem. The main requirement is ability to dissipate energy with a reasonable temperature-rise.

The temperature-rise, in continuous rating, obtained depends primarily on the watts dissipated per unit surface of the wire; the way the wire is shielded by the supports and frame; the proximity of one turn to another; the number of turns vertically above each other; the horizontal distance apart of the elements;

and the side draughts which are difficult to exclude while permitting free access of air. The slightest shielding or side draught causes the temperature to rise or fall erratically, yet the conditions existing in still air must be taken as the basis, for there is no alternative.

Curiously varying results are obtained with low and high final temperatures, owing to the different radiant components at the two temperatures, and quite different results are obtained if the element is horizontal instead of vertical, even when the total wire surface swept by the air is equal in both positions. The highest temperature-rise occurs at the middle of each element, whether

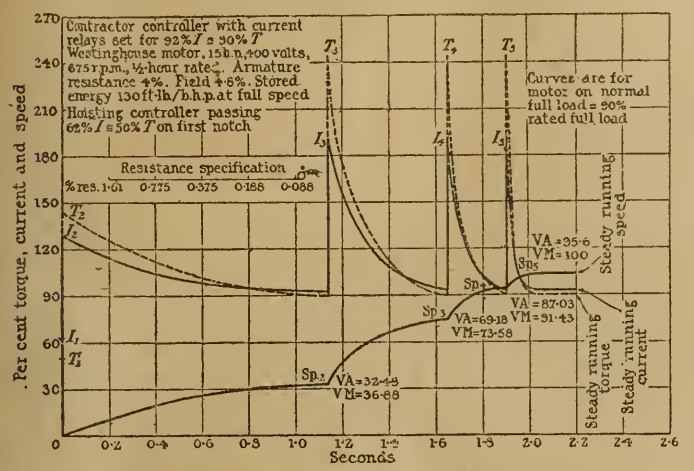


FIG. 3.

long or short. The temperature rise at the middle of the short element is roughly the same as that one-quarter the way up the longer one; the temperatures from element to element do not add up. The same sort of phenomenon occurs with elements immersed in oil. The temperature-rise observed at the top of the oil depends also on the head of oil above the elements.

Rating Difficulties.

There are thus numerous difficulties with continuous rating. Those with intermittent ratings are vastly greater, because if the heating is complex, the cooling is equally so, and heating for one short period with cooling for a different period makes the problem one of the most difficult that can be imagined.

It seems going rather far to have one type with low thermal capacity and high dissipating capacity for continuous rating, another with high thermal capacity and poor dissipating capacity for infrequent starting, and a third intermediate type for running on a consecutive cycle. The element already described is a satisfactory compromise; it dissipates heat readily because the spirals are scrubbed by the air or oil, yet it has a high thermal capacity because the spirals are in close contact with the stoneware.

One of the difficulties is that with shunt magnets the number of watts falls as the temperature rises, while with series windings the watts rise with the temperature.

The study of oil-immersed resistances is full of difficulties and perplexities, and yet starters are rated on the basis of watt-seconds, and the specific heat multiplied by the total weight of the oil. This might be correct if the whole of the oil were in intimate contact with the resistance element, but this is not possible in practical designs.

Fig. 4 shows a standard three-phase rotor starter with three elements, *i.e.*, one element per phase, and a series of brass pockets soldered into the side of the tank. Particulars are given of tests on such apparatus in the original Paper.

An interesting point to note is the lag of the temperature-rise after switching off.

Rating Resistances.

It seems best to rate resistances in the same way as motors and brake magnets, that is, by a definite temperature-rise in a definite time, and then to work out curves for cycles so that the capacity on any given cycle could be read off. The next step, after rating the resistances on a more or less rational basis, is to arrange the results in tabular form suitable for the salesman, and there again another difficulty arises. The currents corresponding to the standard d.c. motor horse-powers rarely agree with those which give the maximum permissible temperature-rise of the elements, so that, for the most part, the resistance units are running far below the maximum.

A table of horse-powers and resistance sizes correctly worked out presents the apparent paradox of the smaller horse-power frequently requiring the larger and more costly resistance; a correctly worked out table is practically impossible for alternating current slip-ring motors, because there are no standard full-load rotor currents. These currents vary enormously for the same horse-power from one motor maker to another, and from Continental to British practice.

One result of such low standard temperatures is that British gear is practically unsaleable on the Continent and in South America, and in pre-war days was very difficult to sell in the Overseas Dominions against German and American competition. The same remark applies to cable connections and switchgear generally. The waste of cable in connecting starters is sometimes grotesque; people apply the I.E.E. Wiring Rules, overlooking that these rules are based on an extremely conservative temperature-rise.

A.C. Starters.

The remarks on step-by-step starters apply generally to both alternating and direct current, but starters for alternating-current motors present certain problems peculiar to themselves. The resistances are generally connected in the rotors of slip-ring motors but they may be, and sometimes are, connected in both rotor and stator. They are connected in the stator of squirrel-cage motors. Resistances in the rotor may be cut out of each phase equally or unequally and may be either star or delta connected; the former is the more usual.

There is no correct number of notches for alternating-current starters, but the greater the number the better the performance of the starter or controller.

It is far more difficult for the user to appreciate the effect of increased notches and diminished out-of-balance rotor currents, because the rotor out-of-balance current is not shown as being out of balance on the stator ammeters, whether the stator is star or delta connected.

The rotor out-of-balance current may be so great that the motor is running as practically a single-phase rotor, but the stator currents are nearly balanced. This balancing transformer effect is so great

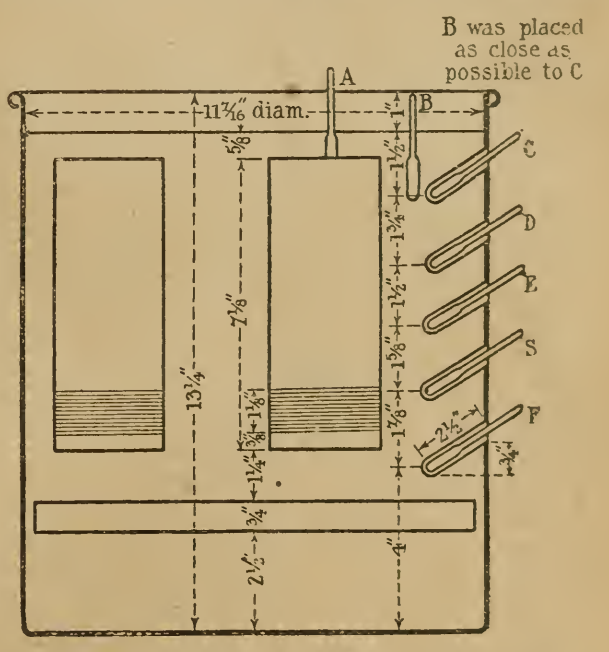


FIG. 4.—No. 1/1 OIL STARTER. 6 100 W PER PHASE. 30 SECS. "ON"; 7½ MINS. "OFF." 335 WATTS IN.² SURFACE OF WIRE. 1—68 TURN POT PER PHASE WOUND WITH TWELVE TURNS 16 S.W.G. "HECKRUM." TANK CAPACITY: 1 370 IN.³ GROSS, OR 103 IN. PER 1 IN. DEPTH. EACH POT 40·5 IN.³ (APPROX.), OR 5·69 IN.³ PER 1 IN. DEPTH.

Oil to top of pot ...	= 64·8 in.³	Oil E to S ...	= 140·0 in.³
,, Top of pot to C ...	= 75·1 in.³	,, S to F ...	= 169·5 in.³
C to D	= 150·2 in.³	Slate ...	= 77·5 in.³ (approx.)
D to E	= 129·0 in.³		

that even the rotor current-rushes on changing from notch to notch are averaged and represented in the stator by quite small swings.

There are probably many ways of calculating the notches and sections for unbalanced resistances, and the author has used several from time to time with more or less satisfactory results, but eventually an original method was developed, and this is described at length in the original Paper.

The Quebec Legislature have approved Bills promoted by the Montreal Tramways and Canadian Light and Power Company to purchase the power station of the National Hydro Electric Company at CARILLON (QUEBEC), with the right to sell electric power in 23 counties. The scheme will take four or five years to complete, and will cost between $30 000 000 and $40 000 000 for constructional work, plant, etc.

The Institution of Electrical Engineers.

At the meeting of the Institution on Thursday, March 2, Papers on "Electric Motor Starters," by Mr. J. Anderson, and on "Design of Liquid Rheostats," by Mr. W. Wilson, were read in abstract. Some notes on the "British Standard Specifications for Motor Starters," by Mr. C. H. Wordingham, were also read, and these specifications, together with the papers, were discussed conjointly. We publish, on another page, an abstract of Mr. Anderson's Paper. Mr. Wilson's Paper has already appeared in the Institution "Journal." Mr. Wordingham's notes are given in abstract below.

British Standard Specifications for Motor Starters.

By C. H. WORDINGHAM, C.B.E.

On the formation by the British Engineering Standards Association in 1914 of a committee under the chairmanship of the author, considerable difference of opinion was found to exist in regard to the distinction between a motor starter and a motor controller. It was finally agreed that the differentiation should be made on the basis of performance and not on construction, and the following definition of a motor starter was adopted:

The term "Motor Starter" denotes a device arranged for starting and accelerating a motor to normal speed, but not adapted for use in positions intermediate between the "off" position and the "full-on" position.

The term "starter" includes the following: (*a*) Rheostatic starters—(i) face-plate starters, (ii) drum starters, (iii) multiple switch starters, (iv) contactor starters, (v) liquid starters; (*b*) auto-transformer (compensator) starters; (*c*) switch starters for induction motors.

The corresponding definition of a motor controller is as follows:

A Controller is a device having several steps, contacts or positions, sometimes called notches, used with or without resistances, for regulating the speed of a motor or motors, and may or may not be used for starting. The term "Controller" does not include the resistances or other means of control employed therewith.

Simple shunt regulators are not included in this definition.

Face-Plate Rheostatic Starters.

A Specification for face-plate rheostatic starters was prepared and issued first. It was found necessary to discriminate between ordinary duty and heavy duty starters, the frequency of starting being the same in both, and the difference being in the starting periods. There was considerable discussion as to the starting periods before these points were settled, and the committee was greatly helped by Mr. G. H. Roberts, C.B.E., who dealt with the matter by the practical expedient of making trials on starters actually in use and known to behave satisfactorily under conditions of service. As a result of this investigation the objections which had been put forward were withdrawn.

Practically all specifications for motor starters prior to the work of the B.E.S.A. Committee included statements as to the number of contacts a starting switch should have, as well as the minimum resistance. Careful consideration, however, of the underlying theory of motor starting will show that the limitation of the current peaks as given in the specification provides all that is necessary in this respect.

Other Specifications.

On completion of the specification for face-plate starters the following specifications were commenced: Drum starters, liquid starters, switch starters, multiple switch starters, contactor starters, and auto-transformer (compensator) starters. These specifications are still in draft form.

Each draft specification is divided into four main parts, namely: (i) General definitions; (ii) rating, sizes and marking; (iii) design and construction; and (iv) tests. Mr. Scott Ram was consulted with regard to Home Office requirements, and he pointed out that as the degree of protection necessary for a motor starter to enable it to pass the requirements of the Home Office depended entirely upon the location of electrical apparatus, it was not possible to indicate in a specification whether a starter would or would not comply with the regulations of his Department.

The provision of an overload release on a standard starter has been made optional. It is recognised in the specification that motor circuits should be protected by independent fuses or overload safety devices, and that means should be provided, independent of the starter handle, for opening the main circuit of the motor.

DISCUSSION IN LONDON.

After the reading of the Papers, which occupied about an hour, the chairman, Mr. CAMPBELL SWINTON, asked a long list of speakers to be brief, and called up Major Gunton to open the discussion.

Major A. C. GUNTON said that Mr. Anderson's complaint of the scarcity of information available for the starter maker might possibly be met in future editions of the "British Standard Specifications." It had been found useful in other specifications to detail the information that should be supplied to the manufacturer, but care had to be taken not to encroach on the rights of the user nor to restrict the manufacturer in the evolution of new designs. In this particular series of specifications they were introducing clauses dealing with construction and testing and a way of making greater use of type tests was pointed out, though the principle of the type test could only be applied when the National Proving House was established. If the specifications were tried and made as full use of as possible, and the experience obtained embodied in representations to the B.E.S.A., the best way of improving the specifications would have been found.

Electrolyte Problems.

At the beginning of his remarks, Mr. J. M. L. SLATER dealt with the question of electrolytes. He had found washing soda to be the best, and though salt was useful when a low resistance was required it crept badly. Potash alum and potassium bichromate were also useful, colliery engineers preferring the former, as it gave steadier speeds during main and tail haulages. No allowance had been made in the rating calculations in the Paper for the variations in the form of starter; but in some the electrolyte was of different temperatures in different parts of the tank, and in others the whole of the liquid round the pots was heated uniformly. The only way of determining exactly what happened in large starters was to make a model and to discover the power absorbed per unit volume or weight of electrolyte.

No-Volt Release Troubles.

Mr. LLEWELYN FOSTER dealt mainly with the question of no-volt releases, saying it was not generally appreciated what troubles these gave on oil starters, whose operation depended on shunt coils which varied considerably with different makes of motors. When no-volt release coils failed the damage was not confined to the starter, but by causing inductive effects in the shunt coils it probably brought on a motor breakdown.

Ideals—Possible and Impossible.

Mr. J. T. MOULD said that the specification of standards for starters was obviously a compromise between the ideal and the practical. Before the panel started work each starter maker had his own standards with which it would have been unwise to interfere, so that what had to be done was not so much to evolve new standards as to co-ordinate those which existed in a form which would be accepted by everyone. The ideal of the user was often higher than that of the manufacturer, but it was not always possible to give the user all he wanted. In fact, it would not be good for him as the cost would be probably so tremendous that he would not be able to pay for it. A great point had been made of American standards, but some of the things the Americans allowed would hardly do over here, and, in fact, they had to choose between British reliability and American optimism. In the draft specification they claimed to have effected a reasonable compromise and to have laid a foundation on which others could build after apparatus produced according to the specification had been tried over a number of years.

Rating Methods Criticised.

Mr. T. CARTER made a number of criticisms of the rating methods followed in the specifications. If a motor to exert a 100 H.P. was required, a motor capable of giving 200 H.P. was not specified. Nor was it tested at half its rated output, but that was what clause 21 in specification No. 1.0 rather implied. A starter was capable of doing far more H.P.-min. than the specification permitted, and he suggested that there should be successive starts, but with long cooling periods between them. This would lead to the selection of a starter really suitable for the motor it was going to work with.

As it was, the B.E.S.A. tests set far too high a standard and would hinder development and restrict trade by making the starters too expensive. As regards temperature rise limits for conductor coils tests he had recently undertaken showed a wide difference in the temperature given when a thermometer and the rest of the resistance methods were used. The figures given in the specification were therefore confusing, and it would be better to be independent of the limit of 72 deg. and put in the correct figures from experiment. He did not think it was practical to give starting currents or full load currents for the motors, and there was also no need to mention efficiencies or power factors in the specification.

Electrostatics and Coils.

Mr. J. R. BLAIKIE said that the high peak shown in the middle of Mr. Anderson's curve probably had to do with the electrostatic state of the coils. In the case of series coils it was quite possible that the top one was nearer earth potential than the bottom one,

and the difference of temperature between the centre and the two ends was therefore considerably flattened out. The effect of dust on the flow of convection currents must also be taken into consideration, as this altered the rate of cooling. He would like to know whether Mr. Wilson was satisfied that the experiments on small apparatus, which he had conducted under a head of electrolyte, would be applicable to other types where a larger part of the action took place near the surface.

Mr. A. Dover called attention to the B.E.S.A. specifications in which the maximum peak of the current was specified. In that way, he said, with practical standards the whole of the resistance sections and the grading of a given rheostat could be expressed in terms of the percentage voltage drop in the motor at full load. Charts which he exhibited showed how the grading co-efficients for different conditions for given numbers of sections could be obtained.

Carbon as a Liquid.

Mr. H. Brazil said that Mr. Wilson's honesty with regard to the defects of liquid rheostats had led him to wonder whether it would not be better to use a material intermediate between solid and liquid, that was a solid broken up into powder. Experiments made on these lines had been perfectly successful, as the powder flowed as easily as liquid, and the resistance could be as easily regulated ; there was no trouble on direct current and the range of temperature possible was so much larger that a very much bigger rating could be allowed. While the space occupied by powder and liquid was practically the same it was possible to obtain 14·5 h.p. per lb. of powder as against 7 h.p. per lb. of liquid, the figure given by Mr. Wilson.

The Authors' Replies.

Mr. Anderson in reply, said that the conditions that starters and motors had to meet at starting were indefinite, and to attempt to set up standard rules to meet such indefinite conditions would be ridiculous. It would be better to give information to the starter maker so that he could intelligently supply a starter for the job. All that was needed in the standard specifications was an advance of the maximum temperature rise in certain classes of material. They could do the rest themselves.

Mr. Wilson, who also replied, said that his experience led him to consider ordinary washing soda as the best electrolyte. He had made no allowance for the variation of the temperature of the solution as it descended, but unless it was boiling he did not think it would interfere with the rating. He hoped that the specification was going to do a great deal of good, but if it did not go hand in hand with development it would mean stagnation. It was, therefore, a good thing that it was going to be revised every year. The rating formula was a very bad one and should be eliminated. He was aware of the discrepancy between his results and those in the text books, but he had repeated his tests and they came out the same every time. The difference seemed to be a matter of conditions. Mr. Brazil's suggestion with regard to the use of powder was well worth trying. His only doubt was as to contact, as there would be a possibility of arcing.

DISCUSSION AT NEWCASTLE.

Mr. Anderson's Paper was also discussed at Newcastle, and we give below an account of the various speakers' remarks.

Mr. J. Schuil pointed out that the practice of installing blow-out coils connected across the mains had the advantage of maintaining the field constant, and that further advantages could be obtained by the distributed effect of using several small blow-out coils instead of one large one. A series hold-on coil could also be utilised as a combined blow-out coil and no-volt release.

The Importance of Contact Design.

Mr. T. Carter considered that liquid starters were on the whole more useful for alternating than direct current working, but the development of the d.c. liquid starter was a matter of importance. Liquid starters he regarded as sound and satisfactory apparatus ; where troubles were encountered they were usually due to particularly bad treatment. An advantage of the liquid starter over the resistance starter was the ease with which it could be seen if anything was going wrong. In the case of resistance starters too much importance could not be attached to the type, condition and shape of the contacts, as the slight roughening which was likely to occur under operating conditions would rapidly upset all test bed data.

Mr. G. Mallinson said that the user frequently saw defects which the designers had never thought of, and mentioned that although a starter might give satisfaction in a power station, the same starter would probably be the cause of heavy maintenance charges if used in a plater's shop. For shipyard work starters required to be particularly robust. If cast-iron resistance grids were used it was necessary to employ the proper grade of cast iron. He advocated a definite stop in the off position for barrel controllers on d.c. cranes in order to prevent the operator moving his handle straight over to the reverse position. Enamelled wire resistances were variable, and he instanced a case of a wire resistance wound on a tube, covered with clay and subsequently baked, which gave a speed variation of 50 per cent. on inching, according to the day, the resistance being affected by the amount of moisture in the atmosphere.

Mr. J. Gibbins found the reluctance of motor manufacturers in giving the needful information to the starter makers to be increasing, and often the information could not be obtained until the motor was on the site. Starting switchgear was often regarded as a side-line, which was a great mistake. The importance of suitable switchgear could not be over-emphasised, as it was a sound investment and was a form of insurance.

Mr. A. P. Pyne emphasised the necessity for the development of push button control, as labour became continually more rough. He was confident that the use of contactors could solve all control problems if the contactors were properly designed for the job.

DISCUSSION AT BIRMINGHAM.

In the discussion on Mr. Wilson's Paper at Birmingham, Mr. J. Anderson said the liquid starter was ideal, theoretically, because the desired accelerating torque could be obtained with the minimum current from the line, but in practice the ideal was far from being realised. The author referred to the iniquities of the standard specifications, and rightly so. As regards temperature rise, "Why not let the stuff boil ?" generate and condense steam and work under pressure at temperatures of 300°F. to 400°F. It was a criminal waste of material to try to dissipate energy at 100°F. rise, and to throw away the possibility of utilising the latent heat of steam in short-rated starters.

Importance of Electrolytic Action.

Mr. H. C. Fox said that the tests did not establish that with alternating current of any periodicity electrolytic action was negligible. The point was of importance when the rheostat was in series with the rotor circuit of a lightly loaded induction motor. Here the frequency was of the order of 1 or 2 cycles per sec. unless the resistance value was very high, and in such circumstances a certain amount of electrolytic action might be anticipated as d.c. conditions are being approached.

Mr. C. Sutton said that a sound Paper on the design of liquid rheostats had been long overdue and this Paper would have served a very useful purpose if it convinced users that the liquid rheostat was a permanent article instead of only being of use in a test room.

Mr. B. A. M. Boyce asked whether there had been any difficulty with high voltage between electrodes just before they were short circuited.

Plain Water.

Prof. Cramp said that the deductions which the author made from his experiments would be rendered much more clear if he would add for each experiment the analysis of the electrolyte. He had referred to the use of "plain water." This was a very hazy term. Throughout the Paper the basis for the calculation of the surface densities was unsatisfactory, for the protection of the backs of the plates with insulation did not mean that there would be no current therefrom.

Islington's Electric Vehicles.

The cleansing superintendent of Islington Borough Council (Mr H. F. Wigfield) has published interesting figures of the comparative cost of collecting house refuse by electric vehicles and horse vans. The cost was 15s. 7d. and 17s. 4d. per ton for horse traction and electric vehicles respectively. The advisability of substituting motors for horse traction depended on local conditions, but there was no doubt that it was a forward movement to employ electric vehicles for dust collection, and this method would be pretty universal in the near future. He found that less outside supervision was required for this class of vehicle than for horse-drawn vehicles. Those who were seriously thinking of adopting electric traction should go fully into local conditions as to electricity supply. In the metropolitan area no two places were exactly alike in their charges, which ran between 1d. per unit at Woolwich to 2½d. in Islington. If direct current was not available large sums would be required for converting plant.

Mr. Wigfield states that allowance must also be made for the fact that the running of the plant would consume as much electricity as the vehicles themselves ; consequently there was a big initial outlay, and large sums were required for depreciation, interest on capital, and a bill for practically three units of electricity for every mile run. Manufacturers of electrical vehicles and users in some places would say that the usual consumption was about 1½ units per running mile, but that only applied when direct current was available. If local authorities and electrical engineers would only get a move on and provide a direct current supply, so that all electric vehicles could be supplied from a charging panel and plug only, without the need of converting plant, more than 50 per cent. of the present cost of charging vehicles would be saved, electric vehicles would be used more generally, and an enormous revenue would accrue to the electric supply undertakings.

Rotary Converters, with Special Reference to Railway Electrification.

We give below an account of the discussions which took place in London and Newcastle on the Paper recently read before the Institution of Electrical Engineers by Mr. F. P. Whitaker on "Rotary Converters, with Special Reference to Railway Electrification." An abstract of the Paper appeared on p. 258 of our issue of March 3.

DISCUSSION IN LONDON.

Mr. Roger T. Smith prefaced his remarks by saying that it was an opportune time to discuss rotary converters for railway purposes. Continuing, he remarked that short circuits would probably always occur in railway work, and it was therefore more important to secure converting apparatus that would withstand them without interfering with the traffic rather than to work for slightly better efficiencies. The d.c. part of the rotary converter was never intended as a generator, though on short circuit it became one and played its part very badly. With all its faults, the cheap cost and high efficiency of the rotary converter on low frequencies made it very attractive, but the space required by the transformers and by two machines in series necessary to get 1 500 V d.c. on a 50 cycle supply was a disadvantage. As nearly all the capital stations would be using a frequency of 50, the employment of motor converters, of synchronous motor generators, or of mercury arc rectifiers must therefore be considered. His own sixteen years' experience with 600 V motor converters had been entirely satisfactory, and he thought the machine would be equally satisfactory on 1 500 V with an a.c. supply at 11 000 V. In addition, such machines with 50 periods were much cheaper and as good as, if not better than, on 25 periods. They were stable on short circuit, and after short circuit came up excited in the right way. Their annual efficiency of output to input was as good as that of the rotary converter, although on isolated tests the latter might show figures 3 or 4 per cent. higher.

Criticism of the Rectifier.

Mr. J. R. Cowie supported the use of the synchronous machine or the La Cour converter in preference to the rotary, at any rate on 3 000 V circuits. He considered, however, that the mercury arc rectifier, in spite of its attractiveness in theory, required a good many mechanical improvements before it could be satisfactorily used on traction circuits. The maximum short-circuit current of 14 000 A given by the author could be kept down to 6 000 A by the use of high-speed diverter switchgear, and the maximum peak could be reached in less than half the time given by the author. One of the things omitted from the Paper were slip ring difficulties. Personally, he had not found a satisfactory a.c. slip ring brush. The dust from the wire brushes powdered the whole of the windings and this, when a short came on, rose up in a cloud.

Experiences with H.-T. Rotaries.

Col. H. E. O'Brien said that at first they had a good deal of trouble with the 1 250 V, 25 cycle rotary-converters used on the Lancashire and Yorkshire Railway, which were designed about 1915, but when they removed the compounding not much further trouble had been experienced. Were it not for the batteries installed, however, the interruptions to traffic would probably have been serious, and Mr. Whitaker therefore deserved a good deal of gratitude for indicating methods by which rotary troubles could be prevented. The flash-overs they had experienced were not very serious, being generally confined to a particular pair of brushes, and the brush gear, which had been working since 1916, was only now beginning to show signs of heavy wear. The suggested improvements in 1 500 V rotary converters would enable them to increase the load factor of the sub-stations. The rotary converter had a rival in the mercury arc rectifier, which functioned well on very fluctuating loads, though it had the grave disadvantage that it was no use for sudden increases in load, as it required from 20 to 25 min. for warming up.

Reliability Rather than Efficiency.

Mr. G. A. Juhlin said that reliability rather than efficiency should have taken first place in the author's schedule. The limit of 13 V per bar for 50-cycle machines was rather low, as there were hundreds of thousands of kilowatts of 50 and 60-cycle plant operating at 15 or 16 V per bar, and there were machines in London with bars not more than 0·14 in. in thickness. In regard to commutator speeds, Mr. Whitaker erred on the other side. He doubted whether there were any machines other than d.c. turbo-generators which ran at 8 000 ft. per min., though by the use of a radial commutator a higher speed than that could be safely obtained. Machines with radial commutators were already operating without difficulty at speeds up to 11 000 ft. per min. If, therefore, 15 V per bar with a speed of 9 000 ft. per min., and a thickness of commutator bar of 0·175 were taken as criteria there should be no difficulty in producing a 1 500 V 50-cycle rotary converter. For 3 000 V it would still be necessary to use two machines in series or to employ synchronous motor-generator sets. The direct-current side could be protected from flash-overs by short-circuiting the machines across three slip rings on the shaft. These slip rings were put in circuit by an automatic switch as soon as a heavy overload occurred. He showed a slide illustrating a set operating under these conditions and carrying seven-and-a-half times normal load, in which brush flashing was only just discernible. The time lag on the "suppressor" was 0·005 sec., and the current rose to about ten times the normal before it acted. With this method the voltage was taken off the machine, and, although the current rose rapidly, there was no flash-over on the machine itself.

Will History Repeat Itself?

Dr. S. P. Smith said that the author catalogued numerous difficulties, but did not indicate the way in which they could be overcome. Every designer tried to keep the pressure between the segments as low as possible, but they would have gradually to approach whatever the possible limit was, and it was no good trying to keep down to a figure of 13 V on the highest frequency, especially as satisfactory machines had been built with 20 V between the segments. The thickness of the mica was also an important point. Machines had been built with bars as narrow as 3 mm. with 1½ mm. of mica between them. Possibly when all these improvements had been made the same thing would happen to the rotary converter as had happened to the direct current generator, which, directly it could be satisfactorily built, had been ousted by the rotary converter. Now the rotary might in its turn be ousted by the mercury rectifier. Col. O'Brien said that his machines had been better since he had cut out the compound winding. They would probably have been equally successful had he reversed the compound winding, as the great thing was to bring down the voltage and keep the current from rising above the normal value.

Uneconomic Overload Ratings.

Mr. P. R. Wray said that with rotary converters the overload capacity was a most important consideration. Enormous sums were spent in providing overload ratings which were never used. Where a number of sub-stations fed into a common system, as was usual in railway working, there was no justification for sustained overload ratings.

Complications v. Simplicity.

Mr. W. E. Highfield said that it was extraordinary how many enemies the rotary converter had and yet how many of them were used. Two or three years ago the question of rotary design was fully ventilated in America, and the causes of the short-circuits were isolated, but the resulting design was decadent and retrograde, as the spaces between the brush arms were filled up with flash guards, wire netting, and other devices which defeated the object for which they were designed. Insulation used in this way carbonised after a time and damaged the commutator, while the machine was so completely masked that it could not be readily cleaned or inspected, Mr. Whitaker's design, though a great improvement in these respects, had the disadvantage that it was very conservative. He had built machines with air-insulated commutators which ran at an average pressure of 90 V per bar and showed no flash-overs. Commutator speed was a question of the design of the brush holder. He had seen brush holders that ran at 10 000 ft. per min., and others which would not run at 3 000 ft. per min.

A Single-Phase Advocate.

Major A. M. Taylor said that 1 500 V was by far too small a voltage for main-line electrification. Between Birmingham and London fifteen main-line trains ran each way during twelve hours. At 45 miles an hour that gave a 36-mile headway. Dividing the lines into three sections there would be in each section two trains, one going each way. With 6-mile sections, and with trains taking 1 000 h.p. each, eighteen rotary converter sub-stations would be required. This would necessitate a tremendous capital outlay which could be avoided with single-phase working, especially if the trolley voltage were raised to 15 000 V with transformers on the locomotives, for the sub-stations could then be 20 miles apart. With the eighteen rotary converter sub-stations there would be a large amount of running at zero efficiency unless automatic devices were used.

The Designer's Point of View.

Mr. R. Jakeman said, fitting a fan to blow out the arcs seemed rather primitive. He preferred a magnetic blow-out arrangement. A high-speed circuit-breaker described in an American paper some years ago was said to have a spring compressed to 8 000 lb. pressure, which was released by a plunger in 0·001 sec. This seemed hardly possible. While it was true, as the author said, that rotary converters were not much larger than motor generators the increased

amount of insulation with which the conductors were wrapped prevented the heat being got rid of so quickly, and the current densities had therefore to be kept lower. It was not necessary to supply the two rotaries in series as shown by the author with two separate secondaries on the transformer. Harm from tooth ripples could be decreased by keeping the number of slots as large as possible so that the tooth ripple was above the ordinary speed ripple on the telephone. The mean air gap should also be made large, but these two things resulted in a larger machine.

Rotaries and Telephones.

Mr. S. C. Bartholomew discussed the paper from the telephone engineer's point of view, and said that the old idea that direct current traction was not harmful to the telephone had had to be changed in recent years. He was, therefore, pleased to find that Mr. Whitaker could produce such insignificant ripples on direct current circuits. Unfortunately the rotary gave a ripple of between 900 and 1 100 per sec., a range which had the greatest effect on speech, while the fact that they were used on an unbalanced power circuit with an uninsulated return also had serious consequences. Those engaged in power supply often overlooked the fact that a telephone circuit was effected by a very few microwatts, and that the effect was cumulative If the ripples could be reduced to 1 or 2 per cent. there was little fear of interference with the Post-office circuits.

The Author's Reply.

Mr. F. P. Whitaker, in replying to the discussion, exhibited a slide of a 1 000 kW, 500 revs. per min., 1 500 V machine which was to be employed on the Victoria Railways. This would stand three times the full load for 20 sec., and when from seven to eight times full load current was thrown on the machine there was only a small amount of arcing if a high-speed circuit-breaker were employed. With a low-speed circuit-breaker there was rather more arcing. Turning to the discussion in detail, he said that for railway work rotaries were the most economical machines to employ, because any high-tension voltage could be handled without transformers. Whether electrification was accomplished by means of motor generators or rotary converters, the flashing problem had still to be solved. A good machine could not be made out of a bad one by the introduction of a high-speed breaker, but if the vapour present were reduced the flashover was also reduced, and that was what the high-speed circuit-breaker permitted. If the slip rings were well spaced there was no need for special protection. With regard to Col. O'Brien's remarks, the more heavily a machine was damped the more easily would it take the full field excitation. To obtain 1 500 V from a single armature meant encroaching on the margins of safety, and at present it had not been proved that there was the same factor of safety with a single as with a double armature. The same applied to the voltage per bar. In this connection spontaneous flashing was the most serious, and the higher the voltage between the bars the nearer the spontaneous flash point was approached. Mercury arc rectifiers eliminated many of the good properties of the rotary converter—a machine which already had practically unity power factor. There was, besides, no ready means of compounding rectifiers, and the train equipment, therefore, had to work over a bigger voltage range than it would if constant voltage could be maintained.

DISCUSSION IN NEWCASTLE

Prof. W. M. Thornton remarked that the cause of flashovers was originally thought to be a rise in voltage, but it was later ascertained that they were actually due to a fall in resistance. The question then arose as to whether the fall of resistance was due to the presence of copper vapour or carbon dust. It had since been traced and confirmed by experience that it was due to the presence of carbon dust, compared with which the conductivity of copper vapour was low. The presence of such dust would obviously lower the resistance of the surrounding air and render a flashover more likely. The practice of fitting wipers on the surface of the commutator immediately behind the brushes had invariably been found effective in preventing flashovers; this confirmed that flashovers were due to the presence of dust or solid particles, which could be collected, as such wipers would not be able to collect or remove vapour.

Rotaries for Automatic Sub-stations.

Mr. W. T. Dalton considered the improved designs of rotary converters, which after a flashover would be able to start up again without damage to the commutator or brush gear, would be eminently suitable for automatic sub-stations where no attendance was provided. Unless such machines were used there would be a danger of a machine being started up in a damaged condition. In order to provide for regenerative braking it would be necessary to reverse the series winding; on a rotary converter he thought it was improbable that this would be done. The question of telephone interference was very important, and although some telephone systems were more sensitive than others, railways were generally in a more favourable position than tramways in this respect due to the rails being insulated from earth.

The Author's Cautiousness.

Mr. F. T. Townend thought the limits of voltage per bar and peripheral speed given in the Paper to be on the safe side. To increase the d.c. voltage obtainable it was necessary to increase the peripheral speed, with an axial commutator it was not desirable to exceed 8 000 ft. per min., but if a radial type commutator be adopted the speed could be increased considerably and might be the means of obtaining 1 500 V on a single unit machine at 50 periods. In addition a radial commutator was much more simple. He also considered an air draught due to an axial fan to be far more effective than any magnetic blow-out for blowing the arc off the commutator. He gave a description of the "Storer" arc suppressor which had proved satisfactory in the prevention of flashovers. To intercept the short circuit on the d.c. breaker took time, and before the breaker could operate a flashover on the machine occurred. It took much less time to close a circuit than to open one and the suppressor, working on this principle, short circuited the slip rings in 0·006 sec., thereby killing the voltage on the armature before the d.c. flashover could occur. The field circuit was also interrupted. Slides were shown of a short circuit on a machine with and without the suppressor, from which it was obvious that when the suppressor was used no damage to the machine occurred. These suppressors were exceedingly useful on motor generators. But not to be used on rotary converters owing to the fact that they would pull the machine out and it would have to be started up afresh.

Mr. C. Sykes described some recent short circuit tests on a 1 500 kW rotary converter which he had witnessed, in conjunction with which high speed circuit breakers were used. He was impressed by the absence of any sign of burning on the commutator or brushes after thirty-seven short circuits had been applied.

Commutator Wear.

Mr. J. R. Beard gave some interesting figures regarding the wear of commutators. On railway machines the commutators frequently had to be cleaned up and considerable wear would be expected. It had been found that in seventeen years service only ¼ in. of wear had resulted, which was equivalent to sixty-eight years per in., a very reassuring figure. The Newport-Shildon rotary converters, operating on 1 200 kW were very satisfactory in clearing short circuits on the d.c. side, continuing to run and being ready to resume load when the d.c. breaker was again closed up.

Mr. H. B. Joynder added that only three times in the life of the machine referred to by Mr. Beard had the d.c. circuit breaker opened on short circuit and on each occasion this was due to the breaker being out of adjustment. Experience with the rotaries at Ayecliffe showed that all the flashovers were to the bedplate or to the pedestal, *i.e.* to earth. In this connection it was found that a coating of paint was quite a large deterrent, apparently due to the resistance being considerably increased. When a circuit breaker opened on overload a flashover frequently followed, and he thought that the requirements were not so much a high speed circuit breaker as a circuit breaker which had a high speed of opening, but finished its movement slowly.

The Use of Diverters.

Mr. H. W. Clothier suggested a high speed diverter switch should be utilised to protect a rotary converter where the conditions were severe, the diverter switch limiting the duration of the short circuit by inserting resistance in the circuit. When the current reached three times its normal value the diverter switch would operate and insert the resistance within 0·3 sec., so limiting the current until the ordinary circuit breaker of a deliberately slow break type had time to operate. It was undesirable to allow high tension switches to operate when a d.c. short circuit occurred, the duration of the short circuit should be limited without interfering with independent switches, thus leaving the machine ready to take up load again.

Mr. J. Rosen, said the flashover problems with rotary converters were similar to the problems encountered in the days of d.c. generators, where compensating windings were found very useful.

Mr. P. F. Allen believed that the experimental results with increased speed and radial ventilation of rotary converters had shown a reduction in the liability to flashover, and in the damage done to the machine.

The Author's Reply.

Mr. F. P. Whitaker in reply, emphasised that the important point was to get the flashover arc off the commutator. Rotary converters had been installed for regenerative breaking, being fitted with a special form of contactor gear to provide for the reversal of the series winding The addition of flash barriers to a machine was not desirable as they simply added to the maintenance. He agreed that the short circuit current should be limited as quickly as possible in order to reduce the quantity of conducting vapour produced, but the final break should not be rapid. The fastest circuit breaker he had seen limited the current in the circuit in 0·005 sec., but it was doubtful whether it would be possible to guarantee that the current would be limited on a 50 or 60 cycle circuit. To instal reactance in the d.c. circuit was not commercially feasible

The Home Idealised.

(*Continued from page* 321.)

"Sun"-ny Domesticity.

An excellent array of labour-saving appliances is to be found on the stand of the SUN ELECTRIC COMPANY, which is divided into two main portions, one of which is arranged as a modern kitchen, and the other as an imposing dining room. In the former are to be found in working order the A B C electric laundress, types of the "super-electric" washer and wringer, one of which is of aluminium

FIG. 7.—VIEW ON THE SUN ELECTRICAL COMPANY'S STAND.

with 12-in. rollers. These rollers swing in a complete circle round the base and automatically lock rigidly in any one of twenty positions. Then there is the oscillating electric washer and wringer in which the tub is given an effective oscillatory motion, so ensuring thoroughly clean work in the shortest time possible. While it may be said that the dolly electric washer and wringer, which is also on view, is pre-eminent because of the care taken in its construction and the high grade materials used. It is interesting to note that no gears or motors are attached to the tub, all of them being fitted to the underneath framing. The dolly is self-locking and takes up the correct position for washing irrespective of the clothes placed in the tub.

Dish Washing Revolutionised.

Next there is the Holiday electric dish washer—a piece of apparatus most aptly named. This is an automatic appliance which, we are told, will handle the average six-piece dinner-service comfortably at one loading, and really does wash the dirtiest dishes in three minutes, which is, after all, what a washer is for. Not only does it wash the dishes, but it also rinses them and dries them before ejecting them, so that the harassed housewife contemplating this piece of apparatus will almost be persuaded that the millennium has come.

Lastly in this section is to be found the "Reco" kitchen table unit, which is a kitchen table equipped with an electric motor, connected to a gear-box and couplings of patented construction. With this simple and ingenious piece of apparatus the housewife can make cakes, beat eggs, whip cream, mash potatoes, drive food choppers, sharpen cutlery, clean silver, and, in fact, do almost every domestic operation except dress and undress the baby.

"Sunco" Fires.

In the dining-room section are Sunshine electric cleaners and representative models of Sunco electric fires. Among the latter we specially noted one of Tudor design with an armoured bright finish, which is placed in a fire grate in the position usually occupied by coal fires, principally, so the Sun Company tell us, because a good many people in their conservatism still prefer to sit round a fire instead of on it. A view on this part of the Sun stand is given in Fig. 7

Wireless in the Ideal Home.

No home is ideal without its wireless equipment. At least, this is the opinion of the BRITISH THOMSON-HOUSTON COMPANY, who are showing in working order their portable wireless receiving set. This, though not actually designed for the purpose, is admirably adapted for home use, as it is simple and by means of three easy adjustments can be employed to pick up signals from all sorts of interesting stations. We gave some details of this equipment in our account of the Shipping and Machinery Exhibition last autumn, but it may be added that the equipment is contained in a highly-finished cabinet which is as artistic a piece of drawing-room furniture as any gramophone. The set requires no aerial or earth wires, and has a range of reception from 300 to 20 000 metres. It can be used as a direction finder, and wave meter, and, becoming more technical for the moment, can also be employed to locate an earth on a.c. or d.c. cables. If, moreover, an aerial can be begged, borrowed or stolen and connected to the terminals fitted on the set wireless concerts and wireless telephone conversations can be excellently received.

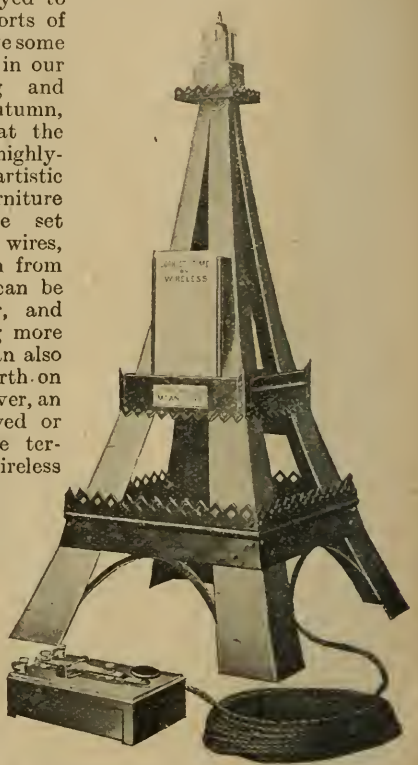


FIG. 8.—B. T.-H. WIRELESS TIME INDICATOR.

In these days when time is money a wireless flashing device which is also exhibited is of interest. This allows the wireless time check from the Eiffel Tower or other stations to be flashed in plain figures to the public four times daily. This time is guaranteed to 1/100th of a second. For spectacular purposes in the shop window this device may be made up in the form of a small Eiffel Tower, as shown in Fig. 8, while more suited for outdoor indications is the large box-form illustrated in Fig. 9.

Another exhibit is a small motor generator with a range of output from 50 to 150 W. This can be connected to a lighting circuit or driven separately by a belt for wireless transmission purposes or for charging accumulators, while, as it is readily portable, it can be put to a variety of other uses which need not be detailed.

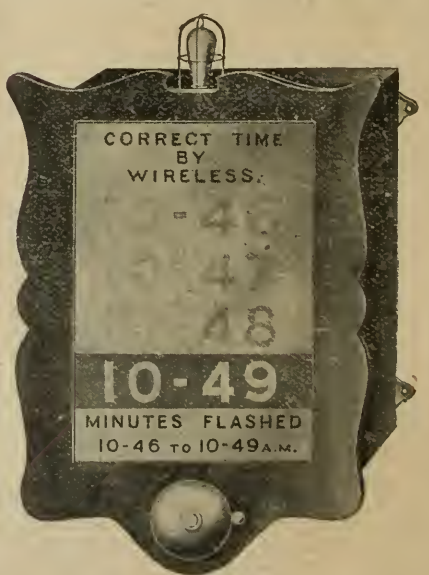


FIG. 9.—ANOTHER TIME INDICATOR FOR OUTDOOR WORK.

It may be pointed out that a successful demonstration of wireless telephony and music which are being given by the British Thomson-Houston Company at the exhibition has not been achieved without difficulty, as Olympia is be-sprinkled with steel structures whose screening effect is pretty noticeable.

"Universal" Labour Saving.

The stand of L. G. HAWKINS COMPANY is crowded with Universal domestic labour-saving appliances, ranging from washing machines to electric kettles through a variety of stages. The various features of these appliances are so well known as not to require any further description, though special attention may be called to the lighting standards shown. These include a Georgian

pedestal candle fitting and canopy shade in one, which carries two metal filament lamps, and by the colouring provided gives a soft mellow light which is most pleasing and comforting. The same idea is applied to pendants. In all cases the lamps are controlled by switches in the lamp-holders, which are operated by positively pulling a chain. A view of one of these lamps is given in Fig. 10.

Needless to say the "Universal" electric washer also finds a place in full working order, and it will be remembered with some interest that the motor of this is so arranged to cut out on overload. A reciprocating motion is given to the drum containing the clothes by means of a cam device. A modification in the "Universal" toasters consists of a special carrier for the piece of bread undergoing the operation. This works on a reciprocating-reversible principle, so that the toast can be turned round without being touched by the hand. This is not only an advantage from hygienic reasons, but prevents burnt fingers, loss of temper, and deposition of the toast on the floor.

We were also shown a new iron whose special feature is its round heels, which prevent the material rucking up when the iron is brought back. The Wallis adjustable bed rail lamp, too, is an exceedingly compact piece of apparatus, which should not only

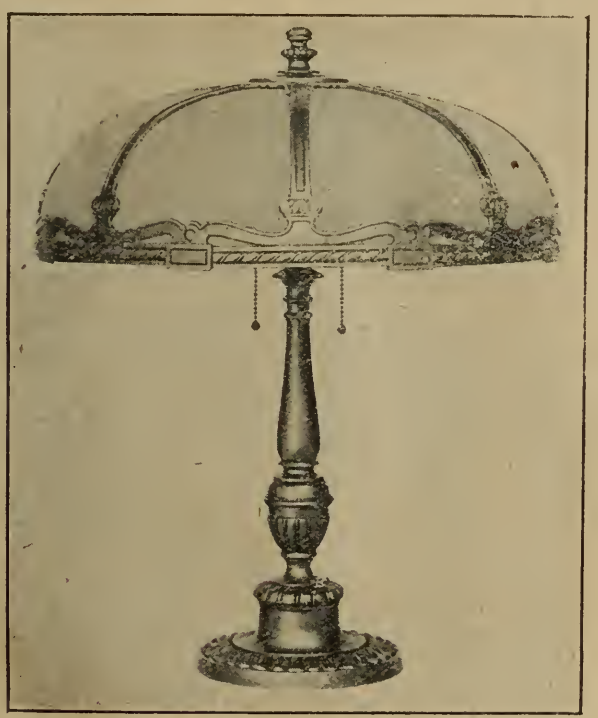


Fig. 10.—A Tasteful Fitting on L. G. Hawkins & Company's Stand.

be in the possession of all those who follow the pernicious habit of reading in bed, but is equally useful for placing on the piano, for excursions by night into the wine cellar, if any, or for employment in any place where it is necessary to have a portable light and at the same time desirable to put it down when both hands are required for some other operation. This lamp will stand and hang anywhere, has the further advantage that it takes to pieces very easily and packs up into a very small space. Then there is the 40 W bed warmer, which contains three heats operated by a most ingenious push switch with an indicator, all so small as to be almost a watchmaker's job. The plunger, which is operated by the thumb, is cut with spiral grooves, which give it a rotary motion round the various contacts when pressed. In decorating the stand considerable use has been made of Hawkins' colours of yellow and gold, and the general effect is very pleasing.

The Olipel Heater.

Mr. Herbert Hogg is showing the Olipel water-heater, which is an electrical means of obtaining hot water without any further difficulty than connecting an adaptor or a wall plug to the electricity supply main. The heater itself is constructed of nickel-plated copper heavily tinned on the inside and weighs 6½ lb. It has no complications to get out of order, and it consumes only 0·75 kW h in twenty-four hours.

The Birmingham Guild, Ltd., have an artistic display of all types of metal fittings for the home. These of course include electric light fittings, of many pleasing designs and efficient execution.

(To be concluded.)

Correspondence.

MECHANICAL AND ELECTRICAL EFFECTS OF LARGE CURRENTS ON H.T. SWITCHGEAR.

To the Editor of THE ELECTRICIAN.

Sir.—In your issue of February 17th there appeared a letter from the Metropolitan Vickers Electrical Company, commenting upon my notes on the above subject contained in your January 20th number. Absence abroad has prevented my giving attention to this before. The switch mechanism illustrated by the Metropolitan Vickers Company contains many excellent features, although I assume, seeing that it embodies a wooden operating rod, which is a type of design now abandoned by modern designers, it is shown mainly for its historical interest. The shape of the brushes, however, is certainly in accordance with the principles laid down by Mr. Torchio as a result of his experiments.

In my opinion, however, nothing can compare for efficiency in oil switch contacts with the controller finger form. For one thing such contacts are very much easier and cheaper to renew than are brushes. I do not think any designer would use a brush form of contact for high tension oil switches unless he is forced to do so by reasons of lack of space to accommodate the finger type.

Many American designs of oil switches in the past have utilised relatively very small oil tanks and it is easy to see why brush contacts have been used with these tanks to such a large extent. The British practice, however, of using very much larger oil tanks is, in my judgment, the better one.

With reference to the statement that the finger contacts shown in my Fig. 3B can "freeze" together, this is quite impossible. "Freezing" only occurs between contacts when an electric arc plays between the contacts. As the two fingers in Fig. 3B however, are always at the same potential there is no possibility of an arc occurring between them.

I quite agree as to the desirability of keeping the resistance of the arcing path as low as possible as compared with that of the main contact path.—I am, &c.

Sutton Coldfield, March 20, 1922. Charles C. Garrard.

The Silvanus Thompson Memorial Lecture.

The fifth Silvanus Thompson Memorial Lecture was delivered before the Rontgen Society on Tuesday, March 21, by Sir Oliver Lodge, the subject being "Magnetism—and the Ether." The first part of the lecture was devoted to an appreciation of the late Prof. Silvanus Thompson, who was first President of the Rontgen Society. Sir Oliver referred at some length to the high qualities of Prof. Thompson, and summed him up by the remark that he was a good friend in every sense of the word.

The Nature of Magnetism.

After mentioning the work of pioneers in radio-activity and its application to medicine, Sir Oliver considered the problem of magnetism and the ether. We could not generate magnetism, or electricity, or matter; but could only set it in motion or re-arrange it. Many still thought that they could generate magnetism, and certainly they could make any number of magnets, but always by the aid of an initial magnet; the specific germ of life had to pre-exist. He admitted that an electric current could be generated by the process of setting an electron in motion, but the evidence went to show that the magnetism which accompanied an electric current was something pre-existing in the ether, and was not called into being out of nothing. Heat, light and sound were forms of energy, but magnetism was no more a form of energy than was electricity or life.

Magnetism and Current Inseparable.

Dealing with the ether, Sir Oliver said that matter was not necessary for a magnetic field. Iron and other magnetic substances had a large number of magnetic loops in their own constitution, so that when these were opened out they added themselves to the loops which existed independently of matter and thus produced a stronger field for a given magneto-motive force. But such extra loops were not essential, for nothing had yet shown that an equally strong magnetic field could not be produced in empty space, that is, in the ether, if a sufficiently strong current were available. Sir Oliver then went on to discuss the prodigious intensity of the circular fields surrounding the equator of a rapidly moving electron, besides which there were the loops which could be opened out in the process of magnetisation, but even when opened out the loops remained perfectly closed curves, passing through the core of the magnet and never terminating on its surface. An electric current was also continuous and circuital, but when the current stopped, the portion inside a conductor ceased to be. Magnetic lines were always closed complete curves. A magnetic loop and a current loop were always linked together, and one seemed to be just like the other, but the difference was that the current circuit could be cut, and when the current stopped the circulation stopped dead.

leaving, if any residue at all, an electrostatic field between the cut ends. But the magnetic loop behaved differently. When the generating current strengthened it expanded, when it weakened it contracted, and when it stopped the magnetic loop shrank so that it enclosed only an infinitesimal area. The amperian circuits remained, and though they existed in matter, they existed also in empty space, so that magnetism was an affair of the ether.

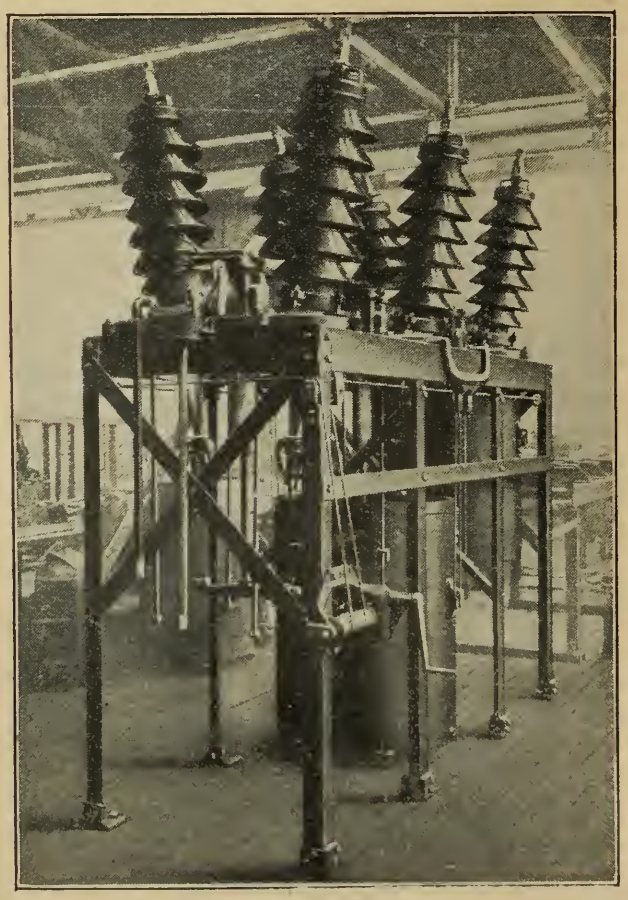
Magnetic Circulation.

As to possible circulation, there was an obvious possibility that something was circulating round a circuit always closed. The working hypothesis was that there was a slow etherical circulation or flow along the lines in a magnetic field, the flow being in orbits of considerable size, so that a beam of light might be sent along against the flow, and a measurement made to see whether the light was accelerated or retarded. It was becoming customary in a few quarters to doubt the existence of the ether of space, and to suppose that Einstein had exploded it. That was contrary to the truth, and, so far as Sir Oliver knew, no great authority on relativity really supposed that. Certainly Einstein himself did not. On the contrary, his discovery, linking gravitation with light for the first time, strengthened the position of the ether.

High Voltage Outdoor Switchgear.

The Metropolitan-Vickers Electrical Company have shown their belief in the need for switchgear for high voltages, and particularly for outdoor gear, in the most practical manner by laying themselves out to build it in their works at Trafford Park. In the accompanying illustration is shown a 73 000 V oil switch in course of construction in their shops. The line of high voltage outdoor switchgear which they are constructing is practically identical with that built by the Westinghouse Electric & Manufacturing Company in America. It is thus in no sense an experiment, but a series of thoroughly tried-out engineering designs.

The particular switch illustrated is intended for outdoor use, and has an assigned breaking capacity of 300 000 kVA. Duplicate butt



A 300 000 kVA Switch for Outdoor Work.

contacts are employed, these being housed in metal castings of smooth profile to avoid corona trouble. For the purpose of the photograph these shields have been omitted in one case, as have also the porcelain sleeves which are fitted to protect from damage by the arc the lower ends of the condenser terminals. On the bench to the right of the switch will be seen the magnet frame and coil for the electrical operating mechanism. When assembled this stands on the floor at the near end of the switch. The long lever shown on the mechanism bracket is removable, and is mainly used for setting up the contacts during assembly.

Industrial Conditions in Norway in 1921.

The year 1921 for Norway, as for most other countries, was a time of crises. In his annual review of the industrial and economic conditions, Mr. C. L. Paus, H.M. Commercial Secretary at Christiania, states: "The readjustment of values has proceeded apace, and many persons have succumbed to the resulting losses, while the fate of others still hangs in the balance. The national finances are also severely strained, and the sources of taxation have begun to fail, at a time when extraordinary funds are urgently required for the payment of debts and the relief of unemployment. Although the excess of imports over exports is much less than in 1920, the balance of trade remains very unfavourable and Norwegian currency is at a heavy discount, but the general feeling is, whether justifiably or not, more hopeful than it was a year ago."

Requirements of Manufacturers.

The requirements of manufacturers in respect of raw materials and instruments of production fell very far short of the normal owing to acute industrial depression, and the capacity of merchants to absorb further quantities of imported manufactures similarly maintained an unusually low level, owing to the existence within the country of large stocks of such commodities, the abnormal condition of the International exchanges and diminished purchasing power on the part of the public. Currency questions played a most important part in determining the sources from which the small demand for new imports should be satisfied. In this respect German exporters enjoyed a very great advantage, and they were, therefore, in a position to book most of the business in current commodities, although, at the same time, buyers hesitated to place in Germany special orders for large machinery, &c., which involved late delivery and advance payments. British traders, on the other hand, found themselves in a most unfortunate situation, since the high value of sterling as compared with that of Norwegian kroner rendered trading exceedingly difficult, if not altogether impossible.

Slow British Deliveries.

The demand for British goods is stated to have fallen off very greatly owing to slow delivery and the abnormal rate of exchange, so that only specialities, such as particular kinds of steel and patent machines, which cannot be procured elsewhere, are now purchased in the United Kingdom. German exporters appear, by virtue of their low prices, not only to have regained their former position in the market, but to have excluded all competition, although, during the earlier part of the year, a good trade was done from Austria. A large importer considers that, when the sterling exchange returns to a more normal level, British manufacturers will have little difficulty in recovering their old trade in such commodities as drills, files, screw-cutting tools, wrenches, &c., which have a good name in Norway, but that they have little prospect of doing business in machinery unless they have improved upon pre-war patterns.

Electrical Machinery and Insulated Cables.

Owing to the depreciation of the mark, German manufacturers dominated the market for all kinds of electrical machinery and cables. British, American, Swedish and Swiss firms, therefore, experienced great difficulty in doing business. For the same reason Norwegian factories secured a very small portion of the trade: they worked at only about half their capacity and sold at prices which probably entailed a loss.

Owing to the prevailing general depression, and particularly that of the electro-chemical industry, the demand for new supplies for industrial purposes was very small. It is anticipated, however, that 1922 will see a fair demand for small transformers and motors and for cooking and heating apparatus in connection with the realisation of municipal power schemes. It has not hitherto been found that the fall in the price of coal has affected the demand for electrical cooking and heating appliances.

At the present moment German manufacturers are doing a good trade, and it is expected that they will continue to secure the bulk of the business unless the mark recovers in value.

Both the electro-chemical industry and the electro-metallurgical industry have suffered severely. The production of carbide is practically at a standstill, as demand is small and it is found impossible to compete with German prices, particularly in overseas markets. The nitrate factories controlled by Norsk Hydro Elektrisk Kvaelstof Aktieselskab have maintained a good level of production, but have suffered from the German competition. The prospects for the engineering industries are described as poor, but it is hoped that an improvement will result from a reduction of wages this spring, when the rates fixed by compulsory arbitration in 1920 lapse.

Water Power.

The Commission appointed by the Storthing in 1918 to enquire into the question of a national plan for the supply of electricity over the whole of Norway has concluded its preparatory work, and draft proposals will shortly be submitted for satisfying the requirements of practically the whole country in respect of energy for lighting and domestic purposes, and for the use of farmers, craftsmen and small industries, on the basis of 250 W per individual. It is estimated that, without including the cost of supplies already available, it will be necessary to expend a further sum of Kr. 300 000 000 to this end. It is apparently intended, the report states, to suggest that the public authorities of each county shall in the main be made responsible for, and shall be given the necessary powers to undertake, the provision and distribution of electrical

energy within the country in so far as the smaller towns and country municipalities are concerned, while the larger towns will be required to organise their own supply, as, in fact, they have already done.

During and immediately after the war a large number of schemes were initiated by various municipalities with a view to providing electrical energy for domestic and agricultural consumption and for the use of minor industrial concerns, and many waterfalls were harnessed to this end. Arrangements for the distribution of the power which has thus become available are now being made. In view of the prevailing industrial depression and the fact that new supplies of energy are required only for domestic service, it is generally felt that power already harnessed will satisfy the demand for the next few years, unless the electro-chemical and electro-metallurgical industry should receive some at present unforeseen impetus.

Government Power Schemes.

It has been arranged that the municipalities of Christiania and Drammen shall receive from the Rjukan Power Station 12 500 kW and 2 500 kW respectively, while the Buskerud county is to receive 4 000 kW from the same source. The scheme for extending the Labro power station with a view to the delivery of an additional 3 600 kW to the Drammen municipality has been suspended for the present. The Norwegian Government will undertake the construction of the transmission line from Rjukan to Kongsberg, while the Buskerud county and the municipalities of Christiania and Drammen will undertake the transmission for the remaining distances. The construction of this transmission line was commenced in the spring of 1921, and it is expected that the power will become available for use in October this year.

Operations are being continued in connection with the power scheme at Nore, where the tunnel and catchment basin are in process of construction and the site for the pipe line is under preparation. A grant of Kr. 4 500 000 has this year been made to the scheme. Work is also proceeding on the railway from Kongsberg to Nore, upon which Kr. 4 500 000 has now been expended.

Work upon the Hakavik installation, which is to supply power to the Christiania-Drammen railway, is nearing completion, and it is now hoped that electric traffic may commence between Christiania and Sandviken or Asker early this year. It will be necessary, however, to construct a new bridge over the Drammen River before the whole journey can be made by electric train, as the existing bridge is not strong enough to carry the heavy electric locomotives.

At Glomfjord, in the Nordland county, 50 000 H.P. has been installed and the installation of an extra pipe line for 27 000 H.P., together with the necessary electrical equipment, is nearing completion. The State is prepared to consider proposals for the application of this power. A zinc-smelting works controlled by Swedish interests, which has rented 50 000 H.P. from this source, has experienced difficulty in fulfilling its contract, and the State has hitherto received no return for the large capital invested in the power station.

The harnessing of Solbergfos, on the River Glommen, has been continued, and is expected to be completed in 1924. Of the power obtained from this scheme, which has been estimated at 50 000 H.P., one-third will be taken by the municipality of Christiania, two-thirds by the State.

Municipal Power Schemes.

The harnessing of the Raanaasfos on the River Glommen is nearing completion, and it is expected that the Christiania Municipality will shortly take delivery of 12 000 kW from this source.

The offer of power to Christiania from Tysse has not been accepted.

The Bergen Peninsula Power Company, an amalgamation of the Bergen Municipality and a number of small municipalities in the Bergen district, is considering the construction of a 100 000 H.P. station at Dale with a view to the delivery of energy to the members of the company. The scheme of the Bergen Municipality to procure 6 000 kW from Herlandsfos has, therefore, been suspended.

The harnessing of the Höge waterfalls, owned by the Aust Agder county, has now been completed.

Work has continued on the following schemes :

That of Nord Tröndelag county for harnessing the Folla watercourse. It is expected that the delivery of power will commence in about a year's time.

The scheme for the harnessing of the Tafjord watercourse in the Romsdal county.

The scheme of the town of Kristiansand S. for the harnessing of the Nomeland fall.

That of the town of Fredrikshald for power stations on the Brekke and Krappeto waterfalls.

The Troms county has initiated a scheme to procure 2 000 H.P. from the Bardo waterfall.

The scheme of the Aalfot Power Company for harnessing the Aalfot waterfall is still in suspense owing to financial difficulties.

Private Power Schemes.

No new private power schemes have been initiated.

As regards old schemes, the position is as follows :

The carbide factories for which the power from the Saude Falls was intended have not yet been put into operation, but several thousand kilowatts form this source are now delivered to local municipalities.

A/S Bremanger Kraftselskap have completed their power station at Svaelgen, and the Nordre Bergenhus county have nearly finished the construction of the transmission net.

A/S Björkaasen Mining Company have completed the harnessing of 7 000 H.P. for their own use.

State Aid to Municipal Power Schemes.

On February 23, 1921, the Norwegian Ministry of Finance concluded with a syndicate of Norwegian banks a loan of Kr.50 000 000 to be devoted to assisting various municipalities in completing power schemes which had been interrupted owing to financial difficulties. From this fund advances have been made of Kr.6 000 000 to the Aust Agder Municipality, Kr.14 000 000 to the Tafjord Power Company and Kr.9 000 000 to the Nord Tröndelag County in aid of schemes mentioned above. A number of other municipalities have also received assistance.

Export of Hydro-Electrical Power.

The commission consisting of members appointed by the Norwegian, Swedish and Danish Governments to consider the possibility of transmitting electrical power from Norway to Denmark has continued its deliberations during the present year. Norwegian experts are of opinion that the scheme will eventually be realised, although financial and technical difficulties have first to be overcome. It is expected that by the end of 1924, which is considered the earliest date at which the transmission line could be completed, Norway will be in possession of a considerable surplus of power available for export. The question whether the power should be carried overland through Sweden or by a submarine cable direct to Denmark remains unsettled, but the former alternative seems to be regarded with most favour.

Railway Electrification.

The electrification of the railway line from Christiania to Drammen is nearing completion, and it is hoped that it will be possible to open the section Christiania-Asker (about 26 kilometres) for electric traffic early this year.

Work is proceeding upon the electrification of the Ofot Railway (from Narvik to the Swedish border).

The question of the electrification of other sections of railway is still under consideration.

Theoretical and Practical Engineering.

Engineer Vice-Admiral Sir George Goodwin Engineer-in-Chief of the Fleet, delivered an address on Saturday night as honorary president of the Engineering Society of the University College of Southampton. Mr. John Smith, of Thornycrofts, the retiring honorary president, was in the chair.

Sir George Goodwin said that college societies in engineering centres where practical work could be associated with study and research must be productive of a great deal of good—both to the students and to the experienced engineer. Perhaps the connection between the school and the shop had not been sufficiently thorough. In many cases the effect had been to produce two different types of engineers, one regarding himself as highly accomplished in theoretical engineering and being somewhat disdainful of operative and manipulative skill; the other equally proud of his practical proficiency, and especially of the fact that no one could possibly accuse him of being an "x chaser." The differences sometimes became acute, and the result was very unfortunate. As an example of the advantage of a student combining theoretical and practical knowledge, Sir George Goodwin referred to turbine reduction gearing. The idea of it emanated from theoretical considerations alone, but it would never have materialised except through the skill of the workman. The responsibility that engineering education and training proceeded on proper lines rested with the university authorities and other bodies who controlled the respective syllabuses. He did not find much fault with their syllabuses, but he did wish that those who drew them up would include just sufficient to ensure due appreciation of the interdependence of theory and practice.

Ball Bearings in Electrical Machinery.

At the Birmingham and District Electric Club on March 11 a paper on "Ball Bearings, with Special Reference to Electrical Machinery," was read by Mr. C. Allen, of the Skefko Ball Bearing Company. The lecturer gave an account of the physical, mechanical and mathematical considerations which govern the design and construction of ball and roller bearings, with special reference to the investigations of Hertz, Striebeck and Goodman. Single row and double row self-aligning bearings were explained, with the thrust capacity of each type. A number of figures were given, bearing upon transmission efficiency of plain and ball bearings, the co-efficient of friction of ball bearings being given at 0·001, and of plain bearings, under good conditions, of at least ten times this figure, thereby making possible an economy of power loss of 90 per cent. In electric motors ball bearings were extensively used in small powers, but in shafts over 2½in. diameter trouble had been experienced. Some of the causes of the trouble were analysed, and an account was given of recent experience and practice on the Continent and in America, where large motors and rotary converters were being constructed with ball bearings with very satisfactory results, and the larger British manufacturers were now making serious investigations into the subject.

Bringing Victorian Economics Up-to-Date.

By ERNEST J. P. BENN.

Since the War everybody is talking of economics and the interest in the dry-as-dust science has spread to every part of the community. Politicians, industrial leaders, and students of economic questions generally have, under war pressure, rushed at the writings of the mid-Victorian era and accepted the sayings of Adam Smith, Karl Marx, and their contemporaries almost as if they were revealed truth, and based their arguments and actions upon them almost without further enquiry. But surely a science of economics which was formulated before the days of electricity may be as useless as a science of medicine which overlooked the discovery of the circulation of the blood. Karl Marx told us that wealth arises from land and labour, Sidney Webb has widened the meaning of the term "labour" to include forms of toil which do not soil the hands, and that is really about as far as many of us have got in the science of economics. It is indeed questionable whether we have begun on economics, properly so called, at all, and whether such thoughts as we employ in this direction would not be more correctly described as "Sidney Webbics." So little has the science of economics advanced with the times and taken cognisance of human development, that Professor Ramsey Muir is at this moment busy saying in the language of 1920 almost exactly what Karl Marx said in 1860 and Sidney Webb in 1890. England is becoming a mass of Socialism, and unless we realise that fact the present process of universal limitation will continue, the standard of living will get lower and lower, and the glorious era of wealth production which is really England's contribution to humanity may be said to be drawing to a close.

A Fresh Start.

We must start again, and there could not be a better time to start. The first big fact which must be accepted from the house-tops, and written in capital letters in the front of our minds, is that we live by exchange. If only we would digest that one big truth we should be able to get the others into true perspective. Capital and labour would cease to occupy the whole of the stage as they have hitherto done, and we should realise that the prime factor in the creation of wealth is neither capital nor labour, but exchange. The War has given us our first real chance to grasp and understand this. Commodities are not in themselves wealth. They may be the raw materials of wealth, but they only become the real thing when they are exchanged. If the Isle of Wight were heaped up sky-high with pianos there would be a good deal of labour and a good deal of capital involved in the process, but there would be nothing which could be recognised as wealth. Capital and labour would in that case both have performed their functions, and both, no doubt, would be engaged in arguing as to their respective proportions of the property; the argument would be the only music arising from this wonderful plethora of pianos.

We talk of the laws of supply and demand, but we forget that both supply and demand require making, and demand often requires more making than supply. The man who can bring supply and demand together is performing a higher function than he who can make supply or he who possesses demand.

The Land of Practical Economics.

America is the land of practical economics. They seem to be gifted over there with an understanding of the science of wealth creation. They spend a far higher percentage of the price of an article upon the selling of it than is usual in any other country of the world. That does not mean that American prices are high; their successful competition in foreign markets proves the contrary. By providing adequate remuneration for the sellers or exchangers the Americans succeed in exchanging goods at a quicker rate than the rest of us, which is the whole secret of mass production with its high wages, high profits, and low prices.

The new economics which cannot now be long delayed will classify us in a more scientific manner and correct our sense of proportion. Instead of a Labour Party we shall have an Exchange Party, into which will congregate all the people who really carry the bulk of the responsibility for wealth creation. The Exchange Party membership will consist of merchants, shopkeepers, travellers, salesmen, advertisers, and demand-creators generally. It will embrace all those brains which Mr. Sidney Webb has made such frantic efforts to secure for Labour. Everyone who is engaged in doing anything to facilitate exchange, which means everyone who takes an interest in his job and really does his duty, will be an enthusiastic member of the Exchange Party. Behind this front rank of the industrial army will range themselves side by side the old-fashioned Capital and Labour, each recognising that they are necessary, but subsidiary, functionaries.

In some such way as this we shall be able to support our populations in ever increasing comfort, and provide for larger populations yet to come; but unless we do take some such steps, unless we learn in time the lesson of Russia, then we shall assuredly have to face a steady reduction in the standard of living, and the corresponding necessary reduction in the numbers of the human race.

The Acting British Consul-General at SAN FRANCISCO reports that a local firm of dealers in china, glassware and household appliances are desirous of buying household electric appliances direct from United Kingdom manufacturers. Further particulars can be obtained from the Department of Overseas Trade. (Ref. D.O.T. 14 359/F.W./S.C. 2.)

Telephone Developments in the North.

Mr. J. R. M. Elliott, Superintendent Engineer at Newcastle Post Office, delivered an address on "Telephones" to the NEWCASTLE ROTARY CLUB last week, dealing particularly with developments in the northern district. In Newcastle, he said, the necessity for a new exchange, to take the place of the existing City and Central Exchanges, had for some time past been under consideration. A site was available for the erection of a new building, and investigations were proceeding with a view to determining whether the system to be adopted should be manual or automatic. In the event of the decision being in favour of automatics, it would be necessary to convert all the exchanges within a radius of a few miles of Newcastle to automatic also.

In this connection it might be of interest to know that the private branch exchange system of one of the largest engineering works on Tyneside had been converted by the department to automatic working.

Extensive Programme.

The programme of new underground cables which was in hand was extensive. At Gateshead eleven miles of new cable were being laid, comprising 1 100 miles of wire, and on completion 600 miles of open wire on congested pole routes would be taken down.

In Newcastle twenty-seven miles of cable, comprising 5 000 miles of wire, were being added in seven different areas to the existing plant, and the work was nearing completion.

For Wallsend and Walker area the work of laying seven miles of cable, comprising 650 miles of wire, was also progressing; and at Jarrow and Hebburn work of a similar character was nearing completion, whilst at North Shields, Tynemouth, and Whitley Bay the existing cables were being augmented.

Since the war new cable plant had been provided or was in course of provision for local development purposes at forty-two different centres throughout the district. The cables reached an aggregate of ninety-three miles, and comprised 11 000 miles of wire, the total cost having been £150 000.

In addition to these local development works, a main cable route was at the moment being constructed between Newcastle and Durham, and thence to West Hartlepool, a distance of thirty-two miles, and, when finished, would increase the trunk facilities to the Durham and Hartlepool areas. The cables would contain over 5 000 miles of wire, and the cost of the work would be about £142 000.

The open line trunk facilities of the district had been increased during the past two years by eighty-four new circuits, involving the erection of 1 300 miles of wire, at a cost of £47 500.

A new cable route between London and Glasgow had been decided upon, having repeater stations at sixty-mile intervals. The route would pass through Catterick, Darlington, Durham, Newcastle, Otterburn and Jedburgh. When this cable was completed, the local long-distance trunk facilities, now available, would be greatly augmented, as the new route would provide for the industrial centres of the North-East Coast. The cost of this particular work would be about £500 000, a development in which Newcastle directly participated.

Low-grade Coals for Electric Power.

In a paper read before the Society of Arts recently, Professor W. A. Bone discussed the UTILISATION OF BROWN COALS AND LIGNITES, and the steps which are being taken in Australia towards the production of cheap electric power by this means. In the Latrobe Valley, Victoria, there is an area which is estimated to contain, within 1 000 ft. of the surface, over 31 000 000 tons of brown coals and lignites. These are low-grade fuels, which contain something like 50 per cent. of water in the raw state, but by a drying process the water content can be considerably reduced.

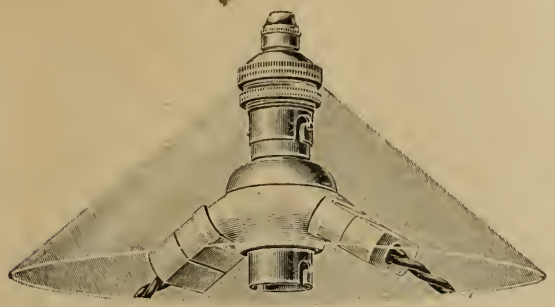
Researches have been carried out by Prof. Bone in the direction of the heat treatment of these fuels below 400° C. as a possible method of enhancing their fuel values, and it has been found that such treatment affords a ready means of up-grading such coals, and of improving their fuel values generally. The Underfeed Stoker Company have designed and patented an apparatus for both drying and up-grading the fuel continuously in one operation, using only the sensible heat in the burnt gases passing away from a boiler.

One of these specially fitted mechanical stokers has been installed at Morwell, and is now undergoing systematic trials there under the supervision of Mr. H. R. Harper, their Chief Engineer. One of the principal advantages of such a fuel provider in connection with big power-station boiler installations, such as at Morwell, where low-grade brown coal must be used, is that by so drying and up-grading the fuel before burning in the boiler grate, it will give a much hotter and more radiant fire than it would otherwise do, with consequent increase in both the steam output per boiler and the thermal efficiency of the system as a whole. The Underfeed Company guaranteed that nine boilers fitted with their new fuel improver attachment would give the same steam output as twelve boilers fired with the untreated fuel, and with a greater thermal efficiency.

During the discussion which followed the reading of the paper, Mr. John McWhae, Agent-General for Victoria, said it was anticipated that early in 1924 electrical energy would be supplied from Morwell throughout the whole State. It was calculated that they would be able to supply electrical energy to manufacturers at £4 8s. per H.P. year, and at the mine mouth at £2 17s. 6d. per H.P. year.

Eastick Lampholder Adapter.

This lampholder adapter, which is marketed by J. J. Eastick & Sons, 4, Belfast-road, Stoke Newington Station, London, N.16, is becoming popular with users of electric lighting appliances, because



The Eastick Lampholder Adapter.

the plugs are at an angle, and they can be easily attached without removing the lampshade. Wiring contractors and supplies dealers can obtain further particulars, including trade terms, of this device from the makers.

Co-Operative Non-Ferrous Research.

At the second annual meeting of the British Non-Ferrous Metals Research Association at Birmingham, the chairman, Mr. T. Bolton, detailed the progress of the association during the year, and referred particularly to the organisation of the body, the work in progress, and to the proposed establishment of research fellowships at the Universities. The association was one of the very few which admitted users or consumers to membership on the same terms as manufacturers or producers, and they hoped to obtain support from the engineering and other great industries. The majority of the work in hand referred to copper, as most of the support came from that section of the trade.

Dr. W. Rosenhain, of the National Physical Laboratory, stressed the fact that many non-ferrous troubles could not be solved because there was insufficient fundamental knowledge, to secure which men and money were necessary. He thought the Research Association an ideal channel through which such research could be arranged, because it provided the means whereby research could be applied in industry after having been carried out in the laboratory. He also instanced recent advances in the ferrous industries, which would necessitate non-ferrous manufacturers making efforts to regain their position.

Sir Frank Heath, Secretary of the Scientific and Industrial Research Dept., congratulated the association on the extraordinary expansion which had taken place during the past year in its membership and activities, and illustrated the way in which the user and producer could aid each other by proper co-operation. He considered the establishment of an intelligence service one of the most valuable things an association could do, and offered the aid of his department in working out a scheme of research fellowships. It was significant of the view now taken by business men that the Geddes Committee had not recommended any cuts in his department, but he hinted that manufacturers should use the million pound fund for research as expeditiously as possible.

Other speakers included Vice-Admiral Sir George Goodwin, Engineer-in-Chief to the Admiralty and President of the Institute of Metals; Sir Henry Fowler, Chief Mechanical Engineer to the Midland Railway; Sir Gerard Muntz and Sir Richard Threlfall.

I.E.E. Summer Meeting.

The summer meeting of the Institution of Electrical Engineers will take place in Scotland from May 30 to June 2. The programme is substantially the same as that of the meeting arranged for last year, which was abandoned on account of the coal strike.

On the first day a visit will be paid to Dalmarnock generating station. This will be preceded by a Paper by Mr. R. B. Mitchell on the station, and subsequently a lunch will be held at the Municipal Building by invitation of the Corporation of Glasgow. In the afternoon visits will be paid to the works of John Brown & Company, the Clyde's Mill power station of the Clyde Valley Electrical Power Company, and some of the Glasgow Corporation reservoirs. In the evening a reception will be held at the Municipal Buildings by the Corporation of Glasgow.

On the morning of May 31 a Paper will be read at the Glasgow University by Prof. Magnus Maclean on "The Hydro-Electric Resources of the Scottish Highlands." In the afternoon a visit will be paid to the works of Babcock & Wilcox at Renfrew, which will be followed by a steamer excursion on the Firth of Clyde by the invitation of the firm.

On Thursday, June 1, the party will leave Glasgow, breaking their journey at Tulloch to inspect the sources of supply of the Lochaber water power scheme, and arriving at Fort William in the evening. On Friday a steamer excursion will be made to Kinlochleven, where the works of the British Aluminium Company will be inspected, and the party will afterwards proceed to Oban.

E

High Electric Ordnance Crane.

The Cleveland Crane and Engineering Company, Wickliffe, Ohio, have recently built a 75-ton electric travelling crane for handling naval guns of the larger sizes during heat-treatment operations at the U.S. naval ordnance plant at Charleston, W. Va. The run-way, states the "Times Trade Supplement," is 165 ft. above the ground, and the lift is believed to be the highest ever arranged for in a crane of this type. An exceptionally high lift is required, because the guns, which, with their test piece, are 87 ft. long, have to be handled in a vertical position. The guns are brought to the plant on railway trucks, placed in a vertical position in a heat-treating furnace, and after being heated are lifted from the furnace and placed vertically in a tempering tank, 108 ft. deep. These tanks extend into a pit 60 ft. below the floor and project 48 ft. above the floor level, so that the upper end of the gun must be raised at least 135 ft. to permit the lower end to clear the top of the tank.

The crane run-way, being the height of an average 15-storey office structure, a building of unusually massive construction is required to carry the load. A locomotive crane with a 250 ft. boom was used in handling the steel during the construction period. In addition to the height of lift, the outstanding features of the crane include a high speed of lift and a span which is exceptionally long, 104 ft., for the capacity. The hoisting speed is 50 ft. a minute and the lowering speed double that figure, both these rates being with a full load. In this way the guns can be handled between the furnace and the quenching tank very rapidly. Another interesting feature is that when lowering the rated full load at the maximum speed the braking equipment provided will stop the load within 1 ft. The crane has an automatic limit switch that stops the load 110 ft. below the crane rail. Should it be necessary to lower the gun farther, the operation is continued by the use of a push button.

The trolley and the bridge each travel at the rate of 50 ft. a minute, rapid bridge travel not being required, as the crane run-way is comparatively short and only of sufficient length to cover the furnaces and the tempering tanks. The crane is operated from a pulpit, and magnetic control is provided throughout. Five motors aggregating 550 h.p. are used in its operation—two 200 h.p. motors on the main hoist, a 50 h.p. motor for the trolley travel and two 50 h.p. motors for the bridge travel, there being one motor on each bridge girder. The hoist has brakes on each motor and on the second reduction shaft. On account of the high lift the hoist requires 2 600 ft. of $1\frac{1}{8}$ in. rope.

The Newspaper Press Fund.

The announcement that Lord Leverhulme is to preside at the fifty-ninth Annual Dinner of the Newspaper Press Fund on April 27 draws attention to an organisation of which the outside world knows but little. By the very conditions of his occupation the journalist is, for the most part, anonymous. Consequently, dependent though we are all upon him for news of the happenings of the day, it is inevitable that, if in the stress and competition of modern life he "goes under," very few beyond his immediate circle and those dependent on him are aware of his distress.

It was to help the journalist who has fallen on evil days, and the widow and children he may leave behind him unprovided for, that the Newspaper Press Fund was founded in 1864, and for nearly sixty years it has done splendid work in relieving sickness and want among the journalistic profession. Last year, owing to the general depression, the claims were exceptionally heavy, and the fund distributed in grants and pensions the record sum of over £10 000.

The regular income of the fund, from members' subscriptions and interest on investments, covers less than half this sum, and if it is to meet the calls upon it, to say nothing of extending its beneficent operations, a large amount of money has to be found from outside sources every year.

It is undoubtedly merely lack of knowledge which has prevented the public in the past from coming more generously to the support of the men, who not only in their ordinary vocation render valuable service alike to the business and the social world, but who are themselves always among the first to give their services freely in any worthy charitable cause.

Cheques should be made payable to the Secretary, Newspaper Press Fund, 11, Garrick-street, W.C. 2.

The extension of electricity supply to the communes and rural districts of Belgium is attracting much attention at present, and in the case of East Flanders the Provincial Governor (Count Kerchove) has put forward a scheme under which the Provincial Council and the communes would provide the necessary capital for the distributing companies. Of the 297 communes in the province, 101 of the most populous have electricity supply, and a credit of five million francs has been voted for the proposed extensions of mains, &c. Most of the other provinces have taken somewhat similar steps to provide a supply of electrical energy. The communes of Houdeng-Gœgnies, Houdeng-Aimeries and Strépy-Bracquegnies have just decided to provide a supply of electricity for lighting and power. They will lay the distributing network and purchase high-tension three-phase current (50 periods) in bulk. It is proposed to enter into a thirty years' contract, and at the outset 250 kW will be required. The town of Dinant is also inviting tenders for a supply.

Legal Intelligence.

The Lodge Tuned Wireless Patent.

The Royal Commission on Awards to Inventors continued on Monday the hearing of the claims of Marconi's Wireless Telegraph Company and Lodge Muirhead Wireless and General Telegraphy Syndicate in respect of the infringement by the Admiralty of Patent No. 11 575 of 1897.

The Attorney-General said that the Admiralty had paid the Marconi Company £257 000, of which £77 000 was for thirteen strategic stations. He submitted that the balance, £180 000, sufficed to liquidate the claims.

Mr. J. Hunter Gray, K.C., said that if the Commission meant to take into account the amount already paid the company would not submit to arbitration. They were only prepared to discuss the question of what was due on installations for which no royalty had been paid.

The Chairman said what had been referred to them for decision was the amount to be paid by the Admiralty for the use of the patent in the whole of the installations, whether royalty had been paid in respect of them or not. That would be a preliminary step to ascertaining what was the amount finally due.

An adjournment to permit of consideration of the legal position was granted on the application of Mr. Gray, who said in the event of an agreement he would call Mr. Marconi as a witness.

Theft of Electric Lamps.

Two young men, James Young, a porter, and John Sheldrake, painter's mate, were charged on remand at the Mansion House on Tuesday with being concerned in stealing 3 100 electric lamps, value £490, the property of the B.T.T. Lamp and Accessories Company. On Feb. 9 the padlock staple was removed from the door of the company's premises and the lamps were taken away. Both prisoners pleaded guilty to the theft and made statements. They alleged that they sold the lamps for £85 to an engineer named Kelly.

Mr. Reader, the contractor whose horse and van were used, denied that he had received £5 from the accused, and Mr. Kelly said he dealt principally in sewing machines and motor-cars; he did not sell many lamps. He did not buy any from the accused, and he had no warehouse in Old Montague-street, where they were alleged to have been taken. Counsel for Kelly said the latter had a recollection that some time since Sheldrake asked him to buy some lamps at a very low price. He communicated with the police, and that perhaps was the ground of this wicked suggestion of prisoners.

The Lord Mayor sentenced Young to six and Sheldrake to two months, each in the second division. With regard to Reader, he could not help thinking he knew more about the matter than had come out, but he did not believe the accusation against Kelly.

A. E. Wall v. Falcke.

On Tuesday Mr. Justice Branson heard this action, brought by the plaintiff to recover £250 from Mr. Cecil D. Falcke, secretary of the B. E. Company (of London and Birmingham), Ltd., manufacturing electricians.

It appeared that plaintiff took over the business of Witehall & Company (electric switch manufacturers) after the war, and he came to an arrangement with defendant to have the use of his company's selling organisation. Plaintiff said part of the arrangement was that he should take £250 worth of shares from one of the defendant company's shareholders, a Mr. Baylis. He alleged that though he had paid his £250 he had not received the shares, and therefore he asked for the return of his money.

The defence was that it was never proposed that plaintiff should have 250 shares, but that his payment was an instalment in part payment for £750 worth of shares. In his evidence defendant said he did not stand to make or lose anything out of the transaction, and Mr. Baylis knew that witness was selling the shares to plaintiff.

His Lordship accepted plaintiff's version, and gave judgment for plaintiff for the amount claimed and costs. The counter-claim for £500, the alleged balance for the 750 shares, was dismissed.

A Disputed Settlement.

On Tuesday Mr. Justice Swift heard an action by the Christian Bergh Electric Company, Ltd., against the E. C. Brooks-Voss & Company, of Birmingham, to recover £16 12s. 8d., the amount of two bills of exchange, dated Dec. 1 and Jan. 7 last. It was stated that the bills were part of a series of ten given in settlement of an action brought by plaintiffs against the defendants in May last. Defendants agreed to pay £36 on account and the balance by ten monthly bills of £80 each.

For defendants it was stated that they desired to raise a counter-claim to set aside the agreement of settlement.

His Lordship said he must give judgment for plaintiffs for the amount claimed with costs, but defendants could bring another action to set aside the agreement.

Patent Cases.

An interesting amendment of Patent No. 142 934, relating to electrodes for soldering and depositing metals by an electric arc wound with asbestos yarn, subsequently coated, was recently authorised by the High Court. An application for the revocation of the patent was made, but we learn from "Engineering" that the judge allowed the cancellation of two claims and the deletion of parts of the specification, so as to make the amended document cover only the original invention claimed. According to the modified claims, the electrodes are wound with asbestos yarn in open spirals, coated with a silicious compound, and a fluid slag-forming mixture containing lime is afterwards added, with or without a suitable proportion of powdered aluminium.

Another interesting case which raised the question of what is a patentable invention came before the Solicitor-General on appeal from the decision of the Comptroller-General of Patents that an application disclosed no "manner of new manufacture." The specification described the use in a high-compression internal-combustion engine of a hydrocarbon fuel having a high heat value and a high critical compression, namely, a cyclic compound of the naphthene group, for example, cyclohexane. The claim was for the method of using the fuel, and it was argued for appellants that, although cyclohexane was a known compound, it had formerly been known only as a laboratory substance, and that they were the first to discover its advantages as a fuel.

The Solicitor-General held that it was a well-established principle of patent law that once a substance is known, its methods of production ascertained and its characteristics well defined, a patent cannot be granted for its mere application to an unknown purpose. The specification gave no indication of any special feature of novelty in the engine in which the fuel was to be used, beyond that it was a "super-duty" engine. The use of such a known substance in a known type of engine might be a useful discovery and have valuable results, but it was not invention within its statutory meaning.

Parliamentary Intelligence.

Special Orders.

The House of Commons have approved the Special Orders made by the Electricity Commissioners and confirmed by the Minister of Transport in respect of part of the parish or township of Wye, in Kent; the urban district of Wigston Magna; parts of the rural districts of Blaby, Hinckley and Lutterworth, in the county of Leicester; the urban district of Cheadle and Gatley, in the county of Chester; the urban districts of Haywards Heath and Cuckfield, and parts of the rural districts of Cuckfield and Chailey, in East Sussex; the burgh of Johnstone, in the county of Renfrew; the burgh of Milngavie and part of the parish of New Kilpatrick, in the county of Dunbarton; the urban districts of Bromyard and Kington and the rural districts of Bredwardine, Bromyard, Dore, Hereford, Kington, Leominster, Ross, Weobley, Whitchurch and Wigmore, and part of the rural district of Ledbury, all in the county of Hereford, and for the amendment of the Hereford Electric Lighting Order, 1898; the county borough of Preston, the urban district of Fulwood, and the townships of Broughton Lea Ashton Ingol and Cottam Woodplumpton Barton and Penwortham, in the rural district of Preston. They have also approved the Special Order amending certain Provisional Orders granted to the Electrical Distribution of Yorkshire, Ltd.

French Telephone Service.

Mr. Pike Pease (Assistant Postmaster-General), in reply to Sir J. D. Rees (House of Commons, March 20), who asked whether he had information to the effect that a Bill had been introduced into the French Chamber to transfer the national telephone back to a private company, said, so far as he was aware, the answer was in the negative. A Bill was introduced by the Minister of Public Works and the Minister of Finance on Jan. 12 this year to abolish the flat rates and substitute a general message rate on the grounds that a more equitable basis of charge, by which subscribers paid according to the use made of the service, would tend to develop the system, enable an improvement in the service to be effected, and at the same time restore the balance of expenditure and receipts.

Water-Power Developments.

In the House of Commons last week, in reply to Mr. Perkins, Mr. Baldwin stated that the Government did not see their way at present to introduce legislation dealing with the control of water-power developments or constituting a Water Commission, as proposed by the Water-Power Resources Committee, but the Minister of Health had taken certain administrative measures, and was setting up an Inter-Departmental Committee, as recommended by the Committee, to co-ordinate the work of the several Departments responsible for the different water interests.

Marconi Bonds (China).

In reply to Colonel Wedgwood (House of Commons, March 17), Mr. Harmsworth stated that H.M. Minister at Peking had been and was continuing to press the Chinese Government for the payment of the interest due on these bonds.

The Toll Exchange.

In the House of Commons last week Mr. Pease stated that there was no intention at present to extend the toll area for telephone calls.

The Education Estimates for the coming financial year show decreased grants for scientific investigation and industrial research. Scientific and industrial research salaries are £9 945 lower; the Fuel Research Board salaries are £1 393 lower, and the grant for experimental plant is reduced by £8 000. Expenses of research boards and committees are £26 880 and development grants £39 500 lower than in 1921-22. The National Physical Laboratory salaries are down by £21 035, and the sum for new researches is reduced by £10 156. Grants in aid for universities and colleges are also £247 000 less.

Electricity Supply.

At SALFORD Council meeting on Wednesday morning last week's decision was reversed on the Electricity Committee's recommendation, and the question of Mr. J. A. Robertson's appointment as consulting engineer was referred to a special committee of the Council.

The Finance and General Purposes Committee of HAMMERSMITH Borough Council recommend that £7 300, part of the estimated net surplus on the electricity undertaking for the current year, be carried to the credit of the Borough General Rate for the ensuing half year. This is equal to a 2d. rate.

The Minister of Transport proposes to confirm the Special Order made by the Electricity Commissioners authorising HULL CORPORATION to supply electricity in Sculcoates Rural District. Any objections must be sent to the Secretary, Ministry of Transport, 6, Whitehall-gardens, London, S.W. 1, by April 10.

BECKENHAM Electricity Undertaking, which has been run at a loss for several years, and last year made a loss of £3 156, has this year made a gross profit of over £19 000. In announcing the fact at the last meeting of the Council, Councillor Oliver said that the success was chiefly due to the new machinery which had been installed and which enabled them to save 56 per cent. in the consumption of coal. In addition, the cost of labour and materials both showed a decided reduction.

The appointment of an expert to report on HULL electricity undertaking, as recommended by the Inquiry Committee and confirmed by the City Council, was considered by the newly-formed Electricity Committee last week, when it was decided that the chairman (Councillor T. McLeod), deputy-chairman, Lord Mayor, and the Town Clerk should be empowered to make a selection from four experts nominated by Mr. J. S. Highfield, president of the Institution of Electrical Engineers.

A committee of representatives of electric supply undertakers in the WEST OF SCOTLAND ELECTRICITY DISTRICT has been formed in order to prepare a scheme of reorganisation. The committee consists of one representative each from the counties of Renfrew, Ayr, Dumbarton, Lanark and Stirling; Glasgow Corporation Electricity and Tramways Departments; the burghs of Paisley, Greenock, Ayr, Kilmarnock, Hamilton, Motherwell and Wishaw, and each of the authorised electrical companies in the district. The engineers and town clerks are to prepare a draft scheme or schemes for the committee.

New Schemes and Mains Extensions.

The Norchard Syndicate, Ltd., LYDNEY, have applied to the Electricity Commissioners for permission to erect an electricity generating station adjoining the Norchard Colliery.

TAUNTON Town Council has applied to the Electricity Commissioners for a loan of £1 500 to meet extras on contract for the installation of a new turbine plant. The estimated cost was £12 000 and the actual outlay £13 497 11s. 1d.

ESTON Urban Council has agreed upon a scheme of electricity supply for the town. Since the scheme was first proposed the contract price of the plant and mains is £14 000 below the original estimate.

CRIEFF Town Council have asked Mr. J. E. Sayers, of Glasgow, to act as consulting electrical engineer for their electricity supply scheme. The Burgh Special Order has been granted by the Electricity Commissioners and now awaits the formal approval of Parliament.

Alteration of Charges.

The increased charges for electricity which were made at COVENTRY to meet the additional expenditure incurred by the coal strike last year are to be withdrawn as from Jan. 1 last, to both bulk and private consumers.

RAMSGATE and District Electric Supply Co. has reduced the price of electricity for power, heating and cooking by ½d. per unit. The charges now are: Power, first 100 units per quarter, 7d.; next 3 000, 4d.; beyond, 3d.; heating and cooking, first 100 units, 4d.; beyond, 3d.

A further reduction in the price of electricity in SHEFFIELD is notified. This latest concession dates from the present quarter's reading, and, together with the reductions made in June and September last, means that about one-half of the maximum increase imposed as a result of the war has now been swept away. A year ago the increases on the pre-war rate were: 50 per cent. on all units over 2d. and 150 on units of 2d. and under. These rates are now reduced to: 30 per cent. on all units over 2d. and 75 on units of 2d. and under

Reduced scales of charges for electricity supply have been adopted by HACKNEY Borough Council. In future every lighting consumer will make a minimum payment of 10s. a quarter, and he can pay either £3 15s. per quarter per kilowatt demanded, plus 1d. a unit, or a flat rate of 6d. or if by prepayment meter 8d. per unit. For power the charge will be £1 12s. 6d. per kW demanded, plus ½d., or a flat rate of 6d., or if by prepayment meter 8d. per unit for June and September quarters and 2d. in December and March quarters. For domestic supply, where the premises are wired throughout, the tariff will be a fixed charge of 2s. per quarter per 60 W lamp equivalent, plus 1d. a unit. For charging batteries of electric vehicles the standard scale will be 1d. a unit, but the Council reserve the right to cut off supply between 4 and 6 p.m. from October to February, and for charging batteries at 90 to 110 V the charge will be 2d. per unit.

Electric Traction.

BURNLEY Town Council have set aside £10 020 to provide the amount expended by the Tramways Committee in relaying the permanent way.

SIR WILLIAM MARWOOD and COLONEL PRINGLE, on behalf of the Ministry of Transport, will conduct the inquiry into the system of traction to be used in Princes-street, Edinburgh.

CARDIFF City Council have given full powers to the Electricity and Tramways Committee in connection with the proposed purchase of the Llandaff North and Whitchurch motor omnibus undertaking.

Since the reintroduction of penny fares on the BRIGHTON tramways there has been a large increase in the number of passengers carried, and the falling off in revenue is also stated to be less than a month ago.

The Minister of Transport has extended until August 7 next the period allowed by the SWANSEA CORPORATION ACT, 1912, for the completion of the tramways authorised by that Act, and for the compulsory purchase of lands for Part IV. (Electricity) of the said Act.

Traffic on the whole of the Underground railway system (except the Central London Railway, which has its own power plant) was "held up" for twenty minutes last Thursday afternoon owing to the FUSING OF A HIGH-TENSION SWITCH AT THE LOTS-ROAD POWER STATION, CHELSEA.

The Minister of Transport has extended until May 31, 1923, the period allowed by the CHESTERFIELD CORPORATION ACT, 1914, for the completion of tramways, and that allowed by the CHESTERFIELD CORPORATION RAILLESS TRACTION ACT, 1913, for the completion of overhead equipment, and other apparatus for working trolley vehicles.

At the annual meeting of GLASGOW SUBWAY RAILWAY COMPANY last week the chairman said that the Corporation had offered to purchase the subway, but at such a price that the directors did not feel they could even put it before the shareholders. It was probable, however, that further negotiations would take place both with the Corporation and with other parties. The directors recently had a report on electrifying the subway, and it was estimated that the cost would be £100 000.

Acting on the advice of Mr. E. W. Cockerlyne, highways and permanent way engineer of Leeds, KEIGHLEY Tramways Committee recommend the Council to apply to the Ministry of Transport for power to borrow £40 000 for the purpose of reconstructing about two and a half miles of single track. The Committee also recommend that as from April 1 the ordinary fare on each stage be increased from 1d. to 1½d., provided that the fares for children and workmen, and the hours of the issue of workmen's tickets, shall remain as at present.

NEWCASTLE-ON-TYNE Tramway men, after a twenty-two days' strike, decided on Sunday to accept the employers' terms, which included the working of a 48-hour week and full observance of the national agreement. A ballot was taken on Saturday, which resulted in 887 votes for and 185 against the offer. But the question arose as to how the men of the other unions out on strike would be affected by this decision. At a meeting on Sunday, however, the following resolutions were put, and the former was carried by a fairly large majority: (1) "That we accept the ballot vote as taken on Saturday, and return to work to-morrow. In the event of any of our members being instructed to do the work of the men on strike, they shall be instructed to refuse to blackleg." (2) "That this mass meeting decides to remain out on strike in conjunction with the members of other unions in order to assist them to get a satisfactory settlement to their claims."

EDINBURGH Corporation give notice of intention to apply to the Secretary for Scotland on or before April 18 for a Provisional Order authorising the Corporation to construct certain new tramways in the City of Edinburgh; to run coupled and trailer cars on the new and existing tramways; to acquire certain lands and to carry out specified works; to authorise the local authorities of Musselburgh, Prestonpans, and Cockenzie and Port Seton respectively, and the local authority of the County of East Lothian, or any of them who possesses the right of purchase of any of the undertakings of the Musselburgh and District Electric Light and Traction Company to transfer to the Corporation such undertakings, upon exercise of their purchase rights; to authorise the Corporation to suspend the sinking fund in connection with the money borrowed for the Portobello station and sub-stations and mains in connection therewith; to borrow money for the conversion of the Corporation tramways to electric traction, &c.

The ELECTRIC VEHICLE is steadily increasing in popularity, and is being used in a wider field for transport purposes. A London firm of brewers have decided, after tests of steam, petrol and electric vehicles, that horse traction is too expensive to be maintained, and to dispose of the steam lorries, of which several five-tonners have been in service. For the longer journeys 40 H.P. petrol-driven four-ton vehicles will be employed, but electric battery vehicles will be used for London deliveries within a radius of eight miles, as these have proved themselves to be eminently suitable. The operating costs, including depreciation, maintenance and other charges, but excluding interest on capital, were 10d. per vehicle mile cheaper than the petrol or steam vehicle. The firm have provided a well-equipped garage for repair work, &c. In the loading of the lorries electric elevators and other mechanical devices are employed, and it has been found possible to finish the daily deliveries over a considerable area in an eight-hour day.

Personal and Appointments.

Mr. T. J. Aitkin has been appointed electrical representative of Dalgleish & Baird, electrical engineers, Riccarton, Kilmarnock.

The engagement is announced of Mr. Trevor F. D. Rose (late R.F.A.) and Miss Irene Hirst, younger daughter of Mr. Hugo Hirst, chairman of the General Electric Company.

Mr. H. T. Kerr is now no longer connected with the City of Hereford Electricity Department, and for the next few weeks his address will be Netherwood, Tupsley, Hereford, where all communications in regard to the West Gloucestershire power scheme should be addressed.

Middlesbrough Electricity Committee has decided to place on record its high appreciation of the services of Mr. R. H. Scotson, the engineer, in connection with the taking over of the electricity supply to the tramways. The chairman (Ald. Calvert) said the work had been carried out with ability and ingenuity. The transference had resulted in Mr. Scotson effecting a saving of a large capital outlay, and an annual saving of at least £600 to the Tramways Department.

The retirement, in May, is announced of Sir William Noble, Engineer-in-Chief to the General Post Office, who succeeded Sir William Slingo in May, 1919. Sir William, who is 61, has passed the retiring age of 60, but is remaining at the Post Office in order to complete three years as Engineer-in-Chief. Sir William Noble entered the service of the Post Office in 1877, and acted as a telegraphist in the Aberdeen office for some years. He was early attracted by the technical side of his work, and, having won medals for telegraphy and telephony, lectured for some years in Aberdeen on those subjects as well as on magnetism and electricity. In 1901 he was made an assistant superintending engineer in the Central Metropolitan District, and, as second in command, he was responsible for a large share of the work of the "telephoning of London." In 1905 he was promoted to a first-class staff engineership, and had charge of the telegraph section at headquarters. In 1907 he became superintending engineer of the Central Metropolitan District, and in 1912 Assistant Engineer-in-Chief. Sir William, who rendered very valuable services on many technical committees, was knighted in 1920. He is a member of the Council of the Institution of Electrical Engineers.

Business Items, &c.

The Electrical Specialities Company are opening a branch at 67, Briggate, Leeds. Mr. Sherwood will be in charge.

Mr. F. G. Titchmarsh, 23, Soho-road, Handsworth, Birmingham, is now representing the Jeary Electrical Company in Birmingham and the Midlands.

The British Thomson-Houston Company have removed from their offices at 83, Cannon-street, to Crown House, Aldwych, London, W.C. 2. Telephone, Regent 8 040.

With a view to increasing the efficiency of their organisation, the Premier Electric Welding Company have decided to concentrate a number of their departments in the London area. Arrangements are being made to transfer the head office, technical and research laboratories, and electrode factory to Abbey Wood, London, S.E. 2, to which address all communications should in future be sent. The telephone is Woolwich 866, and the telegraphic address, "Premelwel, Abwood, London."

Electric Control, Ltd., announce that after April 1 their London office address will be Hastings House, Norfolk-street, Strand, W.C. 2. Telephone, City 2 487; telegrams, "Elecontrol Estrand, London." Information regarding "Empire" automatic control gear for both alternating and direct current, and "Empire" S/C high-tension fuses, may be obtained immediately by communicating with this address. The firm are now acting entirely independently of any other manufacturers of switch gear or control gear.

Exhibition Notes.

Kingston-on-Thames Corporation have arranged to hold an electrical exhibition at the Baths Hall, Wood-street from April 3 to 18 inclusive.

It is hoped that British manufacturers will visit the sixth Swiss Industries Fair, which is to be held at Basle from April 22 to May 2. The following are among the groups of exhibits:—(4) Lighting and heating; (6) inventions and patents; (8) advertising; (18) delicate mechanical instruments and apparatus; (19) electrical industry.

Among the exhibitors of electrical appliances at the National Trades Exhibition, which was opened at Birmingham on Monday, are the City of Birmingham Electric Supply Department, the British Thomson-Houston Company, Callender's Cable & Construction Company, the General Electric Company, Metropolitan-Vickers Electrical Company, and W. S. Vaughan, Ltd.

The Milan correspondent of the "Times Trade Supplement" states that at the International Sample Fair, which will open in Milan early next month, a section will be applied to the display of unregistered inventions, and the space let at a nominal charge. Exhibits will be safeguarded by the Italian law, which gives temporary protection to unregistered ideas. This section will be devoted particularly to improvements in industrial machinery, labour-saving devices, internal-combustion engines, factory equipment, &c. The committee hope that scientific instruments especially will be shown by English manufacturers.

Telegraph and Telephone Notes.

A new telephone call office has been opened at Old Marston, near Oxford.

Guernsey State Telephone Department made a net profit of £811 last year.

Work has at last been begun on Sheffield's new telephone exchange.

An automatic telephone exchange was brought into operation at Devonport Dockyard on Monday.

The report of the Select Committee of the House of Commons on Telephones was laid on the table of the House of Commons on Monday. It is understood that the principal recommendations are: (1) The message rate of charging to be continued, but with an elasticity of application where such would help telephone development, particularly in rural areas; (2) appointment of a director-general and a general administrative board on the Swedish model; (3) telephone administration to be separated from that of mails; (4) improved business methods.

It is hoped that the London-Manchester underground telephone cable will be in operation next month. The cable, which is 183 miles long and contains 160 pairs of wires, is the first trunk cable to be equipped with telephone repeaters, and on that account it has been possible to reduce the weight of the copper conductors to 40lb. per mile. At the outset there will be one temporary repeater station at Leicester. Later two permanent repeater stations will be introduced, at Derby and Fenny Stratford, and when they are working it will be possible to switch right through from London to Liverpool, Leeds, and other places farther north. Under the present system a call between London and Liverpool has to pass through fifty-seven circuits; with the repeater system it is expected that this will be done on one circuit.

Wireless Notes.

Reuter's Paris correspondent states that a wireless telegraph station is being established on the summit of Mont Blanc.

Mr. Wm. Le Queux has consented to become President of the newly-organised Wireless Scientific Society for Reading and District.

It is stated that in order to avoid the erection of competitive wireless stations in Argentina the German Telefunken Company, whose share capital is held half by the Berlin A.E.G. and half by the Siemens and Halske Company, is transferring a portion of its hitherto dominating holding in the Transradio Argentina to the Radio Corporation of America, Marconi's Wireless Telegraph Company, of London, and the Société Générale pour Telegraphie sans Fil. The Transradio Argentina is erecting a large wireless station in the vicinity of Buenos Aires, which it is expected will be brought into service in 1923.

Dealing with the Question of Wireless messages in a lecture on Monday to the students of journalism at King's College, London, on "The Function of the Press in Empire Building," Mr. Percy Hurd said we seemed to be entering upon a fresh clash of nations in the matter of words. It was not a very happy future to contemplate when nations were sending out into the air their own version of current events, to be contradicted, also in the air, by other nations. It would be far better if, when news was carried over the world by the wireless system, it should be scattered by journalists and not by Government officials. Mr. Hurd added, "We want to establish a free wireless."

The council of the Empire Press Union, at a meeting on Tuesday, presided over by Mr. Robert Donald, and attended by many representatives of newspapers at home and overseas, including the president, Viscount Burnham, unanimously adopted the following resolution:—"That this meeting views with anxiety the continued lack of adequate telegraphic communications within the Empire, and records, on behalf of the newspaper Press of the Empire, its deep concern at the prolonged delay in securing the full advantages of inter-Imperial wireless telegraphy; further, it understands that the Post Office scheme does not meet with the approval of the Dominions overseas, and presses H.M. Government, as a matter of urgent importance, immediately to carry out or support such a scheme for establishing an Imperial wireless chain as will obtain general approval throughout the Empire."

Institution Notes.

The Thirteenth Kelvin Lecture will be delivered by Prof. Sir Ernest Rutherford, K.B.E., F.R.S., before the Institution of Electrical Engineers on May 18, instead of on May 11 as previously announced. The subject is "Electricity and Matter."

The North-East Coast Institution of Engineers and Shipbuilders invite all members to communicate suggestions of papers for next session. They are specially invited to offer papers themselves. Those who feel unable to do so are asked to suggest (1) subjects for papers; (2) suitable authors. Replies should be made as early as possible, and before April 30.

The second annual dinner of the North of Ireland Section of the Electrical Power Engineers' Association was held in Thompson's Restaurant, Belfast, on Saturday, when, under the presidency of Mr. J. S. Graham, the members of the section entertained various local gentlemen connected with the electrical industry and representatives from the South of Ireland Section. A varied and excellent musical programme, interspersed with toasts, was thoroughly enjoyed by all present.

Social Notes.

The third social gathering of the season of the SOUTHPORT Electricity Mains Department was held last Thursday, when after a hot-pot supper various members of the staff contributed to a musical programme. Mr. E. Moxon, the borough electrical engineer, who responded to the toast "Our New Chief," spoke of the need of co-operation if the department was to be made a success.

The landowners and farmers in the Amman Valley, over whose land Swansea Electricity Department's new overhead transmission line to the Amman Valley has been erected, were entertained to dinner at the Hotel Metropole, Swansea, on Friday, by CALLENDER'S CABLE & CONSTRUCTION Co., who carried out the work. Mr. G. W. Burr, Swansea Borough Electrical Engineer, presided. The line extends 16½ miles from the sub-station at Manselton, Swansea, to the sub-station at Gelliceidrin Colliery, Brynamman, and there are three transmission lines and an earth line carried on 158 poles. Contracts have already been entered into with three collieries for the consumption of about four million units, and negotiations are proceeding with other collieries. The bulk of the requirements of the Gorseinon Electric Lighting Company will also be supplied by means of this extension.

The BATTI-WALLAH'S SOCIETY, which, in common with other societies and recreative organisations, has met with the prevalent difficulties since the War, held its annual general meeting at the Holborn Restaurant on Monday. A goodly gathering, representing all the different personalities that this lively society includes, was presided over by Mr. W. F. Ireland, the retiring president. Mr. Pooley, who has been the hon. secretary for the past twelve years, and Mr. A. J. Greenly, the hon. entertainment secretary, both very busy men, who have wished to retire, but felt unable to do so while the society's affairs languished, now relinquish their posts. They are succeeded by Mr. M. Whitgift as hon. secretary and Mr. F. G. Batt as hon. entertainment secretary. Mr. Edgar Barralet is the new president, with a strong committee, and it has been resolved that the meetings shall now be recommenced, and an active season is in contemplation.

The CHELMSFORD ENGINEERING SOCIETY held its annual conversazione at the Hoffmann Manufacturing Company's Works on Saturday. The president, Mr. G. F. Barrett, and Mrs. Barrett welcomed the large company of guests, including the Mayor and Mayoress. The society, which has concluded a most successful season of lectures, held for the encouragement of students for whom a competition was arranged. The president's prize was won by Mr. P. Matthams, and Mr. G. H. Johnson's prize by Mr. E. L. Tomalin. The secretary, Mr. Wise, reported a membership of 181, and thanked the Marconi Wireless Telegraph Company, Crompton & Company, and the Hoffmann Manufacturing Company for the use of apparatus and for lectures. A capital musical programme was carried out; experiments and demonstrations were made showing some of the principal processes of the three firms referred to, and in another room there was a cinematograph display illustrating the developments in wireless telegraphy and telephony.

C. and G. Examinations.

In a communication, dated the 17th inst., Mr. Gus. C. Lundberg points out that during the past three years he has in various quarters drawn attention to the fact that after nearly forty years' successful and progressive work, the CITY AND GUILDS EXAMINATIONS in all electrical subjects, Grades I. and II., were cancelled at the instigation of the Board of Education. For some unknown reason the Board felt that such a course was good for the general public, but considered that certain Government employees should not participate in this decision for the common good, and therefore permitted them to carry on as before. Although practically everyone realised the retrograde step the Board had taken, no decided protest was made by either education authorities or the electrical Press. However, it is proposed to reinstate the examination in "electrical installation work," which is to be held on May 2 and 6 next. This is a very satisfactory beginning, and Mr. Lundberg hopes that it will soon be followed by the reinstatement of all the remaining examinations in electrical subjects. The best thanks of the industry must be accorded to the Electrical Contractors' Association for their personal efforts in this matter.

Railway Electrification Proposals.

The scheme for the ELECTRIFICATION of the SUBURBAN LINES of the SOUTH-EASTERN & CHATHAM RAILWAYS has been advanced a stage during the week. As our readers are aware, the S.-E. Company contemplate an expenditure of £5 800 000 on electric traction. The first stage will cover 210 track miles and extends to Orpington, Hayes and Addiscombe-road (Croydon). The second stage will extend to Gillingham, Tonbridge and Dorking, and the third will be mainly sidings in the same areas. The London, Brighton & South Coast Company propose to extend the electrification of suburban lines north of Coulsdon and Cheam, thus adding 300 track miles to the 111 miles already electrified. The full cost of converting the main and suburban lines will be £10 000 000. It is announced that the L. & S.W. Company have withdrawn their objection to the technical scheme of the South-Eastern Company, and the Ministry of Transport have forwarded the electrification proposals to the Trade Advisory Committee, whose early consent is anticipated.

Imperial Notes.

RENMARK (South Australia) Council have decided to invite estimates of the cost of extending their electrical generating plant.

Melbourne Electric Supply Company have applied for an Order authorising them to supply electricity in portions of the shire of BELLARINE (Victoria).

MUSWELLBROOK (N.S.W.) Council are using the accumulated profit on the gas undertaking (£3 000) to meet the cost of establishing electricity supply works.

TINTENBAR (N.S.W.) Shire Council have been compelled to defer consideration of the question of establishing electricity works owing to the present high price of money.

It is stated that on nearly nine thousand farms in NEW ZEALAND the cows are milked by electricity at an annual cost for current of between £25 and £30 per farm.

The erection of the power house at the WANGARATTA (VICTORIA) woollen mills, which will also supply current to the municipal council, has been commenced.

The transmission line being erected by the TASMANIAN GOVERNMENT HYDRO-ELECTRIC DEPARTMENT from Waddamana to Launceston is expected to be completed before next August, and several new factories at Launceston will be ready to take power from the line by the time it is available.

Works at Launceston (Tasmania) have been reopened by Australian White Lead, Ltd., who propose to manufacture a NON-POISONOUS WHITE LEAD by means of the Gitsham-Evershed process, in which an electric furnace is used to vaporise the metallic compounds, atmospheric oxygen is added, and the resulting acids produce the pure white lead. Mr. Gitsham is to be retained as managing director for at least three years.

Machinery and appliances of iron or steel, of a class or kind not made in CANADA, and elevators and machinery, and machinery of floating dredges for use in alluvial gold mining, may be imported free of duty. On electric motors and electrical apparatus, and all machinery not otherwise provided for, and iron or steel integral parts of all machinery specified in this item, there is a British preferential tariff of 15 per cent. and a general tariff of 27½ per cent. *ad valorem*. A sales tax is also levied on the duty-paid value as follows :—2½ per cent. on importations by manufacurers or wholesalers, and 4 per cent. on importations by users or retailers.

Foreign Notes.

It is reported that the Czecho-Slovak Government intends founding a RADIUM INSTITUTE AT PRAGUE.

Efforts are being made to arrange for the development of WATER POWER IN THE DUTCH EAST INDIES in order to provide cheap electric power for industrial purposes. Already plans of some schemes have been prepared, but they are being held up for financial reasons.

There has been an increase in the TAX ON PATENTS IN FRANCE, and in place of 100 frs. a year, 125 frs. must be paid for each of the first five years, 200 frs. for each of the succeeding five, with a fee of 300 frs. for each of the remaining five years of the life of a patent.

THE AMALGAMATION of the Spanish company, Aceros Electro Rapidos, of San Sebastian, with a German (Cologne) combine is announced. The Spanish company owns metallurgical and machinery works, while the German group is engaged in railway wagon and material construction.

Two additional 30 000 kW generating sets are to be installed at the WINDSOR (W. VA.) electricity works of the West Penn Power Company, which also owns stations at Springdale (4 200 kW) and Connellsville (56 500 kW). The new units will bring the total rating of the company's plant to over 180 000 kW.

As the result of a questionnaire recently sent out by the German Metallurgical Society to electricity undertakings using ALUMINIUM as OVERHEAD CONDUCTORS, it is announced that out of fifty-nine replies only eighteen reported deterioration due to corrosion at points where the aluminium was in contact with other metals. In general, aluminium conductors have given satisfaction, though special precautions against atmospheric influences are required at joints. Insulating tape or varnish is usually employed for this purpose.

The Bureau of Standards, Washington, is endeavouring to STANDARDISE AMERICAN DRY-CELL SPECIFICATIONS. At a recent conference of manufacturers and users of batteries, 17 sizes of the larger cells were considered, and 7 were recommended as standard; of 30 different sizes of flashlight batteries 8 were adopted as standard, and 2 sizes were selected for radio apparatus. It is stated that 150 000 000 dry cells are sold each year, and it is considered that the elimination of many of the little-used sizes will result in a considerable saving in the cost of manufacture and a reduction of prices.

The American Railway Express Company, which claims to be the largest user of ELECTRIC TRUCKS in the world, and has at present more than 1 200 of these vehicles in service, has recently given an order for an additional 104 trucks for NEW YORK, PHILADELPHIA, and BUFFALO. Twenty of the trucks are of 5-ton size, for New York; 50 2-ton, for Philadelphia; and 34 of 2- and 3-ton sizes, for Buffalo. For New York the trucks are (according to the "Electrical World") to be on a 24-hour basis, and standardised interchangeable batteries are to be used. Each truck is provided with two storage batteries, and at the end of the first shift the exhausted battery will be removed and a freshly charged one put in its place.

Obituary.

We regret to announce the death of Dr. Geo. B. Mathews, F.R.S., Professor of Mathematics at the University College of North Wales, Bangor, from 1884 to 1896. Dr. Mathews was the author of works on the theory of numbers, algebraic equations and projective geometry, and with Prof. A. Gray he wrote a treatise on Bessel Functions.

The death is announced of Mr. Richard Rice, manager of the Lynn plant of the American General Electric Company. Deceased, who was 59 years of age, joined the company in 1903 as a consultant on steam engineering, and was in charge of the steam turbine department of the works until 1918, when he became manager of the plant.

The death occurred at Newcastle-upon-Tyne on March 21 of Dr. J. T. Merz, vice-chairman of the Newcastle-upon-Tyne Electric Supply Company. Dr. Merz, who was born at Manchester in 1840, at first devoted himself to chemistry, although he was also a mathematician of a high order. But in addition to his other extensive scientific and philosophical work, he was from an early date interested in the development of electrical supply. He was one of the founders of the Newcastle-upon-Tyne Electric Supply Company, established in 1889, of which he was for many years chairman. Dr. Merz was closely connected with and took the deepest interest in the expansion of this company from an electric lighting company into one of the most important power undertakings in the country. He was also, in 1881, a director of the Swan Electric Light Company, the first electric lamp manufacturers in this country. In addition to all his business interests, he also took a close interest in the question of technical education, and was for many years closely associated with the work of the Armstrong College, Newcastle. Among his numerous important literary works, the most notable were "A History of European Thought in the Nineteenth Century," "Religion and Science," and "A Fragment on the Human Mind."

Miscellaneous.

It is proposed to employ the electrolytic process for the production of zinc out of the huge dumps of material at the inactive zinc and lead mines in North Cardiganshire.

A deputation from Edinburgh Electricity Committee visited Glasgow last week and inspected the mechanical soot-cleaning appliances in operation at Dalmarnock Electricity Works.

A disastrous fire broke out in the Galway Electrical Lighting Company's premises in Galway last week. The fire started in the power station machine room, and the building soon became a mass of flame. The damage is estimated at £15 000.

The most imposing architectural feature of the new Waterloo Station, which was opened by the Queen on Tuesday, in the absence, through indisposition, of the King, is the new Victory Arch, in the centre of which is an electrically driven clock, supplied by the Synchronome Company. Over 200 electric dials have been supplied by this company for the station and the adjacent offices.

An examination for first and second class certificates of competency as Manager and Under Manager of Mines will be held on May 24 and 25, 1922, at Edinburgh, Newcastle-on-Tyne, Sheffield, Wigan, Cardiff and Birmingham. The written part of an examination for certificates of qualification as Surveyor of Mines will be held at the same places on May 25. Candidates must, on or before April 2, send their names, stating also the district in which they are employed, to the Secretary, at the Mines Department, 46, Victoria-street, London, S.W. 1, from whom all particulars can be obtained.

A meeting of the British Organising Committee formed in connection with the International Navigation Congress is to be held at the Institution of Civil Engineers this week, when the following, among other subjects, will be considered:—The location and construction of lighthouses and of marks at sea; illuminating apparatus, fog signals; working through the air, under water, or by Hertzian rays; advances made and new principles; the utilisation of tides for the production of power for the working and lighting of ports and for maritime work (working of lock gates, &c.); the improvement of rivers for navigation and the production of power; new types of dame for canalised rivers.

Licenses of right have been granted to Norsk Alkali A/S for patent No. 121 460 (18 135/18) for "apparatus and process for the electrolysis of chlorides and of alkaline metals"; to Peter Ford & Sons, Ltd., and another for Patents Nos. 3 030/15 and 4 289/15 for "a new or improved process and composition for moulding or forming articles such as light reflectors or shades, vases, or the like, or decorative slabs for partitions, wall or ceiling covering or the like"; to C. D. Ehret for Patent No. 123 081 (2 585/19) for "improvements in or relating to apparatus for electric wave transmission, particularly applicable to telephony"; to Splitdorf Electrical Company for patent No. 131 899 (21 067/19) "for operating mechanism for electrical generators and magnetos."

Recent Wills.

Mr. James Copland Glegg, a director of the Aberdeen Electrical Engineering Co., has left, in addition to real estate, personal estate in the United Kingdom valued at £50 840.

Dr. Edward Hopkinson, vice-chairman of the Chloride Electrical Storage Company, a director of Mather & Platt, and past-president of the Institution of Mechanical Engineers, has left estate valued at £141 675 (net personalty £137 904).

Companies' Meetings, Reports, &c.

Newcastle-upon-Tyne Electric Supply.

The report of the Newcastle-upon-Tyne Electric Supply Company for the year to December 31 last shows a profit of £347 219, against £392 643 in 1920. From this has to be deducted £10 000 for "Reserve for plant renewals," leaving £337 219. After adding £13 091, the balance brought in, there is a total available profit of £350 310 (£372 241), against which has been charged interest on debenture stocks, loans, &c., amounting to £106 442, transfer to "reserve for special depreciation and contingencies, other than equalisation of dividends," £50 000, leaving a balance of £193 868, which the directors recommend should be appropriated as follows: In the payment of a dividend of 3½ per cent. on the 7 per cent. cumulative preference shares, making, with the interim dividend of 3½ per cent. paid on September 30 last, 7 per cent. for the year (subject to income tax), £105 000; in the payment of a dividend of 5 per cent. on the 5 per cent. preference shares for the year (subject to income tax), £74 885. The sum of £13 982 10s. remains to be carried forward, against £13 091 last year. The expenditure on plant renewals and improvements during the year amounted to £9 441. The three months' stoppage of the coal mines and the general depression in trade caused a serious reduction in the Company's output, and this, together with a continuance of high labour costs, has materially affected its profits. As a result, the directors are unable to recommend the payment of a dividend on the ordinary shares. The additional capital expenditure on works for the year amounted to £801 862 10s.., and represents power station extensions and addition to the Company's transmission and distribution system. During the year £1 383 109 of first and £850 000 of second mortgage debenture stocks were issued.

Chelsea Electricity Supply.

Comparing the present position of this company with its position in 1913, the chairman, Mr. W. R. Davies, who presided last week at the annual meeting of the Chelsea Electricity Supply Company, said that an immense improvement was shown. The profits had not increased very largely, but the intrinsic position of the company was bettered out of all knowledge. The gross receipts had risen from £72 500 to £120 400, but the costs had gone up from £35 000 to £77 000. The balance of profit, after providing for depreciation, had risen from £17 900 to £24 600, and this notwithstanding that rates, to mention only one item, had risen from £5 874 to £11 196. The improvement in the capital position was even more striking. Nine years ago the debenture stock outstanding was £175 000, but this had been reduced to £89 670. The depreciation fund, notwithstanding they had withdrawn heavy amounts for plant which had been scrapped, had risen from £124 000 to £205 000. In 1920 they dismantled and sold a considerable amount of uneconomical generating machinery, and an agreement had been entered into with the Central Electric Supply Company for a bulk supply to meet all the company's requirements in excess of that provided by the Diesel Plant, which it was intended to continue to use. They had found this plant both economical and reliable, and it was useful to have an oil plant to set off against coal-using plant, so that, whichever form of fuel was the cheaper, they could make use of the plant accordingly. The capital commitments consequent on this bulk supply would amount ultimately to between £35 000 and £40 000, for which they had plenty of funds in hand available. An abstract of the accounts was given in our issue of March 10.

Brompton and Kensington Electricity Supply.

Addressing the shareholders at the annual meeting of the Brompton and Kensington Electricity Supply Company last week the chairman, Mr. H. R. Beeton, who presided, stated that the company had connected more consumers than in any previous twelve months, excepting only last year and the year before. They sold more current per lamp installed than in the previous year, and although the average price was somewhat lower, the gross receipts showed an increase of 7½ per cent. over the record year of 1920. This continued progress was due mainly to the conversion of the larger houses in their area into flats and maisonettes and to the growing use of electrically-operated labour-saving devices, and partly to the reasonable rates at which the company supply electricity for heating and cooking, as well as for lighting. Their new 1 500 kW turbine alternator was installed during the year, but, owing to delay in delivery, they only enjoyed the benefit of it for less than a month By its installation they had provided all the plant likely to be required for a long time. The cost of this and other developments (£39 000) the Company intended to provide entirely out of profits. With regard to the Brompton and Kensington Accessories Company, he could only repeat what he said last year, namely, that its assets continued to be worth their book value, that it constituted one of their best customers, and that its work contributes effectively to the business of supply in their area. Our issue of March 3 contained an abstract of the accounts.

City of London Electric Lighting.

In moving the adoption of the report and accounts at the annual meeting of the City of London Electric Lighting Company last week, Mr. J. B. Braithwaite (the chairman), who presided, said that the receipts from the sale of current and from other sources amounted to £676 455, compared with £649 390 in 1920. The total generating costs were £270 885 (271 604), the distribution costs £303 685 (£311 785). There was, however, an increase of £12 675 in rates and taxes, and also an increase in rents and wayleaves, making an increase of £7 010 in the total expenses and a net

increase of £27 065 in revenue. The reserves now stood at £412 664, showing an increase of £41 000. They naturally hoped last year that they would have a record output this year, but owing to the prolonged coal strike and other factors their actual output was about three-quarters of a million units less. But owing to the economies introduced into the generating station and in other ways, although the output had been less, the profit had been increased, and they hoped that, now that costs of coal and other things were inclined to come down, there would be increased economy this year, which would enable them to do something for their consumers. The new plant was now installed, and they hoped to have it in operation within the next week or two.

British Insulated and Helsby Cables.

The report of the BRITISH INSULATED AND HELSBY CABLES, LTD., for the year ended December 31, 1921, shows a profit for the year (after making provision for estimated liability for Corporation Profits Tax to date) of £502 524. to which has to be added £116 854 brought in, making a total of £619 388. From this sum have to be deducted directors' and debenture trustees' fees and remuneration to works' committee (£9 665), interest on first debenture stock (£22 500), interest on second debenture stock (£10 000), dividend on preference shares to December 31, 1921 (£30 000), interim dividend on ordinary shares to June 30, 1921 (£37 500), which leaves a disposable balance of £509 723, of which the directors have appropriated £30 000 to depreciation and £5 000 to first mortgage debenture stock redemption account, leaving available for dividend a balance of £474 723. The directors recommend the payment of a further dividend of 6¼ per cent. on the ordinary shares, together with a bonus of 5 per cent., making, with the interim dividend already paid, a total distribution of 15 per cent. for the year ended December 31, 1921, which will absorb £112 500 and leave £362 223 to be carried forward. The directors report that, though fully employed during the first half of the year, the factories were not so busy during the second half, and there had recently been a decided diminution in the value of orders received.

Para Electric Railways and Lighting.

The gross receipts of the PARA ELECTRIC RAILWAYS AND LIGHTING COMPANY for the year ended Nov. 30 decreased from £296 898 to £267 310, and operating expenses from £175 032 to £163 891; the difference in exchange rose from £9 741 to £58 796, on account of heavy fall in exchange from the average remitting rate of 14·93d. in the previous year to 8·39d. this year, leaving net revenue at £44 623, compared with £112 124. Adding interest and transfer fees £37, against £5 347, deducting London expenses £4 604, provision for income-tax £11 000, loss on investments £3 322, Debenture interest and sinking fund £38 500, and adding £18 157 brought in, the balance was £5 391, against £81 057, transferred to depreciation and renewals reserve. A further factor which seriously affected the net revenue was the inability of the municipality to pay accounts for public lighting. Interest on sterling Treasury bills held by the company in respect of lighting accounts of previous years remains unpaid, consequently bills have been written down to present market value from reserve created against this contingency. The directors regret that dividends on preference and ordinary shares cannot be paid this year. As preference shares are cumulative, accrued dividends will be paid when possible out of future earnings.

Llanelly and District Electric Lighting and Traction.

The report of the LLANELLY AND DISTRICT ELECTRIC LIGHTING AND TRACTION COMPANY for the year to December 31, 1921, shows available profit, including the balance (£1 341) brought in, of £25 895. Loan and debenture interest, less tax, absorbed £8 326, and after allowing for debenture stock redemption (£1 216) and general reserve (£4 500) there is an available balance of £11 853. Out of this sum dividends amounting to £5 931 have been paid, and the directors further recommend the payment of a dividend on the ordinary shares of 7 per cent. for the year to December 31 last, less tax (£5 449), leaving £473 to be carried forward. Although adversely affected by the coal strike and industrial depression, which was severely felt in the South Wales district, the result of the year's working shows improvement as compared with former years. The power business continues to develop satisfactorily, and the new plant recently intalled is being used to its full capacity. During the year £125 000 7½ debenture stock, 19 760 preference shares and 46 830 ordinary shares were issued to provide funds for capital expenditure incurred to the end of 1921.

Kensington and Knightsbridge Electric Lighting.

The report of the KENSINGTON AND KNIGHTSBRIDGE ELECTRIC LIGHTING COMPANY for the year 1921 shows net profit available for dividend of £18 147, to which £1 857 is brought in from previous year, making a total of £20 014. From this sum has to be deducted £9 700 for dividends already paid during the year, and the directors recommend payment of a further dividend at the rate of 12 per cent. per annum for the last half-year, which will absorb £6 300, making 10 per cent. for the year on the ordinary shares, and leaving £4 014 to be carried forward. The balance of the renewal and reserve fund now stands at £176 525, of which sum £102 540 is the amount expended in excess of capital received, the balance being represented by working capital, investments and cash balances.

The directors of METROPOLITAN-VICKERS ELECTRICAL COMPANY recommend the payment of a dividend on the ordinary shares of 12½ per cent., less income tax, for the year ended December 31, 1921.

RANSOMES, SIMMS & JEFFRIES have passed the dividend on the preference shares.

PHILIPS' LAMPS WORKS, of Amsterdam, announce a dividend of 11 per cent. for 1921.

The WESTERN UNION TELEGRAPH COMPANY have declared a quarterly dividend of 1¾ per cent.

HADFIELDS, LTD., have declared a final dividend of 6d. per share, making 5 per cent. for the year, free of tax.

THE JUTLAND TELEPHONE CO. offered for public subscription this week £500 000 5½ per cent. sterling bonds at £93. The issue was over-subscribed.

HALIFAX & BERMUDAS CABLE COMPANY announce an interim dividend at the rate of 6 per cent. per annum, tax free, for the half-year ending Dec. 31 last.

The STOCK EXCHANGE Committee have ordered 20 000 £1 fully paid ordinary shares of Marconi's Wireless Telegraph Company and 75 571 £1 fully paid ordinary shares of the Cordoba Light, Power & Traction Company to be quoted in the Official List.

THE VICTORIA FALLS AND TRANSVAAL POWER COMPANY'S net earnings for the quarter ended Dec. 31 last, including those of the Rand Mines Power Supply Company, amounted to £205 682, before providing for taxation in South Africa and the United Kingdom.

The profit of the COUNTY OF DURHAM ELECTRICAL POWER DISTRIBUTION COMPANY for 1921 was £60 952, plus £1 274 brought in, making £62 227. A dividend of 11½ per cent. is announced on the ordinary shares for the year, leaving £842 to be carried forward.

In regard to the issue of £1 500 000 7 per cent. debenture stock of the BRITISH THOMSON-HOUSTON COMPANY, allotment letters and scrip certificates should be forwarded to the Company's office, Crown House, Aldwych, W.C. 2, for exchange for definitive certificates.

PRITCHETT & GOLD & E.P.S. COMPANY have declared a dividend of 10 per cent. on the ordinary shares. The sum of £2 000 has been added to the workmen's compensation reserve, and £10 000 to the general reserve, leaving £29 063 to be carried forward, subject to taxes.

The NATIONAL ELECTRIC SUPPLY COMPANY have declared dividends at the rate of 4 per cent. for the year on the preference and 6s. 6d. per share on the ordinary shares for the half-year, making with the interim dividend paid in July, 9s. for the year, and £5 8s. 6d. on the founders' shares.

BIDEFORD AND DISTRICT ELECTRIC SUPPLY COMPANY are offering for public subscription 7 500 7 per cent. preference shares of £1 each and 17 500 ordinary shares of £1 each. The company has not yet been registered, but will be incorporated on the necessary capital being obtained. The issue closes on March 31.

The net earnings of the BELL TELEPHONE OF CANADA for 1921 were $2 276 421, after providing $2 549 715 for depreciation and $595 000 for taxes. Interest charges absorbed $1 168 800, and after providing for a dividend of 8 per cent. a deficiency remains of $776 009. Surplus and reserves stand at $22 501 399.

The accounts for 1921 of the CARMARTHEN ELECTRICITY SUPPLY COMPANY show a profit of £886, to which is added £644 brought forward. The half-year's preference dividends absorbed £252 10s., and the directors recommend that £545 be transferred to the depreciation fund, leaving a balance of £753. Out of this sum they recommend a dividend of 5 per cent. (less income tax) on the ordinary shares, leaving £497 to be carried to next account.

The net profit of BROWETT LINDLEY & COMPANY for 1921, after charging debenture and bank interest, writing off £6 244 for depreciation of buildings, machinery and patterns, and making provision for income tax, corporation tax and contingencies, was £14 059, plus £9 178 brought in, making £23 237. The directors propose a further dividend of 11½ per cent., less tax, on the preference shares (disposing of all arrears), a dividend of 10 per cent., less tax, on the ordinary shares, carrying forward £10 737.

Presiding over the meeting of the HASTINGS AND DISTRICT ELECTRIC TRAMWAYS COMPANY, LTD., Mr. Geo. Kitchin said that the traffic receipts for 1921 had increased by £1 855 and the expenses were £950 less, but power was up by £950 owing to the conversion of two boilers for oil fuel burning. After meeting debenture interest they were able to pay the preference dividend for the year and to wipe out the arrears of 1½ per cent. on those shares. The overhead equipment on the front line had been working very satisfactorily. The company was successful in the appeal against the decision of the arbitrator on the question of the new lamps and cables on the front, and the threatened further appeal by the Corporation had been abandoned.

The Report of the URBAN ELECTRIC SUPPLY COMPANY for the year ended Dec. 31, 1921, states that the balance carried to net profit and loss account amounts to £95 563, as compared with £86 685 in 1920, and after deducting the amounts required for interest, debenture stock, redemption and income tax amounting to £60 856, there is, with £2 163 brought forward from last year, an available balance of £35 869, which the directors recommend should be applied as follows: To reserve for depreciation, £25 000; to dividend for one half-year on the cumulative preference shares, £6 250; to balance to be carried forward, £5 619. The total load connected to the thirteen undertakings of the company is 48 120 kW, compared with 46 882 kW in 1920.

It is stated that a company is being formed at Nairobi, Kenya Colony, called the EAST AFRICAN POWER AND LIGHTING CO., to acquire the undertaking of the Nairobi Electric Power and Lighting Co., Ltd, and other electrical interests in the Colony.

COMMERCIAL INTELLIGENCE.

County Court Judgments.

[Note.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

BURGE, Mr. H. J., 8, Fernhead-road, Paddington, master electrician. £10 4s. 11d. Jan. 10.

MITHAM, Mr. D., Terrace-road, Walton-on-Thames, electrical contractor. £23 1s. 3d. Jan. 6.

REYNOLDS, Mr. W. A., 2, Aldgate East-chambers, Aldgate, electrical engineer. £33 1s. Jan. 13.

THURLOW WHOLESALE ELECTRIC SUPPLIES, LTD., (trading as Herberts), registered office, 337, Norwood-road, S.E. £16 6s. 11d. Jan. 14.

Deeds of Arrangement.

CARTER, William Henry, trading at Manchester and Salford, and residing at 30, Thomas-street, Cheetham Hill, electrical engineer. Trustee, L. Taylor, 4, St. Ann's-square, Manchester. Liabilities unsecured, £639; assets, less secured claims, £67.

KNIGHT, Wilfred Lempriere, trading as W. L. KNIGHT & SONS, 6, Oak-end-waye, Gerrard's Cross, electrical engineer and contractor. Trustee, W. A. J. Osborne, 119, Finsbury-pavement, E.C. Liabilities unsecured, £850; assets, less secured claims, £525.

Mortgages and Charges on Limited Companies.

[Note.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

B. E. MANUFACTURING COMPANY, LTD., London, E.C., electrical apparatus manufacturers. Registered March 7, £3 000 debentures, present issue £2 350; general charge. *——. June 29, 1920.

BURNHAM & DISTRICT ELECTRIC SUPPLY COMPANY, LTD. Registered March 8, £750 debentures; general charge. *£8 308 8s. 6d. Oct. 6, 1921.

CESCO, LTD., Cardiff, electricians. Registered March 8, £2 000 debentures; general charge.

COOPER & SMITH, LTD., Maldon, electric motor and cutter manufacturers. Registered March 8, £3 000 first debentures and £9 500 second debentures; general charge.

HEXHAM & DISTRICT ELECTRIC SUPPLY COMPANY, LTD. Registered March 9, debenture and mortgage securing £23 000; general charge. *£7 650. Aug. 20, 1920.

INDIA RUBBER, GUTTA PERCHA & TELEGRAPH WORKS COMPANY, LTD., London, E.C. Registered March 10, £250 000 debentures to bank. *£400 000. Dec. 14, 1921.

LONDON FACTORS & AGENTS, LTD., London, S.W., electrical and general merchants. Registered March 10, £5 000 debentures, present issue £660; general charge. *Nil. July 19, 1921.

WOKING ELECTRIC SUPPLY COMPANY, LTD. Registered March 7, £110 debentures, part of amount already registered. *£64 170. June 25, 1921.

Satisfaction.

DUBILIER CONDENSER COMPANY, LTD. (late DUBILIER ELECTRICAL SYNDICATE LTD.), London, W. Satisfaction registered March 9, £20 000, registered Feb. 23, 1920.

Private Meetings.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

PITKIN, JAMES, & COMPANY, LTD., 28, Hatton-garden, E.C., scientific instrument makers. A meeting of creditors was held at 28, Hatton-garden, E.C., to consider a scheme of arrangement proposed between the company and the unsecured creditors. An informal conference of the principal creditors was held in January last, and the creditors had been requested to agree to a scheme by signing a form accepting immediate part payment. The great majority of the creditors had accepted, but the present meeting had become necessary in order to get formal approval. The necessity for the scheme had arisen entirely through the Aladdin Renew Electric Lamp Corporation, Ltd., having failed to pay a large sum of money owing to the company. The Aladdin Company, it was alleged, ordered a number of machines involving thousands of pounds, and refused to take delivery and pay for more than a small proportion. The protection of the court was sought, but by the time the final judgment in Pitkin's favour was obtained the Aladdin Company went into liquidation. The verdict was for £3 400 and costs, totalling over £4 000, and of this sum only £1 100 was obtained. Under the scheme now proposed at least 5s. in the £ would be paid promptly, and it was confidently hoped that a further sum would be paid, assuming the company could carry on business and dispose of its stock and assets.

SEMCO, LTD. (in voluntary liquidation), electrical engineers, 19, High-street, Shoreditch, London, E. At a meeting of creditors held last week Mr. F. B. Darke, the liquidator of the company, submitted a statement of affairs which showed liabilities of £5 952. After allowing £155 for preferential claims, the assets were estimated to realise £2 583, or a deficiency as regarded the creditors of £3 369. Mr. Darke reported that the company was registered on Sept. 10, 1919, to acquire a business from the Standard Electrical and Maintenance Company. The goodwill was valued at £2 000. In the twelve months to Aug. 31, 1920, there was a loss on the trading of £870, the turnover being approximately £19 000. In the following year the turnover was £19 555, and there was a loss on the trading of £4 780 accounted for chiefly through unremunerative contracts and the electrical strike. In addition the company opened a foundry at Forest Gate, on which money was lost, and it had since been closed down. The company also lost on the manufacture of the Semco Sparking Plugs. In answer to questions, it was stated that the issued capital of the company was £6 200, of which £2 200 was issued for cash. The company had carried out a substantial contract for the Islington Borough Council, and work to the extent of about £2 000 remained to be completed. It was a profitable contract to complete. A resolution in favour of the voluntary liquidation of the company being continued with Mr. Darke as liquidator was carried unanimously, and an informal committee was appointed consisting of the representatives of the General Electric Company, Phœnix-Tester, Ltd., and the Cable Accessories Company. The principal creditors are: B. T.-H. Electric Lamp Company, £327; Metallic Electrical Engineering Company, £115; General Electric Company, £104; Metropolitan-Vickers Electric Company, £64; Vulcan Electric Company, £81; Phœnix-Tester, Ltd., £82; Cable Accessories Company, £99; Wholesale Fittings Company, £75.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Companies Winding-up Voluntarily.

BRITISH SWITCHGEAR, LTD. T. D. Marshall, of 10, Bush-lane, Cannon-street, London, appointed liquidator.

ELECTRIC BRASS WARES, LTD. T. Edgar A. Killip appointed liquidator. Meeting of creditors at 21, Tempest Hey, Liverpool, on Tuesday, March 28, at 3 p.m.

MIDLAND ELECTRIC COMPANY (SOUTHPORT), LTD. W. F. Brown, of Southport, and J. A. Bond, of Southport, appointed joint liquidators. Meeting of creditors on Monday, March 27, at 3 p.m., at the offices of Davies & Crane, Hoghton Chambers, Hoghton-street, Southport. Particulars of claims by April 30 to the liquidators.

Notice of Dividend.

BAKER, Reginald Percival, and STUBBS, Frederick Clarence, trading together in co-partnership as the SHEFFIELD ELECTRIC CONSTRUCTION COMPANY, at 124, Pond-street, Sheffield. Amount per £, 4s. 10½d. First and final. Payable, March 22, 14, Figtree-lane, Sheffield.

Notices of Intended Dividends.

MATHERS, Ernest Edward, 10c, High-street, Doncaster, electrical engineer. Last day for receiving proofs, April 5. Trustee, L. J. Clegg, 14, Figtree-lane, Sheffield.

WILLCOX, Albert John, The Garage, Farnham Common, Bucks, electrical, &c., engineer. Last day for receiving proofs, April 5. Trustee, F. W. Davis, 28, Theobald's-road, Bedford-row, London, W.C. 1.

WOLLMAN, Harry Michael, late 9, Greasbro'-road, Parkgate, near Rotherham, Co. York, electrical factor. Last day for receiving proofs, April 3. Trustee, L. J. Clegg, 14, Figtree-lane, Sheffield.

Partnerships Dissolved.

BARCHAM, Constance Wormald, and EDWARDS, Christophe, manufacturers and repairers of electrical accessories, &c., at 29, Portman-mews South, London, under the style of EDWARDS & BARCHAM, by mutual consent as and from Feb. 3, 1922.

ROLLINSON, Joseph Ernest, and GREENSMITH, Ernest Joseph, electrical engineers, at Tavistock Chambers, Beastmarket Hill, Nottingham, under the style of ROLLINSON & GREENSMITH, by mutual consent as from Feb. 12, 1922. Debts received and paid by J. E. Rollinson.

Bankruptcy Proceedings.

BARRETT, Bernard, electrical engineer, 104, Whitechapel-road, E. A general meeting under the receiving order made against this debtor was held last week to enable the creditors to appoint a trustee. A statement of the debtor's affairs showed gross liabilities £2 203, of which £1 475 was expected to rank for dividend, against assets valued at £1 146. The debtor began business in 1911, and in May, 1920, after spending £800 on plant and machinery, he began to manufacture electric switchboards. Owing to foreign competition this venture proved a failure, and in January last he sold the whole of the plant and machinery for £400, which he applied in payment of certain debts. He continued as an electrical engineer, and in March last was joined by two partners, who each provided £250 capital. A branch shop was opened at 17, Maddox-street, W., under the style of the Regent Electrical Installation Company, but in July last the partnership was dissolved and a receiver was appointed at the instance of his partners. He afterwards traded on his own account as an electrical engineer at 104, Whitechapel-road, until September last, when he sold the business to a company of which he became managing director. Debtor valued his interest in the late partnership at £781, and had returned it as an asset to realise that amount. The creditors appointed Mr. William Osborne, of Balfour House, Finsbury-pavement, as trutee of the estate.

HALLETT, Graham Moore, 7, King-street, Frome, Somerset, electrical engineer. The receiving order in this matter was made on March 7, on debtor's own petition. The statement of affairs shows liabilities of £881, while net assets are estimated to realise £358, a deficiency of £523. Debtor attributes his failure to loss on contracts through lack of experience in estimating, depreciation of stock through falling market, and bad trade. He commenced business at 7, Alexandra-road, Frome, in April, 1919, with £65 capital. In November, 1920, the business was removed to his present address. Debtor became aware of his position in December last. A fair set of books has been kept.

LIDDELL, Robert Henry (trading as LIDDELL & McINNES), 4, The Crescent, Carlisle, electrical engineer. The receiving order in this matter was made on Feb. 21 on debtor's own petition. The statement of affairs shows gross liabilities of £359, of which £333 is expected to rank for dividend, and there is a deficiency of £181. Debtor attributes his failure to bad trade ever since the coal strike, and tendering for contracts at too low a price, partly to keep on his workmen. It appears that he commenced business shortly after the armistice, going into partnership with another. This partnership was dissolved in April, 1919, debtor receiving £125 as his share. Later in the same year he started at his present address in partnership with a relation, but this was dissolved in February or March, 1921. Debtor had no capital on starting the last partnership, but his partner brought in £370, of which only £231 had been repaid. Debtor became aware of his position in April last year.

Prices of Metals, Chemicals, &c.

TUESDAY, MARCH 21.

		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£64 0 0	—	10 0
Electro Wirebars ..	,,	£67 15 0	—	5 0
H.C wire, basis	per lb.	0s. 10¼d.	—	1/16d.
Sheet	,,	0s. 9 11/16d.	—	1d.
Phosphor Bronze Wire (Telephone)				
Phosphor-bronze wire, basis	,,	1s. 2¼d.	—	1/16d.
Brass 60/40—				
Rod, basis	,,	0s. 7⅛d.	—	—
Sheet, basis	,,	0s. 9¾d.	—	—
Wire, basis.....	,,	0s. 10¼d.	—	—
Pig Iron—				
Cleveland Warrants .	per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 SWG	,,	£19 0 0	—	—
Lead Pig—				
English	,,	£23 0 0	£0 15 0	—
Foreign or Colonial ..	,,	£21 12 6	£0 15 0	—
Tin—				
Ingot	,,	£143 15 0	£0 2 6	—
Wire, basis	per lb.	2s. 0d.	—	—
Spelter	per ton	£22 15 0	—	£2 17 6
Aluminium Ingots	per ton	£120 0 0	—	—
Mercury	per bottle	£11 0 0	—	—

Salammoniac.—Per cwt. 65s.-60s.

Sodium Chlorate.—Per lb. 3½d.

Sulphur (Flowers).—Ton £10 10s.

„ (Roll-Brimstone).—Per ton £10 10s.

Sulphuric Acid (Pyrites, 168°).—Per ton £9 17s. 6d.

Copper Sulphate.—Per ton £26 10s.

Sodium Bichromate.—Per lb. 5¾d.

Boric Acid (Crystals).—Per ton £60

Rubber.—Para fine, 11d.; plantation 1st latex, 8d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd, and the rubber prices by W. T. Henley's Telegraph Works Company.

New Companies.

Dalgetti Electric.

DALGETTI ELECTRIC, LTD. (180 308). Private company. Reg. March 14. Capital, £500 in £1 shares. Electrical engineers for dealing in all contracts and sales of electrical fittings and materials pertaining thereto, &c. First directors: W. E. L. Bury, R. H. Limming and J. G. White. Registered office, 10, Conduit-street, W.

Elite Electricians.

ELITE ELECTRICIANS, LTD. (180 386). Private company. Reg. March 17. Capital, £2 000 in £1 shares. To carry on business as indicated by the title. Subscribers: E. H. Lewis and F. S. Munn. Solicitor: C. Crowther, 23, Abingdon-street, Westminster.

London Lamps.

LONDON LAMPS, LTD. (180 314). Private company. Reg. March 14. Capital, £500 in £5 shares. Manufacturers of and dealers in electrical and other lamps and apparatus, &c. Subscribers: G. C. Walsh and J. Mackay. Secretary: J. Mackay. Registered office: 69, Hatton-garden, E.C. 1.

London Radio College.

LONDON RADIO COLLEGE, LTD. Private company. Nominal capital, £2 000 in £1 shares. To establish schools for instruction in radio telegraphy or telephony or other methods of inter-communication, &c. Subscribers: A. E. Fournier and J. Ball. Solicitors: Amery-Parkes & Co., 12, Fleet-street, E.C. File number, 120 296.

Lelios Lamp Co.

LELIOS LAMP CO., LTD. (180 339). Private company. Reg. March 15. Capital, £2 500 in £1 shares. To acquire the business of A. de Jong carried on at St. Andrew's House, 32-4, Holborn-viaduct, E.C. 1, and to carry on the business of electricians, electrical engineers, manufacturers of, dealers in and agents for all kinds of electric lamps, &c. Subscribers: W. J. Woodhouse and S. Groves. Registered office: 32-4, Holbornviaduct, E.C.

Perfecta Electric.

PERFECTA ELECTRIC, LTD. (180 298). Private company. Reg. March 13. Capital, £1 000 in £1 shares. To acquire "The Perfecta Cinema Shutter" from the patentee, J. H. Greenfield, and to carry on the business of cinema, theatrical and general maintenance work, electricians, mechanical engineers, &c. Permanent directors: J. T. Hall, J. H. Greenfield and A. G. Hides. Solicitor: J. Baker, 29, Bank-street, Sheffield.

Ride & Bell.

RIDE & BELL, LTD. (180 401). Private company. Reg. March 17. Capital, £10 000 in £1 shares (9 000 ordinary and 100 founders'). Electrical and water engineers, &c., and to adopt an agreement with Ernest Newell & Co., Ltd. First directors: J. A. Ride, G. Bell and E. Newell. Registered office: Misterton, Notts.

Serck Tubes.

SERCK TUBES, LTD. (180 353). Private company. Reg. March 15. Capital, £1 000 in £1 shares. Tube makers, general, mechanical, electrical and water supply engineers, &c. Subscribers: P. O. Serck and H. Ashford. Solicitors: Speechly, Mumford & Craig, 10, New-square, Lincoln's Inn, W.C. 2.

Welsteads, Ltd.

WELSTEADS, LTD. (180 359). Private company. Reg. March. 15. Capital, £1 000 in £1 shares. Motor, electrical and general engineers, &c. Subscribers: C. F. Welstead and F. T. Shearcroft. Directors: C. F. Welstead and Agnes Welstead. Registered office: 27, New-road, Richmond, Surrey.

Workington Electric Power.

WORKINGTON ELECTRIC POWER CO., LTD. (180 361). Private company. Reg. March 15. Capital, £25 000 in £1 shares. Manufacturers and suppliers of electrical energy, &c. First directors: S. Kelly, Mrs. M. Kelly, S. Moss and T. S. Durham. Secretary: W. Addison. Solicitor: O. F. Ormrod, Whitehaven, Cumberland.

York Shipley.

YORK SHIPLEY, LTD. (180 377). Private company. Reg. March 16. Capital, £10 000 in £10 shares. Mechanical, electrical and general engineers and contractors, &c. Provisional directors: J. B. Farish and R. C. Bolton. Solicitors: Bristows, Cooke & Carpmael, 1, Copthall-buildings, E.C.

PROSPECTUS.

Bideford and District Electric Supply.

BIDEFORD AND DISTRICT ELECTRIC SUPPLY COMPANY, LTD. Prospectus of a company to be formed to acquire the benefit of two agreements entered into by S. I. Knill, of Barnstaple, sanctioning the construction of work for the supply of electricity in Bideford and Northam, &c. Capital, £25 000 in £1 shares (7 500 7 per cent. preference and 17 500 ordinary). Proposed directors: Major W. Ascott; E. W. S. Bartlesse, J. U. Fulford, J. N. A. Houblon, Sir Robert M. Hyslop, H. N. G. Stuceley and G. C. Smyth-Richards. Engineers and contractors: Crompton & Co., Ltd., London and Chelmsford. Solicitors: Hole, Seldon & Ward, Bideford. Secretaries and office (*pro tem*): Robert and Richard Blackmore, Alexandra House, The Quay, Bideford.

Damage to the extent of about £700 has been caused by a fire at the premises of SMITH & GILL, electrical engineers, of Nelson, Lancs. The outbreak was caused by the fusing of an electric wire and the subsequent ignition of a number of accumulators. The stock was destroyed before the arrival of the fire brigade.

Tenders Invited and Accepted.

UNITED KINGDOM.

West Derby Guardians. March 27.—Electric supplies, engine packings, &c., for three months. Particulars from the Clerk, Brougham-terrace, Liverpool.

Belfast District Asylum, Purdysburn. March 27.—Three or six months' supply of electrical fittings, oils, &c. Forms of tender from the Clerk to the Committee, Saintfield-road, Belfast.

London County Council. March 27.—Wiring and fitting Stamford Hill Stores Depot, Portland-avenue, N. 16. Specification from the Chief Engineer, 19, Charing Cross-road, W.C. 2.

Kettering Electricity Committee. March 27.—Two-feeder cables. Specification, &c., from the Engineer and Manager, Electricity Works, Kettering.

Belfast Guardians. March 28.—Renewal of wiring in Nurses' Home and other works. Form of tender, &c., from the Clerk, at the Workhouse.

Hove Corporation. March 31.—Low-tension feeder switchboard. Specification, &c., from the Engineer and Manager, Electricity Works, Davigdor-road, Hove.

Wigan Corporation. April 3.—Circulating water conduit, engine foundations, &c. Particulars from Mr. R. B. Donald, Municipal-buildings, Library-street, Wigan.

Bedford Corporation. April 5.—Supply of e.h.t., h.t., and l.t. underground cables for one year. Specification from the Borough Electrical Engineer.

Corporation of Douglas (Isle of Man). April 10.—Six miles l.t. three-core lead-covered and armoured cable. Particulars from Handcock & Dykes, 11, Victoria-street, London, S.W. 1.

Loughborough Electricity Department. April 14.—Extra high-pressure switchgear and extensions to d.c. switchgear. Particulars from Mr. C. H. Wordingham, 7, Victoria-street, Westminster, London, S.W.; or 11, Mosley-street Manchester.

Hull Guardians.—Extension of wiring at Anlaby-road Institution. Specification, &c., from the Clerk, 182, Anlaby-road, Hull.

INDIA.

High Commissioner for India. March 31.—Electric cable. Particulars from the Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1.

High Commissioner for India. April 7.—(*a*) Cells, electric, inert; (*b*) cells, Leclanche, and spare parts. Particulars from the Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1.

SOUTH AFRICA.

Municipal Council of Johannesburg. April 12.—*Supply and delivery of six (or more) h.t. metal cubicles suitable for 3 000-3 300 V two phase, 50 cycles, 200 A normal working load, and for, alternatively, similar equipment for 500 A. (Contract 887.) Fifteen miles 0 000 S.W.G. (0·4 in. diameter) round section hard-drawn trolley wire of a conductivity not less than 98 per cent. Mathieson's standard on stout wooden drums, each containing half-mile of wire. The drums are to have a hole 3 in. in diameter through centre for mounting on bar for rolling off. Tenders are to be based on electrolytic copper at £69 per 2 240 lb.

Rand Water Board. May 5.—*Two-ton overhead travelling crane, machine tools, electric motors, &c., for the Board's Vereeniging and other pumping stations; also two portable electric grinders and four electric drills. All the power-driven plant is to be equipped with individual electric motor drives. The electricity available for driving the machine tools, &c., will be 3-phase current at 500-550 V, 50 cycles per second. (Reference D.O.T. 8148/E.D./P.N.)

Dover Town Council has accepted the tender of Mr. J. Martin for electric wiring at the Isolation Hospital at £103 3s.

Warrington Corporation have accepted the tender of the British Thomson-Houston Company for main e.h.t. switchboard extension.

Bradford Corporation have accepted the tender of the Kirkstall Forge Company for front and rear axles for railless electric vehicles.

Berkshire County Mental Hospital Committee has accepted the tender of Mr. Wheeler for the reinstatement of the electric wiring at the hospital at £5 862 6s. 10d.

Metropolitan Asylums Board have accepted the tender of the Chloride Electrical Storage Company for a battery for an electric vehicle at Queen Mary's Hospital, at £219.

The French Thomson-Houston Co. is reported to have obtained an order for 1 000 dynamos for the French State Railway, these being required in connection with the lighting arrangement of local trains.

Burton-on-Trent Corporation have accepted tenders for electricity works extension amounting in the aggregate to £78 726. The largest tender was that of Babcock & Wilcox, Ltd., for boilers, at £40 180.

Glasgow Corporation has been recommended to accept the tenders of the British Thomson-Houston Company for five sets of rotary converters and transformers, £36 283; Ferguson, Pailin, Ltd., for switchboards, £2 422; and British Insulators & Helsby Cables for insulated bolts for tramway purposes.

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* *Particulars from the Department of Overseas Trade.*

Arrangements for the Week.

FRIDAY, March 24th (to-day).

Physical Society of London.

5 p.m. At the Imperial College of Science, South Kensington, S.W. Guthrie Lecture, "The Effect of Electric and Magnetic Fields on Spectral Lines," by Prof. N. Bohr, of the University of Copenhagen.

Electrical Power Engineers' Association.

7 p.m. At the Institution of Electrical Engineers, Savoy-place, London, W.C. Lecture on "Electric Control of Large Amounts of Power," by Dr. C. C. Garrard.

North-East Coast Institution of Engineers and Shipbuilders.

7.30 p.m. In the Lecture Theatre of the Library and Philosophical Society, Westgate-road, Newcastle-on-Tyne. Paper on "Standardisation: Its Fundamental Importance to the Prosperity of our Trade," by Mr. C. le Maistre. The nomination of candidates for the Council will also take place.

SATURDAY, March 25th.

Royal Institution of Great Britain.

3 p.m. At the Institution, Albemarle-street, Piccadilly, W. 1. Lecture IV., "Radioactivity," by Sir Ernest Rutherford.

MONDAY, March 27th.

Institution of Electrical Engineers.
North-Eastern Territorial Centre.

7.15 p.m. At Armstrong College, Newcastle-on-Tyne. Paper on "Protective Apparatus for Turbo-Alternators," by Mr. J. A. Kuyser.

Royal Society of Arts.

8 p.m. At John-Street, London, W.C. Lecture on "The Constituents of Essential Oils," by Mr. G. Radcliffe.

TUESDAY, March 28th.

Institution of Electrical Engineers.
East Midland Sub-Centre.

6.45 p.m. At the College, Loughborough. Paper on "The Future Aspect of Power Generation," by Mr. A. H. Seabrook.

Institution of Electrical Engineers.
North Midland Centre.

7 p.m. At the Metropole, Leeds. Paper on "Protective Apparatus for Turbo-Alternators," by Mr. J. A. Kuyser.

Junior Institution of Engineers.
North-Eastern Section.

7 p.m. At Armstrong College, Newcastle-on-Tyne. Paper on "Utilisation of Waste Heat," by Mr. G. H. Martin.

Institution of Electrical Engineers.
North-Western Students' Centre.

7.30 p.m. Houldsworth Hall, Deansgate, Manchester. Address by Mr. W. Walker, the Chairman of the Centre.

Illuminating Engineering Society.

8 p.m. At the Royal Society of Arts, John-street, London, W.C. Discussion on "The Lighting of Public Buildings; Scientific Methods and Architectural Requirements."

THURSDAY, March 30th.

Institution of Electrical Engineers.

6 p.m. At Savoy-place, London, W.C. Paper on "Applications of Electricity to Agriculture," by Mr. R. Borlase Matthews.

FRIDAY, March 31st.

Institution of Mechanical Engineers.

6 p.m. At the Institution, Storey's-gate, St. James's Park, S.W. Extra General Meeting. Paper on "The Milling of Screws, and other Problems in the Theory of Screw-Threads," by Prof. H. H. Jeffcott.

Institution of Electrical Engineers.
London Students' Section.

7 p.m. At Savoy-place, London, W.C. Address by the President, Mr. J. S. Highfield.

Junior Institution of Engineers.

8 p.m. At Caxton Hall, Westminster, S.W. Lecturette on "The Steel-melting Shop," by Mr. D. P. Dickinson.

Dictionary of Applied Physics.

Macmillan & Company announce that the first volume of "The Dictionary of Applied Physics," edited by Sir Richard Glazebrook, will be published this month. Succeeding volumes will appear at intervals of from two to three months, it being expected that the publication of the work will be completed before the end of the year. The work is arranged in five volumes, as follows:—Vol. I., Mechanics—Engineering and Heat; Vol. II., Electricity; Vol. III., Meteorology, Metrology and Measuring Apparatus; Vol. IV., Optics, Sound and Radiology; Vol. V., Metallurgy and Aeronautics. Produced under the editorship of Sir Richard Glazebrook and written throughout by experts, it would be difficult to over-estimate the importance of "The Dictionary of Applied Physics." It is the first attempt which has been made to bring within the compass of a single work the latest results of research and the most approved methods in all branches of the subject. It constitutes, therefore, a unique work of reference, containing a mine of information which must prove invaluable, not only to those engaged in educational work, but also to all manufacturers who are vitally concerned with the question of physics as applied to industry. The price of each volume is 63s. net, but orders for the complete set of five volumes will be accepted through a bookseller at the price of £14 14s. net, payable in advance.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MEWBURN, ELLIS & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

COMPLETE SPECIFICATIONS.

144 305 GUINET, L. Vacuum tubes. (26/12/18.)
144 720 BREISIG, F. System fo the conversion of continuous or direct currents into alternating currents. (11/3/19.)
145 030 SIEMENS-SCHUCKERTWERKE. Metal vapour elcctric discharge apparatus. (18/6/18.)
146 122 SIEMENS & HALSKE AKT.-GES. Telegraphic reception. (27/9/18.)
146 991 WESTERN ELECTRIC Co., LTD. Telegraphic ciphering and deciphering mechanism. (9/12/18.) (Addition to 146 520.)
147 555 TELEGRAPHON GES. Telephonographs. (17/7/19.)
168 925 MACRORIE, A K., AIREY, H., & MORRIS-LONG, S. H. Wireless reception, and particularly methods and means whereby the direction of the incoming waves can be determined. (16/3/20.)
168 935 BRITISH THOMSON-HOUSTON Co., LTD., & SHUTTLEWORTH, N. Electric motor control. (15/4/20.)
168 936 COPE, H. A. (Haefely et Cie., Akt.-Ges., E.). Dynamo-electric machines. (20/4/20.)
168 944 HOUSTON, R. C. Secondary or storage batteries. (10/5/20.)
168 947 BRITISH THOMSON-HOUSTON Co., LTD. (General Electric Co.). Methods of and means for producing alternating currents. (10/5/20.)
168 954 MARCEL'S PERMANENT, LTD., & KERKA, F. Electric heating apparatus for waving or curling the hair. (13/5/20.)
168 955 WATKINSON, J., FRANCIS, N. C., & QUENNELL, A. E. Resistance switches for controlling the intensity of electric currents. (13/5/20.)
168 964 SCHOLES, G. H., & CLAREMONT, E. A. Tool for electric cable stripping. (3/6/20.) (Addition to 149 739.)
168 965 BERRY, F. E. Reactance or choke coils. (4/6/20.)
168 966 NOTTAGE, W. H. Land line and wireless telephony. (5/6/20.)
168 967 WESTERN ELECTRIC Co., LTD. (Western Electric Co. Inc.). Method of signalling in systems generating high-frequency oscillations. (7/6/20.)
168 989 DOOLEY, J. Handle for electric arc welding. (11/6/20.)

APPLICATIONS FOR PATENTS

January 12, 1922.

1 002 A. E. KNOWLES. Electrolyic cells.
1 004 R. AMBERTON. Electricity meters.
1 026 B. T.-H. Co. (G. E. Co.). High-frequency signalling systems.
1 027 METROPOLITAN-VICKERS ELECTRICAL Co., R. BROOKS & N. E. NORTH. Electric railway motor equipments.
1 029 A. BUCK. Connector for electric wires.
1 046 AUTOMATIC TELEPHONE MANUFACTURING Co. & HUDD. Indicating devices for electric signalling systems.
1 050 F. H. LARNDER. Grapnels for submarine cables.
1 065 and 1 066 W. A. TESTER & S. THOMPSON. Power supply controlling means of a.c. motors.
1 067 GES. FÜR DRAHTLOSE TELEGRAPHIC. Wireless telephone transmitters. (13/1/21, Germany.)
1 070 J. E. POLLAK (Siemens & Halske Akt. Ges.). Telephone systems.

January 13, 1922.

1 093 H. LOMATH. Electric conduit box.
1 110 A. HICKMAN. Electric lamp for police lanterns.
1 152 F. G. PARKS. Electric lighting device.
1 126 R. BOSCH AKT. GES. Electric starters for heavy oil engines. (17/1/21, Germany.)
1 129 R. BOSCH AKT. GES. Electric ignition apparatus. (14/2/21, Germany.)
1 137 RANSOMES & RAPIER & P. D. IONIDES. Electric vehicles.
1 149 L. G. DE KERMOR. Regulation of heat generated by electricity.
1 151 L. G. DE KERMOR. Self-regulating electric-steam generators.
1 158 H. ZANGERS. Electro-magnetic releasing device. (24/1/21, Germany.)
1 167 E. GRANAT. Electric distant control apparatus. (14/1/21, France.)
1 170 R. H. BARBOUR. Electricity meters.
1 171 B. T.-H. Co. (G. E. Co.). Switches.
1 190 C. BOURGEOIS. Electric warp stop motion.
1 203 J. W. HALL. Magnetic clutches.
1 207 J. T. ROBIN. Incandescent lamps.
1 208 T. N. WHITEHEAD. Electro-magnetic compasses.
1 209 T. N. WHITEHEAD. Electric relays.
1 212 BRITISH ELECTRIC TRANSFORMER Co., HUBER & ROOTHAAN. Transformers.
1 215 AUTOMATIC TELEPHONE MANUFACTURING Co. Telephone systems. (23/2/21, U.S.)

January 14, 1922.

1 216 A. M. TAYLOR. Electric power transmission systems.
1 218 H. W. SULLIVAN. Submarine telegraph cables.
1 230 R. AMBERTON & R. H. BARBOUR. Electricity meters.
1 235 E. POLLOCK. High-frequency telephone systems.
1 239 A. J. CHEYNE. Electric terminal.
1 253 O. FRICK. Electric induction furnaces. (15/1/21, Sweden.)
1 270 W. S. SMITH. Electric conductors.
1 279 METROPOLITAN-VICKERS ELECTRICAL Co. & D. R. DAVIES. Switches.
1 281 CHAMBERLAIN & HOOKHAM, LTD. & JAMES. Electric current meters.

January 16, 1922.

1 326 G. P. GRENFELL & J. ROBINSON. Wireless navigation apparatus.
1 327 C. B. WARDMAN. Telephone apparatus and installations.
1 339 F. W. HAMPSHIRE. Means for audibly signalling upon sounds being reproduced in a telephone receiver.
1 345 C. SAUNDERS, L. EBELMAN, & F. E. PRATT. Electric rheumatic spring foot support.
1 356 METROPOLITAN-VICKERS ELECTRICAL Co. Insulating sheet materials. (26/1/21, U.S.)
1 360 T. LENAGHAN. Automatic telephone systems.
1 363 NAAMLOOZE VENNOOTSCHAP PHILIPS' GLOEILAMPENFABR. Gasfilled electric discharge tubes. (10/2/21, Holland.)
1 364 J. H. RUNBAKEN & W. TORRANCE. Commutators or current distributors of electric ignition systems.
1 381 A. H. HUNT. Combined electric lamp holder and switch for vehicle lamps.

January 17, 1922.

1 392 V. A. KELLER. Automatic switches for control of current.
1 394 W. M. EDWARDS. Portable electric apparatus for attachment to domestic baths.
1 432 DRAKE & GORHAM & A. H. ST. C. WATSON. Combination of dynamo-electric machines to maintain constant loads on water wheels, turbines, &c.
1 435 J. W. HALL. Electro-magnetic clutches.
1 442 V. J. HINKLEY. Variable electric condensers.
1 458 METROPOLITAN-VICKERS ELECTRICAL Co. & E. A. BINNEY. Control of electric motors.
1 459 METROPOLITAN-VICKERS ELECTRICAL Co. & J. P. CAMPBELL. Air connections for electro-magnetically actuated valves.
1 460 & 1461 METROPOLITAN-VICKERS ELECTRICAL Co. & W. A. COATES. Switchgear.
1 463 R. HANSEN. Wireless signalling systems.
1 476 G. & J. OLDHAM. Portable electric lamps.
1 481 T. S. & T. H. S. JONES. Electric organ actions.
1 488 SIEMENS-SCHUCKERTWERKE. Electrical commutator machines. (17/1/21, Germany.)
1 500 J. R. WEST. Electric alarm signals, &c.
1 503 J. B. BOWER. Joints or couplings for electric conduits.
1 504 O. T. BANKS. Electric candle lamps.
1 506 S. L. PRICE. Incandescent lamps.

January 18, 1922.

1 509 A. M. TAYLOR. Elimination of currents in lead sheathings of cables.
1 512 G. S. HYNES. Device for preventing theft of electric vehicles.
1 568 RADIO COMMUNICATION Co. & J. SCOTT-TAGGART. Wireless telegraphy, &c.
1 574 H. G. MATTHEWS. Photographic sound recording and light telephony.
1 583 GES FÜR DRAHTLOSE TELEGRAPHIE. High frequency telephony. (11/2/21, Germany.)
1 599 V. MARTINETTO. Automatic maximum and minimum current circuit breakers. (15/3/21, Italy.)

January 19, 1922.

1 609 VERITYS, LTD. & F. W. THORPE. Bulb and reflector fittings of electric lanterns, &c.
1 610 E. A. CLAREMONT & G. H. SCHOLES. Electric fuse box.
1 611 F. H. EELES. Thermal switches or automatic cut-outs for incandescent lamps.
1 621 F. C. TIPPING. Electric signalling devices.
1 628 E. J. QUINN. Signal transmitting device for wireless, flashlight, and land line telegraphy.
1 648 A. C. SMITH. Spring contacts for electric switches, fuse holders, &c.
1 651 SIEMENS BROS. & Co. & H. G. WOOD. Electric fuses, cut-outs, &c.
1 655 R. TILLEY & W. T. WILKINSON. Electric lighting on motor vehicles.
1 661 METROPOLITAN-VICKERS ELECTRICAL Co. & J. P. CAMPBELL. Electric ship propulsion systems.
1 666 W. S. GRAFF-BAKER. Electric relays, &c.
1 677 W. SECK. Electric horns, &c.
1 700 A. T. PADMORE. Dimming switches.

January 20, 1922.

1 704 D. MACADIE. Coil winding machines.
1 707 H. J. CAREY. Electrically operated trucks.
1 714 CALLENDER'S CABLE & CONSTRUCTION Co. & C. W. KAY. Fault localisation for underground cables.
1 717 BROOKES, WARD, & Co. & G. BROOKES. Suspension chains for electric light fittings.
1 730 BUCKLOW & MONTAGUE. Electric projector lamps for advertising, &c.
1 739 A. WILSON. Electric heaters for incubators, &c.
1 756 J. W. HALL. Electro-magnetic clutches.
1 762 A. E. & K. S. MILLS. Electro-mechanical relays.
1 763 W. S. JEAL & M. PAYNE. Accumulators, &c.
1 769 METROPOLITAN-VICKERS ELECTRICAL Co., W. A. COATES, & D. R. Davies. Potential transformers and fuses used therewith.
1 770 METROPOLITAN-VICKERS ELECTRICAL Co. Protective relay apparatus. (20/1/21, U.S.)
1 774 SACHSENWERK LICHT UND KRAFT A. G. Three-pole oil switches. (21/4/21, Germany.)
1 784 SIEMENS-SCHUCKERTWERKE. Mounting commutators of electric machines. (20/1/21, Germany.)
1 785 J. F. MONNOT. Electric switching devices.
1 790 B. T.-H. Co. Systems for producing oscillating currents. (18/15/21, U.S.)
1 791 B. T.-H. Co. (G. E. Co.). Leading in wires.
1 792 B. T.-H. Co. Electron devices. (29/8/21, U.S.)
1 793 B. T.-H. Co. Electron discharge devices. (1/7/21, U.S.)

January 21, 1922.

1 834 J. F. SUTTON. Machines for making coils of insulated wire, &c.
1 838 J. F. SUTTON. Inductance coils for wireless telegraphy, &c.
1 840 A. E. J. BALL & I. H. PARSONS. Electro-magnetic hammers for bells, &c.
1 847 H. W. RUSH. Incandescent lampholder.
1 848 E. POLLOCK. Radio telegraphy, &c.
1 862 SIEMENS & HALSKE AKT. GES. Telephone systems. (21/1/21, Germany.)
1 864 H. LEITNES. Accumulators.
1 865 J. H. COMPTON.—Electro-pneumatic relays and sustaining devices therefor.
1 875 GENERAL ELECTRIC Co., A. E. ANGOLD, & F. L. CASTLE. Electromotive apparatus for track circuit relays or electricity meters.
1 878 E. G. HARCOURT. Electric switches.
1 880 CHAMBERLAIN & HOOKHAM & S. JAMES. Power factor measuring or indicating instruments for alternating currents.
1 891 O. S. CORBETT. Electric control switch.

January 23, 1922.

1 910 J. L. GURNEY. Ampere-hour meter.
1 925 H. WOLFE, G. GRIFFITHS, & W. SLACK. Insulators for aerial lines.
1 936 R. TULL. Aerials for wireless signalling on steamships.
1 938 H. LEITNER. Systems of electric supply.
1 979 G. C. & G. C. N. BEALL. Regulating telephone calls.
1 981 WESTINGHOUSE BRAKE & SAXBY SIGNAL Co. Electric lamps for signalling, &c. (24/8/21, U.S.)
1 988 NAAMLOOZE VENNOOTSCHAP PHILIPS' GLOEILAMPENFIBR. Gasfilled glow discharge devices for amplifying current variations. (9/2/21, Holland.)
2 003 J. V. FOLL. Submarine telegraph, &c., signalling apparatus.
2 008 AUTOMATIC TELEPHONE MFG. Co. Train control systems.

January 24, 1922.

2 020 T. P. HOWARD. Telephone mouthpiece dust-proof cover.
2 033 W. L. SPENCE. Electro-magnetic friction brakes.
2 035 W. WILSON, C. C. GARRARD, & A. H. RAILING. Electric motor controlling apparatus.
2 068 REFARDT & NAGLE ELEKTRIZITÄTS GES. Automatic guard for three-phase asynchronous motors, &c.
2 069 REFARDT & NAGLE ELEKTRIZITÄTS GES & A. NAGLE. Direct acting magneto-electric driving mechanism for pumps.
2 081 J. WILSON. Filter for electric lamps or shades.
2 088 F. KRUPP AKT. GES. Overload circuit breakers. (19/2/21, Germany.)
2 089 F. KRUPP AKT. GES. Control of motors of electric vehicles. (4/2/21, Germany.)
2 097 BABCOCK & WILCOX & A. R. W. RICHARDSON. Electrical indication of impurities in feed water.

2 107 W. Gee. Switchboards and busbars therefor.
2 122 Cambridge & Paul Instrument Co. & W. H. Apthorpe. Pivoted moving-coil electrical measuring instruments.
2 123 Cie. Electro-Mecanique. Automatic starting of motors.
2 125 A. G. T. Cusins & Whittaker-Swinton. Vacuum or thermionic tubes or lamp bulbs.
2 145 Automatic Telephone Mfg. Co. Telephone systems. (9/2/21, U.S.)
2 149 G. Shearing, G. A. Irving, & L. G. Preston. Thermionic valves, &c.
2 150 B. Hodgson & L. G. Preston. Thermionic vacuum tubes.
2 151 B. Hodgson & L. G. Preston. Thermionic valves, &c.
2 152 B. Hodgson, H. G. Hughes, & L. G. Preston. Thermionic valves, &c.
2 153 G. Shearing & L. G. Preston. Thermionic valve transmitting sets for wireless telegraphy, &c.

January 25, 1922.

2 157 P. J. Gates. Switchboards.
2 180 Radio Communication Co. & J. Scott-Taggart. Wireless receiving apparatus, &c.
2 213 D. von Mihaly. Selenium, &c., cells. (9/12/20, Austria.)
2 214 D. von Mihaly. Oscillagraphs. (9/12/20, Austria.)
2 235 Efandem Co. & J. Eton. Electrically-driven sirens.
2 242 Z. Trotzer. Electric water heaters. (24/11/20, Hungary.)
2 258 Crypto Electrical Co. & H. G. Sharp. Induction motors for a.c.
2 260 & 2 262 Metropolitan-Vickers Electrical Co. & L. H. A. Carr. Electric ship propulsion systems.
2 261 Metropolitan-Vickers Electrical Co. & L. H. A. Carr. Alternate current motors.
2 266 A. H. Railing & A. E. Angold. Magneto-electric lamps.
2 267 A. Wirth.—Electric lighters. (26/1/21, France.)
2 277 Bayerische Elektrizitäts-Industrie Rott & Co. Automatic electric fuse switches. (25/1/21, Germany.)
2 280 E. A. Graham. Diaphragms for telephone receivers, &c.
2 281 H. J. Monson. Electric treatment of liquids.
2 287 Aktiebolaget Ferrolegeringar. Product of metals and alloys poor in carbon and silicon in electric furnaces. (29/1/21, Sweden.)
2 294 B. T.-H. Co. Recording and reproducing sounds. (20/5/21, U.S.)
2 295 B. T.-H. Co. & A P. Young. Magneto-electric machine.

January 26, 1922.

2 351 E. W. Pattison (Dictagraph Products Corporation). Extensible cable devices.
2 352 E. W. Pattison (Dictagraph Products Corporation). Telephone transmitters.
2 355 G. H & H. F. Collins. Electric connectors.
2 370 A. Edgar. Appliances for registering telephone calls.
2 375 Vulcan Motor & Engineering Co. (1906) & C. B. Wardman. Electric cable attachments.
2 379 Quasi Arc Co. & A. P. Strohmenger. Arc welding systems operated with a.c.
2 394 Metropolitan-Vickers Electrical Co. & D. R. Davies. Switch gear.
2 395 & 2 396 Metropolitan-Vickers Electrical Company. Electric relays. (26/2/21, U.S.)
2 399 B. T.-H. Co. & A. P. Young. Magneto-electric machines.
2 400 B. T.-H. Co. (G. E. Co.). Lightning arresters, &c.
2 401 B. T.-H. Co. (G. E. Co.). Incandescent lamps.
2 412 F. R. Bull. Electrical sorting machines for sorting perforated statistical, &c., cards. (28/11/21, Norway.)
2 416 W. Gee. Electric wall-plug.
2 430 F. Chiantore. Machines for coating current-conducting wires and cables with asbestos, &c.
2 438 L. G. Preston, H. G. Hughes, & S. R. Mullard. Thermionic valves, &c.

January 27, 1922.

2 458 G. F. Evans. Electric egg tester.
2 511 Akt. Ges. E. Haefely et Cie. High tension transformers. (9/2/21, Switzerland.)
2 513 Western Union Telegraph Co. & J. V. Foll. Synchronous telegraph systems.
2 516 B. T.-H. Co. (G. E. Co.). Current producing seals for electric apparatus.
2 517 Western Electric Co. & G. Deakin. Telephone systems.
2 521 Western Union Telegraph Co., A. H. Railing, & J. V. Foll. Telegraph transmitters.
2 523 C. C. Garrard. Electric propulsion of ships.
2 525 I. Panza. Electric foot warmer for vehicles. (31/1/21, Italy.)
2 536 Ges. für Drahtlose Telegraphie. Radio receiving systems. (3/1/21, Germany.)
2 560 General Electric Co., Ltd. Incandescent lamps. (4/2/21, Germany.)

January 28, 1922.

2 581 H. Green. Signalling and telephoning without special conductors.
2 589 T. S. Rogers. Electric horns.
2 620 F. D. Maclean. Tuned wave transmission.
2 632 L. G. W. Guest & H. O. Merriman. Eelctric signs.
2 641 A. MacCallum. Electric lamps.

January 30, 1922.

2 676 U. Beaton & Kersting. Windings of electrical coils.
2 686 W. J. Minton. Relay or magnetic circuit for relays, &c.
2 689 P. J. Gumbley. Apparatus for ascertaining and indicating capacity of accumulators.
2 698 E. A. Hailwood. Electric lamp bulbs.
2 699 L. Busserrau & R. Thorne. Junction box, &c., for l.t. circuits of motor-cars, telephone bells, &c.
2 706 F. Krupp Akt. Ges. Electro-magnetic overload circuit breakers. (24/2/21, Germany.)
2 712 V. Boscato. Ignition starting devices for magnetos.
2 717 R. Cavedoni & E. Marinelli. Incandescent lamps.
2 728 A. C. Hyde. Electrodes for arc welding.
2 735 Electric Fires, Ltd., C. H. Smith, & F. L. Newhouse. Electric fires, &c.
2 736 Siemens & Halske A. G. Telephone systems. (31/1/21, Germany.)
2 738 H. Baron (Aldendorff). Automatic electric switching systems.
2 748 Whitecross Co., H. D. Lloyd & W. W. Wilson. Electrodes for welding, &c.
2 757 G. & J. Oldham. Galvanic batteries.
2 762 Johnson & Phillips & H. M. Lacey. Voltage regulator for a.c. circuits.
2 764 J. B. Regan. Induction train control systems.
2 769 A. D. Mackenzie. Dynamos
2 778 Soc. Industrielle des Procédés W. A. Loth. Electrically steering movable objects at a distance.
2 782 Allgemeine Elektricitäts Ges. Connecting insulator for high voltages. (31/1/21, Germany.)
2 785 L. Satchwell. Electric controllers.
2 797 & 2 798 H. E. Sunderland. Electric switches, switch fuses, &c.

January 31, 1922.

2 791 E. S. Gray. Electric resistances.
2 824 R. H. Derry. Electrically operated stop motions for textile machines, &c.
2 855 H. C. Hodges. Electric generator field regulators, &c.
2 859 H. B. Swift, E. E. Daglish & W. Lorkin. Electric machines.
2 871 B. T.-H. Co. & F. H. Clough. Protective devices for enclosed electrical apparatus.

February 1, 1922.

2 897 A. R. Page. Thermo-electric pyrometers.
2 930 W. B. Topp. Electric heating and cooking. (5/2/21, Australia.)
2 934, 2 935 & 2 936 Cable Accessories Co., F. H. Reeves, & P. W. Davis. Switches.
2 940 W. H. Clinkard & E. Nicholls. Current collectors for tramways, &c.
2 952 H. Leitner. Accumulators.
2 963 English Electric Co., J. W. Howard & J. A. St. C. Richardson. Electric transformers.
2 964 Automatic Telephone Mfg. Co. Telephone systems. (19/2/21, U.S.)
2 976 B. T.-H Co. & A. P. Young. Magneto-electric machines.
2 977 P. G. Brown. Electric circuit controlling devices.
2 991 Metropolitan-Vickers Electric Co. & R. Brooks (Westinghouse Electric & Mfg Co., partly). Control handles for electric devices.
2 992 Western Electric Co. & G. Deakin. Selecting switch mechanism.
2 997 F. C. Curtis. Regulating switches.
3 009 W. T. Henley's Telegraph Works Co. & Dunsheath. Sealing ends of electric cables
3 013 H. Lahr & V. Bornkessel. Leading in wires for incandescent lamps, &c. (2/2/21, Germany.)
3 025 L. S. Palmer & L. G. Preston. Wireless receiving systems and apparatus.

February 2, 1922.

3 033 E. Y. Robinson. Antennæ systems for wireless communication.
3 034 E. Y. Robinson. Vacuum tubes.
3 080 J. Berry & D. A. Christian. Impulse senders for automatic telephone systems.
3 081 Siemens Bros. & Co. & H. G. Wood. Electricity supply systems.
3 102 B. T.-H. Co. & H. Trensham. Oil circuit-breakers.
3 103 Western Electric Co. Telephone systems.
3 110 C. Kratt. Electric water heaters.
3 116 H. F. Wheeler. Securing shades to electric lamp holders.
3 117 Thermal Electric Works (Hackbridge) & E. Swainson. Heat deflecting device for rheostats, &c.
3 126 British Electric Transformer Co. & S. C. Mount Electrical and mechanical connections or joints.
3 129 Siemens & Halske A. G. Telephone systems. (19/2/21, Germany.)
3 134 C. A. Vandervell & Co. & F. L. Hollister. Magnetos.

February 3, 1922.

3 201 Callender's Cable & Construction Co. & C. W. Kay. Telephone and signalling systems on transmission lines.
3 210 Callender's Cable & Construction Co. & A. E. Wilson. Insulators for transmission lines.
3 219 British L. M. Ericsson Mfg. Co. & W. M. Crowe. Electro-magnetic relays.
3 221 G. Castagnoli. Wireless reception apparatus.
3 228 A. de G. Spino. Voltaic cells.
3 232 F. E. Pernot. Laying and picking up submarine cable, &c.
3 233 S. Davies. Switches.
3 240 R. Longue. Preserving electric motors from prejudicious surrounding medium.
3 256 Naamlooze Vennootschap Financieele Maatschappij Driebergen. Telephone station equipped with telephonograph. (7/2/21, Germany.)
3 258 J. W. Hall. Electro-magnetic clutches.
3 264 W Clark. Electric fuses.
3 266 W. Clark. Electric switches.
3 268 Grafton & Son & W. P. Grafton. Adjustable supporting bracket for electric lamps, &c.
3 270 H. G. H. de G. d'Avenas. Apparatus for charging accumulators. (15/2/21, France.)
3 273 H. F. Joel & T. W. Simpson. Electric generators.

February 4, 1922.

3 280 Lancashire Dynamo & Motor Co. & R. S. McLeod. Electric motors.
3 281 L. M. Waterhouse. Supporting electric cables, &c.
3 285 H B Cornish. Electric fitting.
3 286 H. J. Brearey. Coil or winding for electric apparatus.
3 327 T. Scott & R. K. Robertson. Electric foot warmers and heaters.
3 332 B. T.-H. Co. Indicating instruments.
3 333 H. Baron (Signal Ges.). Determining distances by means of reflected sound waves.
3 345 Radio Communication Co. Signalling systems.
3 347 General Electric Co., Ltd., O. Durdle & C. F. Trippe. Electron discharge apparatus.
3 349 J. H. Reeves. Wireless receiving apparatus.
3 363 E. E. G. Boite & W. H. Edridge. Negative electrodes for batteries, &c.

February 6, 1922.

3 364 H. J. Adams. Electric light and gas fittings.
3 377 C. S. Goode. Vacuum tube for receiving and transmitting continuous wave oscillations.
3 378 J. Simpson. Induction coil or transformer for transmission of speech.
3 413 Callender's Cable & Construction Co. & P. V. Hunter. Electric cables
3 416 London Label Co., T. H. Green & N. C. Headland. Mechanically recording and checking telephone calls of different values.
3 420 P. W. Corless. Magneto brush rotor.
3 423 E. A. Clatemont & C. J. Beaver. Glands of electric joint boxes.
3 432 Smith & Sons (Motor Accessories) & A. C. Lock. Electric lighting apparatus for motor-cars, &c.
3 433 Smith & Sons (Motor Accessories) & A. C. Lock. Ignition apparatus.
3 436 Signal Ges. Means for translating vibrations. (7/3/21, Germany.)
3 446 H. J. Round & G. M. Wright. Radio receiving systems.
3 449 T. Harrison. Indicators for ships' electric signal lamps, &c.
3 452 H. G. Wagner. Storage batteries.
3 453 H. G. Wagner. Positive and negative elements for storage batteries.
3 457 Metropolitan-Vickers Electrical Co. Interrupters for electric circuits. (25/4/21, U.S.)
3 459 Ferranti, Ltd., & A. H. Higgs. Protective arrangements for electric generating, transmission, and distribution systems.
3 460 & 3 461 Ferranti, Ltd., & A. H. Higgs. Protective arrangements for electric switchgear.

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CONTENTS.

Notes of the Week.

The Electricity Bill Opposition.

It is often a little difficult to gauge the exact amount of opposition to a Parliamentary measure when it deals with industrial questions; and the Electricity Bill is no exception to that rule. For opposition, whether great or small, is always "full of sound and fury," but how much this "sound and fury" signifies is another matter. An analysis of the opposition to the Electricity Bill (and we mean opposition that would like to throw out the Bill altogether) may not therefore be out of place. In the first place, the London County Council not only support, but definitely urge the adoption of the Bill. So do the Municipal Electricity Supply Authorities of Greater London and the I.M.E.A. Indeed, all the municipal undertakings are either active or tacit supporters. And as regards the electricity supply companies, a large majority of them, too, are offering no opposition. The West End of London group of companies do not seem to have given any strong public indication of disapproval, and, as in June last they were parties to a proposal to form a Joint Electricity Authority for London, it would surely be anomalous to find them now active in the ranks of the other side, to say nothing of their interest in extended tenure, which only fresh legislation can provide.

Analysis of the Remainder.

This leaves us with only the power companies, and of these the number who are actually in opposition are probably few. For instance, we can assume that the North Metropolitan Company are not among them, as the Commissioners have assigned them a very important part in the scheme for London. The Cornwall Power Company we also assume are not militant, being out of schemes altogether. The Lancashire Power Company, seeing that they co-operate with the Manchester Corporation, are likely to feel nothing but a languid interest in the proceedings. The Newcastle-on-Tyne Supply Company is not interested in any schemes; and if there should at any time be a scheme for the North-East Coast, Bill or no Bill, it is obvious that they would dominate the district. As regards the North Wales Power Company, seeing that they hold the field in the scheme for North Wales and Chester, they may certainly be assumed out of the fight. The Shropshire and Worcestershire Power Company are parties with the Birmingham Corporation for a scheme for that district, so again here militant action would hardly seem to be indicated. This leaves the Yorkshire Power Company, the South Wales Power Company, the Derbyshire and Nottingham Company, the Leicestershire and Warwickshire Power Company, and the four Scottish Companies, some at least of whom seem to be in strong opposition to the Bill. But this is quite a small section of the industry, even giving the opposition one or two we have not enumerated. We can certainly say with propriety that the Bill is not opposed by the industry as a whole, and, if we are right in our analysis, not by even an important section of it. Parliament should therefore pass it without delay.

Institution Affairs.

Proceedings at the special general meetings of the Institution of Electrical Engineers last week were a little dull. The formal transfer of the liabilities of the old Institution to the chartered body was effected as quickly as a high-speed circuit breaker does its work, and the new by-laws were passed after a short discussion, in which only two points of any importance were raised. The first of these criticisms, if that is not too strong a word, was made by Dr. S. P. Smith on the delicate question of the procedure to be followed in cases of expulsion. The effect of the new by-law is to make the deciding body the Council, instead of the general body of members, with a possible appeal to a special court of three past-presidents. It is easy to find weak points in this; and Dr. Smith found most of them.

But it is not so easy to suggest a means of dealing with the difficulty which shall be at once democratic, fair, and avoid that publicity which is not only undesirable but dangerous. But it may be pointed out in such cases the Council is the court, not the prosecutor (that office is performed by the small body of complainants), and that it is better and fairer, both in practice and theory, that a court should be small. It would not be small if it were formed of the general body of members. If substantial injustice is done (and we have reason to hope it never will be done) the members have their remedy in the Council elections.

Council Election Procedure.

The point made by Mr. F. C. Raphael had more substance. Criticising the procedure suggested for the election of the Council, he pointed out that it was a reversion to methods which had been successfully combated years before. While we see the force of Mr. Atkinson's remark, that it is undesirable to ask members to stand on the Council's nomination when that body cannot give all of them its full support, yet this is surely a lesser evil than to revert to a system where nomination to the Council is automatically followed by election. We are glad to have Mr. Atkinson's assurance that the Council have no such retrograde object in view; that, in fact, they welcome outside nominations. It therefore rests with the general body of members to make nominations freely and to ensure that each year there is a well-contested election. This would not only be true democracy, but would overcome Mr. Raphael's objections. The only alternative is some form of negative vote, such as that suggested by Mr. Austin Hopkinson for Parliamentary elections. But that would be a big experiment.

The South-West Midlands Decision.

Approval has been given by the Electricity Commissioners to the scheme of electricity supply reorganisation for the South-West Midlands Electricity District which was put forward by Birmingham Corporation and the Shropshire, Worcestershire, and Staffordshire Electric Power Company at the public inquiry in November last. Instead of a Joint Electricity Authority there will be a Joint Advisory Committee of four, two from each of the promoters, and practically the whole of the district has been divided into two spheres of influence, one of which will be governed by the Corporation and the other by the company. Worcester Corporation, being in a remote part of the district, will develop its own electricity undertaking, and so will Malvern and Sutton Coldfield—at least for some years.

No Joint Authority.

As this is the first case in which a Joint Authority has been dispensed with we shall watch the outcome with interest. A small homogeneous committee of four will start out with undoubted advantages over a larger body, for there will be no conflicting interests to reconcile, and decisions can be promptly made and executed. But, though the parties are working harmoniously at present, there is a danger that later on there may be a two-and-two division of opinion on the committee. There will, however, be an appeal to the Commissioners in this event, and it is probable that the latter may be able to obviate the development of any acute differences. Certain adjustments of the boundaries of the district have been made in accordance with the wishes of the parties interested. Stourbridge, Rowley Regis, Lye and Wollescote have been excluded, and Tamworth and parts of Dudley, Seisdon, and Tewkesbury rural districts have been included. A draft Order, embodying the scheme, is in course of preparation, and it is hoped to hold the further inquiry in May. This would seem to indicate that little local opposition is apprehended, and it is probable that the South-West Midlands may be the first district in which an approved scheme is put into operation. It is a good example of what co-operation can do, and it is also an answer to those who assert that the Commissioners are bent upon the stereotyping of administrative methods by setting up Joint Electricity Authorities throughout the country.

University Education.

The report of the Royal Commission on Oxford and Cambridge Universities, which was issued at the end of last week, will leave electrical engineers a little cold. It is true a fortunate few of them have studied in the ancient shadows of the latter University, and still fewer in the rather unsympathetic atmosphere of the other "home of lost causes," but the large majority, when they have received any University education at all, have belonged to one of those newer bodies, where youth and enterprise to some extent compensate for age and tradition. Some, too, have given their attention to the great technical Universities abroad. Apart from this, however, the report is really a domestic affair. The members of the Commission were all either Oxford or Cambridge men, and might therefore have been expected to view, as they do, the idiosyncrasies of old age with a loving eye. The criticisms are, indeed, very mild, probably because the Royal Commissioners find that both Universities are adapting themselves with readiness and vigour to the demands of a new age. We are glad to hear that this is the case. As Mr. Highfield said last week, science without commerce is as nothing. And it is none the less true that a closer union between pure and applied science is essential for the well-being of both.

The Financial Difficulty.

The chief difficulties that face all Universities—not Oxford and Cambridge alone—at the present time is, of course, finance. The report is in the main a plea that it should be made possible for the institutions financially to do as they are doing, and for that reason it is suggested that the present grant of £30 000 should be increased to £100 000, in addition to £10 000 a year for special purposes. A large part of this increase would go in improving salaries and pensions, and to this no exception can be taken. But we hope that this grant will be accompanied by conditions which will open the doors of the Universities to all deserving students. At present the doors are not so open. Sometimes voluntarily, and sometimes involuntarily, there is discrimination. This is not only undesirable from the educational point of view, but it prevents that intellectual intermingling of all classes of young men and young women for the good of themselves and their country in the way the term University properly connotes. Oxford and Cambridge have advantages of tradition and environment possessed by few other educational institutions. These advantages should be placed at the disposal of all.

The First Wireless Telegraph Prosecution.

The Merchant Shipping (Wireless Telegraphy) Act of 1919 and the Board of Trade Regulations made thereunder are presumably designed for safeguarding life at sea, but if the position of affairs disclosed at the first prosecution under the Act, which we record elsewhere, is present on other ships, it is time the Rules were made more stringent. The actual offence, to which a plea of guilty was entered, was not having a wireless operator or certificated watcher

on board the s.s. " Clan Malcolm " on the night of October 8th last. It was stated that the wireless room was so situated that it would take four or five minutes to receive a message and call the operator, and that it would take seven or eight minutes to communicate with the bridge of the ship. The evidence seemed to show that even if there had been an operator on board at the time, the unfortunate collision, which occurred off Wigtownshire, and resulted in the loss of over 30 lives, would probably have taken place, but it is clearly possible to make better arrangements for wireless telegraph signalling, and it should be the duty of the Board to see that they are made and complied with. Under the circumstances, though the master of the ship may not be responsible for the staffing arrangements, we think that the fine of £25 inflicted is a light penalty.

The "British Insulated"—Record Year.

It is a pleasure to be able to record, despite the depressed condition of most branches of trade and the serious industrial strife, the continued success of that old-established and prudently managed company, the British Insulated & Helsby Cables, Ltd. The profit made in the past year reached the record figure of £502 524, or an increase of £161 811 over that for 1920, and this highly satisfactory result must be attributed to the foresight and sound policy of the directors and managers. At the last annual meeting the chairman, Mr. James Taylor, announced that the company had to face a large capital expenditure for the purpose of reorganising their works after the war. This reorganisation has been carried out to good purpose, and the increased expenditure has been fully justified. For with the developments in electricity supply has come a demand for high-tension cables, and it is claimed that there is no firm in the country in a better position to meet the requirements of the industry in this respect.

Prudence and Progress.

At the annual meeting on Monday Mr. Taylor's task was, therefore, easy and pleasant, and he was able to state that the company had completed the orders on their books a year ago, and to execute promptly other orders subsequently received. Two years ago the directors were empowered to raise fresh capital, but they have been able to pass through the exceptionally trying intervening period without exercising those powers. They were one of the few companies which has not required to increase capital at a time when the rate of interest was high. It will thus be seen that the happy position of the company is due to prudent financial methods in the past and to a judicious expenditure on tools and equipment in order to keep well abreast of the times. After paying debenture interest and the preference dividend, and making provision for reserves and depreciation, the ordinary shareholders get a return of 15 per cent. for the year, leaving £362 223 to carry forward. Though there are indications of a falling off in trade the position of the company is a strong one, and they are able to face the situation with confidence.

Low Pressure at Nottingham.

That keen and persistent critic of the Nottingham Corporation Electricity Department, Mr. H. W. Cox, seems at last to have discovered a genuine grievance; and, as usual, he has written to the papers about it. Having satisfied himself of the theoretical advantages of electric heating, he had a radiator installed in his office, but the practical results were so unsatisfactory that he instructed the dealer who supplied it to take it away. Instead of doing so the latter tested the pressure of the Corporation supply and found it to be only 186 V instead of 200 V, the declared pressure, which explains both the milk in the cocoanut and the lack of heat in the radiator.

The Consumer's Remedy.

But while Nottingham is unique in possessing Mr. Cox, we are afraid it is not alone in supplying at a too low pressure, and we may therefore indicate to Mr. Cox and to other consumers in similar circumstances the remedy that is open to them. By No. 3 of the Regulations of the Electricity Commissioners the supply authority must declare the constant pressure at which it proposes to supply energy at the consumer's terminals, and that pressure must be maintained, subject to a variation of four per cent. Failure to comply with this regulation involves a penalty of £5 for each default, with a daily penalty of £5. Mr. Cox might therefore have recourse to the Police Court if his supply continues to be unsatisfactory. At Nottingham the pressure limits would be 192 and 208 V, and there would, therefore, appear to be a clear cause of complaint. Such action as we suggest would tend to discourage supply at low pressures, and this would be a good thing, as it militates against electrical progress, more especially in the domestic supply field. If there is a shortage of generating plant or the supply mains are overloaded, no more customers should be connected until a proper supply can be given.

The Contractor and the Showroom.

The electrical contractor has for long been exposed to much criticism from other branches of the industry. Some of this is, we fear, justified, and some of it arises from his position in the vanguard of the advance into the domestic field. We forget the exact duties of the leader of a vanguard, but without reference to military textbooks we do recall that they are pretty strenuous; and that upon their proper performance depends much of the success or failure of the campaign. We are therefore glad to see that one firm, Troughton & Young, have realised this, and that by inaugurating an exhibition of a showroom character on their premises have taken a step which we hope will be more widely followed. The duty of a contractor is not to make things, but to secure installation orders and to sell electrical goods. If, therefore, he has on view in his showroom the products of various manufacturers, and advises his clients judicially on what to buy to satisfy their peculiar needs, he is not only likely to reap the reward of his own enterprise, but will do a great deal to benefit the electrical industry generally.

Reduction of Charges Spreading.

We are glad to see that the movement to reduce charges is spreading among electricity supply undertakings. We hope it will continue to spread, both in area and in depth, for this is the most certain way of ensuring that expansion of trade we so sorely need. An interesting example of this tendency is to be found at Hackney, where energy consumed for domestic purposes, other than lighting, is to be charged at 1d. in the June and September and at 2d. in the December and March quarters, instead of at 1½d. and 2½d., as at present. In addition, the two-rate domestic tariff is to be altered from £3 4s. per kW per quarter plus 1½d. per kWh to 2s. per quarter per 60 W lamp plus 1d. This is not only a substantial reduction, but is a more equitable method of charging for small installations. Power and lighting scales and the amounts charged for electric vehicle charging are also to be altered in a lowerward direction, so that we may perhaps expect a migration towards Hackney, and even a demand that the marshes should be built over in order that full advantage may be taken of cheap electricity.

Trade Promotion.

An electrical engineer, who is in charge of an undertaking which supplies what is generally considered to be a well-developed area, recently told us that as a result of a canvass it had been found that only 10 per cent. of his consumers used electricity for any other purpose than lighting. In this area practically every house and flat is connected to the mains, and an energetic and continuous campaign is maintained to secure cooking and heating connections so as to increase the output and improve the load factor. If this is the condition of affairs in such an area, which—we emphasise the point—is already exceptionally well developed because those supplying it see in the increase in the domestic load the one chance of salvation, what must it be in areas where numerous inhabitants do not use electricity for any purpose, and where those who do use it for lighting are not encouraged, and are sometimes even discouraged, from employing it for other purposes.

Why the Domestic Load Must be Increased.

These facts are put forward in no carping spirit. But, as we have pointed out on other occasions, the power load, which in many areas has long been the revenue producer, can almost be allowed to develop itself. Arguments in favour of the electric drive are hardly required; its advantages are self-evident. The same may be said of lighting, though an increase in the lighting load unaccompanied by other uses brings difficulties to the undertaking which almost makes its room preferable to its acquisition. The moral, then, is (if we may intrude it so early in the story) that the domestic field is the one which the electrical industry must till and continue to till at every season so as to obtain its bread and cheese, not to speak of those other amenities which make existence worth the endurance.

A Not Surprising Neglect.

The neglect of that field in the past—even in the present—is not surprising. There have been grave difficulties in the way, which are known to us all; there have been obstacles to overcome of policy, technique, and commerce, but the road is now comparatively clear; we are ready to advance, and it is not, therefore, out of place to examine what is before us and to see what preparations can be made to render the journey as comfortable and profitable as we can.

Possible Domestic Load—Infinitely Large.

The first thing that strikes anyone who looks into the matter is that the possible domestic load is as nearly related to infinity as anything can be. Some figures from the United States make this clear. In that country, while 7 000 000 homes are wired for electricity, 14 000 000 still remain to be wired. These figures do not take new houses into account. Of the houses that are wired electrically 36 per cent. have electric washers, 71 per cent. electric irons, 40 per cent. electric vacuum cleaners, 2 per cent. electric dish washers, and only 2 per cent. electric cookers. We have not been able to obtain similar figures, which we could put forward as accurate, for this country, but we have reason to believe that not only would the gross figures be smaller (that is only natural), but that the percentages of electrical apparatus other than lighting used in wired houses would be much smaller too, as the ratio of electrically wired houses to those not so treated would also be less.

A Reason for Booming the Cooker.

It will be noticed that electric cookers are among the least used of electrical apparatus, and that electric irons are employed most. Yet in an average household cooking is carried on for about 25 hours a week, and ironing for only about five hours. As a consumer of electrical energy, too (which is, after all, the object which the supply engineer and the electrical industry has in view) the cooker is infinitely superior to the iron. One explanation of this may be that the sale of irons has been pressed more vigorously than that of cookers, and that in so doing the electrical industry has been fighting against its best interests.

Price and Timidity.

We think, however, that there are other explanations—price and timidity among them. The cooker has been up to the present inevitably an expensive apparatus. Apart from increases in the cost of labour and materials the research work which has necessarily had to be carried on to convert experimental equipment into a finished article could not be performed without a reflection in the selling price. We hope that the downward tendency which has recently become visible will continue; it is necessary for development. Timidity on the part of the electrical industry has, however, been a contributing factor to this state of affairs. To develop the domestic load, it is agreed, is all very well, but it is better to begin with small things like irons rather than with such a mighty experiment as a cooker. When a short step is taken it is so much easier to retract. We hope that is another thing which is going to be changed.

Public Eagerness for Electricity.

One grave obstacle, however, the electrical industry has not had to face—public prejudice. As a result partly of education by somewhat slow-moving and lethargic propaganda (this is no reflection on E.D.A.) and partly by instinct the public is already interested in domestic electric equipment, and would be much more interested were that equipment cheaper or money more plentiful. It is argued that cheapness is a fetish, and that the public will always pay a good price for a good article. We agree. But at present there is a great gulf fixed between the price asked and the price that can be given. As we have said, we hope that will be changed not only by electrical manufacturers, but by electricity supply authorities. We are glad to see that the tendency is all in that direction.

The Need for Using Hiring Powers.

Development on the lines we all desire will, however, be much assisted by the utilisation by electricity supply authorities of the hiring powers they now possess and by the granting of further powers for the hire purchase of apparatus in conjunction with local contractors. This co-operation, coupled with a reduction in the price of energy for domestic purposes and by well-thought-out propaganda campaigns, cannot fail to assist progress. That this is so is confirmed by the details of the hiring scheme recently undertaken at Glasgow, which Mr. Hardie gives on another page of this issue. The policy is enlightened, and the tariff is low, and it is not to be wondered at that success has been obtained. We hope it is an example which will be widely followed. Mr. Pinkney's careful analysis of the same subject shows what can be done in this direction with success.

The Future of the Domestic Load.

Matters cannot, however, rest as they are. The figures we have given above refer only to existing houses. They do not take into account the new houses which are being built and will be built in years to come. In these houses it should be possible to apply past experience in the most efficient way and make the use of electricity more convenient than it is even at present. One way of doing this is by the means of special "electrical furniture," such as that described by

Mr. Earl Whitehorne, on another page of this issue. This overcomes what is undoubtedly a disadvantage of present methods—trailing wires and the necessity of frequent disconnections. In this arrangement the plugs and sockets are placed on the furniture itself, and though connection is made, as heretofore, from wall plugs, as furniture is only infrequently moved this is no grave disadvantage. On the other hand electrifying the furniture allows electrical apparatus to be employed in a number of ingenious and unusual ways.

There is, therefore, every reason for optimism in the situation, though that is not to say there are no difficulties. They are, in fact, numerous enough. They include questions of price, tariff, design, and manufacture, and, above all, they include the need for electrical engineers to believe, and act as if they believed, in their own specific.

The Telephone Report.

Of all the branches of public administration probably none has been subjected to such severe and general criticism as the telephone service. Inefficiency, due to shortage of plant and other causes, and excessive charges, caused by the political situation, recently engendered such a strong agitation that a Select Committee was appointed to investigate the methods of organisation and of fixing charges employed. This Committee, of which Sir Evelyn Cecil acted as chairman, held 33 sittings and examined many witnesses, including telephone engineers, representatives of commercial and business organisations, telephone users, and others. In addition, the chairman and the Committee's assessor, Mr. W. W. Cook, visited Scandinavia and Switzerland, while Mr. Cook journeyed to America in search of information. The result of this investigation is a business-like and instructive report containing a number of recommendations which, if adopted, should lead to a cheaper and improved service and should also assist in removing that prejudice against the telephone which is a serious obstacle to progress at present.

Separation of P.O. Departments.

The Committee's recommendations are printed in another column, and they may be grouped under two main heads, viz., organisation and methods of charging, though the two are inter-related.

It is suggested that the "reorganisation of the telephone administration on more commercial lines is the fundamental requirement for efficient development, and that it will prove a solution of most of the failings which have been disclosed." It is, therefore, proposed that the mails branch of the Post Office should be separated from the telegraph and telephone departments, and that an administrative Board should be formed of the heads of departments under the Postmaster-General. There is much to be said in favour of this division, which appears to be working satisfactorily in Sweden and Norway, though, as the same buildings are used for the three services, there may be some difficulty in making a fair allocation of the cost of maintenance and upkeep.

Need for Commercial Accountancy and Business Methods.

The Committee also think that the accounts should be kept in a more commercial form, that the transactions generally display a parsimony of business method, and that there is a tendency to a cast-iron application of regulations in an improper way. It is these rigid, cast-iron methods which have engendered the strong public feeling against the Post Office, and we feel sure that a little sympathetic feeling on the part of telephone officials would arouse a ready response in those who have to use the telephone. It should be recollected that the telephone is now an absolute necessity for business, and that human beings are not "mere automata for making telephone accounts balance." On the other hand, the public are asked for a fuller appreciation of technical difficulties and a less chronic suspicion of the Post Office. Both are necessary if the telephone is to improve and be used as it should be.

Reduction of Charges Proposed.

One of the most welcome recommendations is an immediate reduction of ten per cent. in telephone charges. This would be made possible by the abolition of the annual charge for extra depreciation, the revision of the charge for ordinary depreciation, and by debiting salaries and overhead charges for new construction work and renewals to capital and depreciation respectively and not to revenue, as has hitherto been the practice. We understand that the Post Office authorities have already made the last-mentioned change, but the others are to be referred to accountants for report. Proper provision should undoubtedly be made for depreciation, but we are inclined to agree that the present scale is unnecessarily high. Apart from these matters, there is room for a reduction in charges as wages and the cost of materials have come down, and as further falls in these are likely there should be a gradual lowering of the telephone rates.

The Message Rate Approved.

We are not surprised to see that the Committee pronounce in favour of the message-rate system of charging, though it is stated that the flat rate has much in its favour, especially in smaller centres, but these must be exceptional. It is also proposed that the extra mileage charge should be reduced from £10 to £5 a mile, and the reduced charge on trunk calls after seven p.m. should apply after two p.m. on Saturdays and all day on Sundays. On the question of automatic telephony the Committee are cautious, as they do not recommend an unduly hasty adoption of the system until the commercial results of the automatic apparatus installed by the Post Office have been ascertained, though they have no doubt it would give a faster service on a majority of calls.

Technical Staff Not to Blame for Defects.

Whatever the defects of the telephone service may be we have never attributed them to the shortcomings of the technical staff, and, therefore, we are glad to see that the Committee have been impressed with the capacity, assiduity and single-mindedness of the officials of the Post Office who gave evidence. They are described as men devoted to the public service, keenly watchful for its welfare, well skilled in their calling and with an intimate knowledge of their duties.

We have no doubt that the suggestions and recommendations made in the report will have a stimulative effect, and, whether it be possible to adopt the whole of them at once or not, some changes must be made, and we hope that these will inaugurate a reform movement which will provide a telephone service adequate to the country's needs. At present the telephone is not so extensively used here as in America and in certain European countries, and it should be one of the tasks of the Post Office, or, perhaps, of the new telephone Board, to make up for this defect by giving a much cheaper and better service. In this way, and in this way alone, can there be that expansion of the telephone which will enable this country to compare favourably with other commercial nations.

The Hiring of Domestic Electric Apparatus.

By W. F. T. PINKNEY.

Until some ten years ago electricity supply authorities which hired out motors made rapid strides in obtaining consumers for motive power purposes, but with the firmly established recognition that electricity is the premier form of power the necessity of hiring out motors has ceased to exist. Hiring served its purpose in establishing confidence in the prospective consumer, who was more ready to give the electric drive a fair trial when his initial expenditure was reduced to a minimum, and when he knew that if unsatisfactory he could revert to other power, and that his experiment would cost him little.

The Present Domestic Position.

In the domestic field we are in the same position in regard to uses of electricity other than lighting that we were in years ago with regard to motive power. Until the domestic user has had an opportunity of trying it, he does not recognise the enormous advantages of electricity for all purposes, and is not prepared to purchase apparatus for what he looks upon as an experiment, without any real confidence that all a salesman tells him is true.

Apart from the fact that hiring domestic apparatus is the easiest method by which to obtain profitable consumers, the hire figures themselves may be arranged to yield a reasonable profit. There is a great advantage in the hiring of domestic apparatus over the hiring of motors, in that to supply motive power the Supply Authority had, as a rule, to expend a considerable sum in laying in service cables, and therefore did take some risk of loss if the use were discontinued. With domestic apparatus it almost invariably applies to premises where electricity is already installed, and yields extra revenue without further initial expenditure, so that if for any reason the use is discontinued no loss is incurred.

Class of Apparatus to Hire.

The pieces of apparatus most valuable for hire purposes are irons, kettles, fires, and cookers. Water heaters and wash boilers may also be considered. Such apparatus as vacuum cleaners, washing machines, dish washers, polishing machines, etc., should not be hired out, as, apart from the rentals, they yield practically no revenue, and if maintenance is included in the hiring system they necessitate holding a small but very varied stock of replacements.

It may be mentioned here that cookers must be considered as a class apart from other apparatus. It is not possible to obtain the same relatively high rental from cookers as from other apparatus. Owing to the high diversity factor the load is a profitable one, and it is desirable to keep the rentals as low as possible in order to encourage the use of cookers.

Hire Service and Maintenance.

Hiring should include maintenance and prompt service, for then the consumer feels that the Supply Authority shows its confidence in its apparatus if maintenance is included in a reasonable rental. With most modern apparatus maintenance is so low in cost that there should be no hesitation in undertaking it. It is very desirable to keep down the stock of replacement parts and to limit its range, and with this in view the writer advises that hired apparatus should be limited to as few makes of each class of apparatus as possible.

Irons and Kettles.

One type of iron is quite sufficient, and kettles should be limited to the most popular size—that is 2 pint, or at most 2 pint and 3 pint.

To avoid the necessity of immediate repair of irons or kettles, one or two complete spares may be kept ready and a few flexibles and connectors kept wired up; the consumers can be supplied immediately with a replacement when occasion demands, and the faulty iron repaired at any convenient time.

It is a good plan to keep apparatus for this purpose which is serviceable but a little shabby in appearance, as the consumer is more ready to take back his own when repaired, and it is thus easier to keep track of the particular apparatus hired to consumers.

Fires and Cookers.

In the case of fires it will be found advisable to hire a few different types of varying capacity, but they should be of the cheaper designs, and of as few different makes as reasonably possible. The design should admit of quick replacement of parts.

It will be seen from the maintenance figures given below that cooker maintenance is relatively costly at present, but it is likely to be considerably reduced from now onwards, and from figures available to the writer, it appears that the radiant hot plate will prove cheaper to maintain than the non-radiant type.

Maintenance Hints.

Maintenance of cookers, in particular, must be prompt if they are to receive the rapid adoption amongst consumers which they merit. The design of the oven should be such as to enable elements to be replaced quickly, and when replacing hot plates the writer strongly advises the replacement of the faulty plate by a new one, and not to replace elements in hot plates "on the job." The average housewife dislikes a workman hanging round for any longer time than is necessary. Also in the repair of non-radiant plates some experience and considerable care is necessary in the clamping up of the elements if further burn-outs after a short period are to be avoided. It is inadvisable to replace a portion only of the elements of a burnt-out hot-plate and leave any old ones in. The used ones probably won't last long and will lead to another fault after a relatively short period.

The Newcastle Company has recently entered into an arrangement with one manufacturing firm whereby a stock of new spare plates is held in readiness, and in the case of failure new plates are installed and the old ones are returned to the makers, who allow a reasonable credit, and this arrangement is proving very satisfactory in reducing the amount of maintenance and keeping down the labour cost.

Wherever a cooker is hired out a self-contained kettle should accompany it. In the Newcastle district the kettle is separately hired, but the question of making a self-contained kettle part of the standard cooking equipment is receiving consideration, and is an arrangement which has proved satisfactory in other districts.

Form of Agreement.

The agreement or application which the consumer must sign should be as short and simple as possible, but should contain the following provisions:—

(1) That the Supply Authority shall only maintain against fair wear and tear, so that mechanical damage or breakdown due to carelessness is repaired by the Supply Authority at the cost of the consumer.

(2) Six months' notice should be required to terminate the hire.

If no such provision is made, the hiring of fires, in particular, will frequently be terminated in the summer months, and application for re-hire received in the winter. Kettles and irons would be hired for short periods, and the rentals received for such short periods might not pay the cost of any re-polishing which might be necessary before sending out again on hire. Also frequent returns of hired apparatus of this nature would increase the cost of recording and book-keeping, and would necessitate larger storing accommodation.

In some districts the hirer is required to undertake the hire for a minimum period of one year or two years, but

in the writer's opinion many prospective hirers may hesitate to be bound for so long a period.

An alternative to provision 2 above might be as follows: Six months' notice shall be given to terminate the hire, except that in the event of the hirer vacating the premises one month's notice will apply. If the hirer shall terminate the hire within twelve months from the date of hiring he shall pay the cost of any overhaul which may be necessary.

Basis of Rental.

As the object of a hiring system is to obtain as consumers those who are not prepared to purchase apparatus outright, the basis for a rental system must in some measure be governed by the value of service to the consumer. On the one hand, it is unnecessary to hire out, say, electric irons at the lowest possible rental, as this would discourage direct sales. On the other hand, the rental of cookers must be kept as low as possible in order to encourage so valuable a load, and on account of the fact that the present high cost of cookers prevents direct sales.

The writer suggests assessing a rental for kettles, irons, and heaters to give reasonable interest on the expenditure, depreciation at 10 per cent. per annum, and to cover maintenance costs. The result will give a very low figure, which can be increased to such a figure that it will not discourage direct sales, but at the same time will be satisfactory to the user.

With cookers a life of fifteen years can be reckoned on, but even then it will only be found possible to obtain a rental which is economic in itself in wealthy residential districts. The real benefit from the hire is to be obtained from the sale of current.

The table below shows the cost of apparatus and rentals received in the Newcastle district.

Hiring is a means of publicity and a most valuable one, and when cookers are better known and the demand increases in consequence, the initial cost will be reduced and a more favourable rent in relation to cost can be obtained.

Apparatus.	Nett Cost.	Retail Price.	Average Maintenance cost per annum.	Rental per annum.	Approx. units sold per item per annum.
	£ s. d	£ s. d.	£ s. d.	£ s. d.	
Iron	0 12 8	1 1 0	0 1 0	0 6 0	35
Kettle, 2 pint	0 16 0	1 10 0	0 2 8	0 8 0	50
do. 3 „	1 10 0	2 10 0	0 2 8	0 10 0	70
Fires	1 10 0	2 12 6	0 2 7	0 12 0	500/1000
Cookers ...	12 10 0	22 0 0	1 0 0	1 10 0	1600
do.	16 0 0	25 0 0	1 0 0	2 0 0	1750

It should be noted that with most irons and many kettles the current is paid for at lighting rates.

Rental on a basis of an increased price per unit is sometimes advocated, but the writer is convinced that any such basis would be even more foolish with heating apparatus than it has proved in the past in hiring lighting installations. Such a basis discourages use, whereas the whole object of hiring is to encourage use.

Hired Wiring.

Hiring the wiring for cookers and fires should be considered, but except in poor districts it would not appear to be necessary at present. The hirer recognises that the Supply Authority which is prepared to hire is confident of its apparatus, and he therefore feels there is little risk in spending a few pounds on wiring. If it is decided to hire wiring the rental should be such that the cost is paid off in a short period—say two years—otherwise loss will be incurred when changes of tenancy take place, due either to the new tenant not using or requiring the wiring altered to suit his different domestic arrangements.

Tariffs.

It is not the purpose of this article to deal with tariffs, but it may be mentioned that it is not necessary nowadays to sell at such very low rates for domestic heating and cooking as were charged in some districts some years ago. Looked at merely from the point of view of value to the user, heating at 1¼d. per unit and cooking at 2d. per unit is quite reasonable at the present time. In actual fact, one rate is usually charged for both purposes and is generally round about the first-named figure wherever this class of business is cultivated. A two-part tariff is very necessary where any serious effort is made to obtain this load.

Recording of Hired Apparatus and Maintenance.

A card index system of records should be kept, with a separate card for each piece of apparatus, stating all particulars, including the maker's number. The date of any faults should be recorded on the card, together with the details of repair and cost in labour and material. These cards can be analysed monthly and the total monthly cost obtained. This method enables the nature of the most frequent faults to be traced, and steps can then be taken to reduce them as far as possible.

Keep in Touch with the User.

It is very desirable to employ a tactful lady demonstrator who is a good cook. She may be employed solely on demonstrating irons, kettles and cookers, and it should be her duty to visit every cooker user at definite periods. The rest of her time can be employed in leaving kettles or irons on trial with non-users, and a few irons and kettles can be kept for this purpose. If she knows her job she will soon know the consumers well. Arrangements should always be made beforehand for any demonstrations of this nature, either by a polite letter or by personal interview.

Publicity.

Some publicity is, of course, necessary, especially in inaugurating a hire system. The method which gives the best return is by periodical mailing letters, followed up by calls, and a record kept of all such calls. Slides in picture-theatres are a very valuable form of advertising, and can very often be used with advantage in connection with occasional advertising in the local Press.

The "Xcel" Electric Iron.

With the introduction of a new type of plug connector on the "Xcel" electric iron, the manufacturers, the Automatic Telephone Manufacturing Company, announce a considerable reduction in the price of the iron.

When the "Xcel" iron was first put on the market in 1919 we gave a short illustrated description of it (The Electrician, July 14, 1919), but since then various minor improvements have been effected, and the following details of its manufacture are of interest:—

The sole plate is made of specially fine-grade cast iron, entirely free from flaws; the surface in contact with the element is machined on a special electric grinder to a dead level, giving accuracy to 2/1000 in. The ironing face is also ground level to prevent any concavity of the surface, and is afterwards glazed, polished, and nickel plated.

The element is pressed down by a cast-iron clamp, also ground dead level, and is further secured by two substantial nuts on 5/16 in. screwed studs. This ensures intimate thermal contact. The heating element is composed of picked mica plates gauged to a thickness to give perfect insulation when hot. After considerable research, all known types of micanite were discarded owing to the insulation being low when the iron was at full heat. This is dangerous, particularly on a.c. circuits. The resistance ribbon used is the best, and the contact tags are of pure nickel.

Considerable experiment was made to arrive at a self-aligning contact that would be unaffected by heat, and always take up proper contact position on the element tags. This has been satisfactorily obtained by the special shape and metal used. With this arrangement of contacts no electrical connections have to be made when it is necessary to change an element. Absolute certainty of contact is ensured, which is not always the case in irons where contact is made between the brass terminal ends and the tags on the element. The brass in time oxidises, and eventually gives bad contact. The stamped steel top is of substantial thickness, about twice as thick as in American practice. The attached stand and terminal guard are in one substantial piece, entirely enclosing the terminals.

The plug connector is of a novel type, and is designed to prevent the user from pulling the plug off by the flexible, and also to keep the flexible away from the user's arm when ironing. The flexible enters at the side of the connector instead of at the top, the top being used as a grip. Owing to the type of contacts employed, the circuit is made and broken quickly, so that it is quite safe to use this new connector to switch on and off. The handle remains quite cool in operation, being perfectly insulated by reducing the area of metallic contact with the surface of the iron top.

The whole of the components, except the mica and wood handle, are made in the company's works.

Recent Electrical Developments in Glasgow.

By R. HARDIE.

Hiring of Electric Cookers.

The Glasgow Corporation Electricity Department recently obtained sanction to instal in consumers' premises within their area of supply, 200 electric cookers, either (a) on simple hire, or (b) hire-purchase terms. To-day these cookers are at work, and while at this early stage sufficient

Fig. 1.—Gas and Electric Cookers at 19, Westbourne Terrace.

data have not been gathered to warrant anyone dogmatising on the results, it is quite safe to say that the cookers installed are giving satisfaction. Consumers have not shown any anxiety to take advantage of the hire-purchase method, but are content to operate on the simple hire basis.

It may be of interest to recall the circumstances which led the Electricity Department to make this experiment.

Advantages of the Cooking Load.

It is recognised in Glasgow, as elsewhere, that the cooking load is a most desirable one from every point of view. The average cooker will easily yield a greater revenue than an installation of merely lighting, iron, vacuum cleaner or other small appliances. It is, moreover, less subject to abuse than, say, a 3 kW electric fire, which, if left on circuit for a long number of hours unnecessarily, might cause the presentation of a bill which would frighten the consumer.

An electric cooker in use in the average household may be expected to consume from 1 500 to 2 000 kWh per annum, and even at the cooking rate in force in Glasgow and most large towns, forms a very desirable nucleus for a consumer's account. Further, the load in Glasgow, where the midday meal at home is the rule, is necessarily "off-peak." In the opinion of most authorities, this valuable daily, seven days per week, load need not be expected to materialise in the absence of hiring facilities—not even monied people will in large numbers spend from £20 to £50 on the purchase of an electric cooker (plus cost of the necessary wiring). Apart from other reasons, they have been too long spoiled by gas undertakings, who, in their anxiety to secure this remunerative business, do not hesitate to instal any number of gas appliances either free of charge or on easy terms. It was felt, therefore, that in Glasgow, if business was to be competed for on anything like equal terms, the Electricity Department should be at liberty to instal electric cookers on reasonable terms.

Queues for Cookers.

As already stated, the 200 cookers have been installed with ease, and without the slightest attempt at solicitation. The decision of the Electricity Committee to "hire" synchronised with the date of the recent Ideal Homes Exhibition, at which the Electricity Department was represented, and the mere announcement that "Electric cookers may now be had on hire" was sufficient to secure a flood of applications. One reason for the spate of inquiries may be the fact that Glasgow gas is not so good as it might be, nor is its price as low as the public would like. This combination of bad quality and high price undoubtedly contributed to the rapid success of the experiment.

Two types of cookers were installed: (1) The Falkirk Iron Company's No. 5 280/1922, and (2) The Jackson Electric Stove Company's No. 20. These cookers differ fundamentally in several respects, and obviously, in the event of an extension of the scheme, it will be necessary to consider the adoption of a standard type of cooker to ensure cheap and easy replacements of defective or worn out parts.

Hire Charges.

The hire charge is at the rate of £2 per annum, which includes the cost of maintenance. It also covers the cost

Fig. 2.—Electric Cooker at Jordanhill.

of installing the special wiring between the point of supply and the cooker, usually from 10 to 20 yds. in length (consisting mostly of lead-covered cable of 7/20 S.W.G. or equivalent), and the provision of a 30 A switch and fuse to control the cooker independently. A 3-pint electric copper

kettle, with self-contained element, is also supplied as part of the equipment. This is found to be a valuable adjunct to the cooker in the speedy provision of hot water, particularly in the early morning. The wiring has, in every case, been carried out to the order of the Department by local contracting firms.

The Canny Scot.

Cookers have been placed in houses of all sizes. Fig. 1 shows installation in a 3-apartment house in one of the new Government housing areas. This house, which has been occupied for about six months, was at first equipped with a gas cooker, installed as part of the original fittings, free of cost to the tenant. The gas cooker was removed at the request of the tenant, who is now paying the Electricity Department a rental of £2 per annum for the electric cooker illustrated. Within a stone's throw of this house, there are ten others in which electric cookers are installed, in identical circumstances, the tenants throwing out free gas apparatus. In one block of six houses three gas cookers

Fig. 3.—Cooker at Langside Road.

have been displaced in a period of three months and three electric cookers have taken their place. The gas cookers were of the latest type. The gas mains were modern and presumably of adequate dimensions. Yet, in spite of this, these people, without canvassing or pressure of any kind, chose the electric cooker.

Displacing Gas Cookers.

In passing, it may be said that the majority of the electric cookers installed have displaced gas cookers, and the change over was not effected without strong efforts on the part of the opposition to convince the consumer of the folly of meditating any change. In fact, in certain undertakings throughout the country there appears to be a group of selected men whose duty is to interview consumers who request the removal of a gas cooker, and denounce and criticise bitterly everything electrical on the score of prohibitive cost, unsatisfactory service, etc. The average consumer realises the position, and the gas man's errand is usually fruitless.

The original of the following *bona fide* and typical letter has been furnished to me by a representative of an electrical supply undertaking which is in keen competition with a gas undertaking working in the same town.

"With reference to my request for an electric cooker to replace the gas at my house at the above address, I desire to say that a representative of the Gas Department called and endeavoured to convince me that the gas fittings for cooking and heating were much superior to and much more economical than electricity. I felt, however, that he was speaking from a 'gas man's' point of view, and informed him that I had decided to give the electric cooker a fair trial. He has, therefore, promised to remove the gas appliances on Wednesday or Thursday."

Another amusing instance of this type of propaganda can be vouched for. The gas representative called at the residence of one of the cookery demonstrators employed by a certain electrical undertaking, where obviously an electric cooker was at work, and in all seriousness engaged in the customary declamation of electric cooking apparatus. The audience gave him a most attentive and respectful hearing, being glad to have first-hand confirmation of the methods employed.

Old Dogs and New Tricks.

Still another authenticated instance has just been brought to my notice. In this case the consumer was offered a new gas iron, free of charge, on condition that she allowed a new gas cooker to be installed in place of an unsatisfactory one which she had ordered to be removed. It is proverbially difficult for old dogs to learn new tricks and unlearn old ones, but the opinion is widely held that much of the energy expended in trying to sweep back the tide might with profit be directed elsewhere. The arguments now being used against electricity for cooking are on a par with those used against electricity for lighting a decade ago: it costs three or four times as much as gas, etc., etc. They are being used by the same people, and they will prove as futile.

The rate for electricity for cooking is 1d. per unit and gas costs 4/7d. per 1 000 cub. ft., but a reduction in the price of both services is promised in the immediate future. Electricity, therefore, is fighting on advantageous terms.

The 200 cookers referred to may, I think, be regarded merely as an introduction, and there is no good reason why eventually there should not be thousands of cookers connected to the mains in Glasgow. While the stress of competition will doubtless compel improvements in gas cookers, who can place a limit to the development of the electric cooker?

Electrical Homes for Electrical Men.

The slogan "Electrical Homes for Electrical Men" is bearing fruit in Glasgow as elsewhere. Nearly all responsible members of the staff of the Glasgow Corporation Electricity Department can now urge the advantages of electric cooking backed by personal experience in their own homes. The same may be said of many of our electrical contractors. This is as it should be, for how can we make our appeal to the general public until we have by our own example proved that we have a real belief in our own apparatus in complete electric service?

Every effort should be made by electrical men to show their real belief in their own apparatus and in complete electric service. Let at least the salaried employees of all Electricity Supply Authorities, Members of the B.E.A.M.A., the Electrical Contractors' Association, the Electrical Wholesalers' Federation, every electrical manufacturing concern—in short, everyone making his living in the industry, decide at the earliest possible moment to have an electrical home, and the electrical business will receive an immediate fillip.

The "Handilite" Flash Lamp.

The "Handilite" is an inexhaustible pocket flash lamp, just put on the market by the General Electric Company. The source of electrical energy is a small dynamo machine, with permanent magnets completely enclosed in a well-finished and serviceable case, and operated through a train of strong gear wheels by a conveniently shaped lever pivoted to the case. A retaining catch holds the operating handle close to the case when the apparatus is carried in the pocket. A "Bull's Eye" lens is fitted so as to give a concentrated beam, but by removing the lens—which can very easily be done—a wide angle beam can be obtained. The apparatus only weighs 15 oz., and is claimed to be the only lamp of its type manufactured in England.

A Male Mammal at Olympia.

By ALAN SULLIVAN.

I once knew a man who was called by his intimates "Black Alec, the Home Destroyer." He earned this sobriquet because whenever he gained admission to an intimate domestic circle, that circle stood in danger of gradual but persistent dissolution. Black Alec was large in my mind as I walked through the Ideal Home Exhibition at Olympia. He seemed to come back with a conundrum which might be put this way, "Is it the spirit that makes the Home or *vice versa?* Does the thing that one can buy create the atmosphere? Does woman know what she really wants, or does she wait till the male mammal demonstrates the thing?" All through the afternoon I kept on wondering whether Black Alec would have had any chance in a home fitted out with the pick of the exhibits I saw.

The Realities of Life.

You will argue possibly that the two thoughts have nothing to do with each other. That is where we differ. About the only real thing in life is, curiously enough, that which is seemingly unconnected with anything we buy or use, but, in all actuality, is founded on them. I refer to a state of mind, or, in other words, the human factor. And a "state of mind" is generally produced by our surroundings. If you think that this begins now to read like an advertisement for Ideal Homes, you are only partly right. It is merely an attempt to get at the bottom of what makes a home.

There were, of course, to be seen an amazing number of devices—so many, in fact, that they left the mind in a whirl, and one escaped to the Queens' Gardens with thankfulness. Furthermore, if you invested at one booth you were apt to see something more to your taste a little further on. Most exhibitions are bound to suffer from over exhibiting, and the various rooms put up for show purposes generally have too much in them. This is inevitable, and due to lack of space. At the same time I doubt if ever there has been brought together before such an assemblage of things that really help, and against which Black Alec would exert his charms in vain. I think the woman would have been too contented to be much impressed.

What the Electrical Man Knows.

As to the electrical end of it, there was every evidence that the male mammal really did know what his superior half should have to help to make her happy, and had given much thought to providing it. Of all the money that passes over the world's counters, woman spends some ninety per cent. This is a solemn thought for most men, and it seems that the electrical people are determined to hold on to as large a fraction of that ninety per cent. as possible. Had I been a young groom, swelling with primordial pride, and visiting that Exhibition with the fairest creature on earth, there is every probability that my house would have been so equipped that I would have met an early death by electrocution. There were so many appliances that meant sudden cessation of physical effort that one wondered just how long the two million surplus females in England proposed to put up with the old-time and back-breaking way of doing things.

No Need for Dirt.

We take it, and quite rightly, that dirt is the doorstep to disease. There is no reason now why the average home should not be as sanitary as a hospital—and more so. I was not impressed by the exhibitor who poured sand on a carpet—and sucked it up with a vacuum cleaner. Such things don't happen in anyone's home. If the carpet had been in the aisle, and he had cleaned it after a thousand people had walked over it, the point had been better made. But I was impressed by the fact that there is now no reason why a home should *ever* get really dirty. And that stands for a good deal.

The Enemy of Disease.

Another point is light, and here, again, is an enemy of disease. I was talking last week to one of the foremost of British scientists, who dwelt on the therapeutic value of light. It is, seemingly, the sworn foe of certain bacteria without which we are all much better off. Where sunlight is possible it is the most healthful thing in the world; where it is not there is but one substitute. One does not mean that man should bathe in brilliancy, but that both the bodily and mental process are aided by proper illumination. There is in London a glaring instance of how not to do it. I refer to a small shop where unfortunate girls, who will inevitably have eye-trouble—if they don't go mad—are forced to serve customers while intensely bright lights shine directly in their own faces. Charles Brush, of arc light fame, once told me that when his first lamp was exhibited in Cincinnati the public objected to it because it dazzled them. "Do you stare at the sun?" asked Brush. From what I saw yesterday there is no reason why the average home should not be perfectly illuminated.

Washing and "Dry"-ing.

Then there was washing of clothes. Had I been the above-mentioned bridegroom, I should probably have worn two shirts a day for the sheer pleasure of hurling them into an electric washer. It was, perhaps, the most interesting exhibit of all. Behind it moved the indistinct images of women, their arms white with suds, bending over steaming tubs of reputedly clean water and unquestionably dirty clothes. In California, a couple of years ago, I saw bottles of concentrated grape juice, bearing the label, "If you add to the contents three times their weight in water you will be breaking the law." The explanation was that California, being in the first throes of prohibition, was feeling very dry, and had produced some grape compound that gave every heaven-born citizen a chance to become his own distiller. Well, it seemed that those mechanical washers were breaking some unwritten law proclaiming that clothes must not be washed without sweat and fatigue. I am certain that a household thus equipped will have a prodigious weekly washing—and will be much the better off for it—and so will the clothes. Can anything be more distressing to a housewife than to see some husky and high-priced woman exercising all her destructive force on linen which will, as a result, demand mending?

Domestic Secrets Revealed.

So on through cooking, sewing, and all down the line to the curling of hair. What a multitude of things go to make a home! How many of them do we desire, and never knew we needed them till suddenly we found them attainable! As a male mammal I felt almost a sense of shame at the revelation of so many domestic secrets; then realised that they should never have been secrets.

One Kind of Ideal Home.

The average man goes to his office, say, at ten o'clock, reads a few letters, dictates a few more, and it is time for lunch. After lunch he plays fifty up, strolls back to his den of toil, reads the letters he has dictated, talks to people about things in which he is interested, breaks off his duty to sip tea, puts in another hour or so, and turns up at home with an expression suggesting that the situation has been saved—and solely by his personal and intense effort. His wife knows perfectly well that this is a bluff, but he does not know that she knows. She asks solicitously whether he has had a heavy day, and, being assured that this is something less than the truth, immediately forgets her own weariness to make him very comfortable. She has merely done some washing to keep down the laundry bill, supervised the cooking, mended the socks—his socks—bullied the butcher, browbeaten the grocer, looked after the children, put in an hour on a dress with which she hopes to surprise her husband, done her housekeeping accounts—and a few other

things. But for all of this, her face is placid; she does not claim to have saved any situation, and—God save *her!*—she hopes he has not been working too hard. That is the man who says he has an ideal home.

Anglo-Saxon Fair Play.

Here, it seems to me, is where that exhibition at Olympia comes in. It suggests that a good many of us, and perhaps some of those others who take up the collection on Sunday, have rather lost sight of a certain Anglo-Saxon quality of fair play. We accept too much without asking how the thing was brought about. We only see the results, and, because they are good, let it go at that. Not one man in forty could do a woman's work for a week. It is not because his brain is too fine an instrument for such utility, but because he simply has not got the staying quality for small, interminable, and uninteresting duties. Olympia suggested to me an opportunity for giving back—perhaps in a selfish manner—just a little of what we all receive and take for granted. The man who thinks privately that the dearest creature on earth is looking hardly so attractive now as she did when Mendelssohn's March sent his heart into his mouth, might turn this idea over in his mind. If he does so conscientiously, he has the opportunity to really save a situation. If he won't and doesn't, he is three kinds of a skunk.

American Domesticity Through English Eyes.

By MARGARET DYER.

Having recently returned from America I have noticed how very much more slowly domestic innovations have been adopted in this country than over there, and I thought it might, therefore, be of use to readers of The Electrician if I told them some of the ways in which knowledge of new appliances is spread in the United States.

The chief requirement of the English home is comfort, and no trouble is spared by domestic workers to make the home comfortable for the chief resident, the master. In America the master does not hold such an important position; the woman, who, after all, spends all her time in the home, looks more to her own comfort, with the result that ease of working the home becomes paramount. The two aspects are not necessarily antagonistic, but the latter has not received much consideration in the past owing to the ease with which cheap domestic labour could be obtained.

Grades of Residence.

In America there are the same three grades of places of residence as in England: The city, where the living conditions are congested, but electricity is available; the small towns (which may become cities in an incredibly short space of time), where it is usual to have most of the amenities of city life for the home and more space as well; and the isolated farms, which may be very primitive indeed, or, if on the direct line from town to town, may have most of the amenities of town life, including electricity.

The City Menage.

In the cities the majority of people live in small apartments (flats). It is customary for them to prepare their own breakfast by the aid of electric grills or hot-plates, to clean their own apartments by the aid of a vacuum cleaner (which may be centrally installed), and to press their own clothes with an electric iron. The apartments are very small, but in some cases it is possible to find room for an electrical washer. It is customary to lunch and dine out, often in a cafeteria attached to the building, and in the kitchen that supplies the meals are the bigger pieces of electrical equipment—the mincer, the mixer, the potato parer, and the dish-washer.

Electricity in the Small Towns.

In the smaller towns it is almost universal to find the washing machine for the laundry work, the small electrically driven calendar for flat ironing, and the electric iron. Commercial laundries are very expensive, if they exist in these smaller places, and the alternative, hand-washing done by Chinese labour, though cheaper, is not looked upon with favour by many who wash at home without very great labour with the assistance of electricity.

Advertising as a Factor in Development.

There is no doubt in my mind that the widespread use of these machines in a comparatively short time is very largely due to the excellent advertising. There is an enormous amount of propaganda work being done through the schools and colleges that have departments for teaching home economics. (This is the term used to include all forms of instruction given in domestic work.) The standard of living is generally distinctly higher in America than it is in England, but our policy seems to have been of making do with what we have rather than spreading knowledge of better, newer ways. For instance, in large numbers of secondary schools in England, ordinary flat-irons are used because the students have not got, or may not have, electric irons at home. But why have they not got them? Because in many cases they have not heard of them or seen them, and are frightened to use them.

If electric irons were generally introduced into schools, where it is possible to explain something about their construction, this fear would probably quickly pass. A girl guide at a recent laundry test in a large manufacturing town in Great Britain demanded an electric iron. She was provided with it, but the examiner felt she was hardly being brought up in a thrifty manner. But why, in a town of that description, was not everybody using electric irons?

How Manufacturers Can Help and be Helped.

In America a home economics department is usually provided with electrical equipment, free of charge or at a very low rate. Such a place has often only to express a desire for a new piece of equipment and they are offered it on loan for an indefinite period. Or in some cases a new make will be sent to the school in order that its approval may be assured. In one school for training teachers in home economics that I visited, the laundry class were running six different electrical machines (all loaned free), one against another. A really bad machine will suffer from this competition, but for the majority of machines a backing was found. The class seemed to be fairly divided in its opinion as to which was the best machine, and argued amongst themselves as to the superiority of the make they particularly affected. The experience gained by the class of the best manner of using each machine is most useful to the makers, and is often incorporated in the directions given to the public. The great difficulty is to provide a fool-proof machine, and the advantages of having one tried by numerous intelligent, but not specially trained, people are very great.

The manufacturers or store-keepers are also most generous in placing their staff and merchandise at the disposal of the schools and colleges. The class will visit and perhaps be given as much as two hours' instruction on the electrical appliances that are obtainable and the relative cost of running. I think many firms over here would not consider it profitable to spend two hours explaining and giving a great deal of informtion to a class who may not have amongst them the wherewithal to purchase a machine. However, if it is considered what a large number of people may be reached by such a visit, it may be more advantageous than can be estimated.

The "Scrap the Lot" Policy.

The Americans are particularly given to explaining to their English friends that they are a very young nation, and

too much must not be expected. This youthfulness is particularly apparent in their fondness of pulling everything down and beginning all over again. "Scrap the lot" is considered a normal thing to do, and they are perfectly willing to replace old machines with new ones as the improvements take place. In England there is very often great difficulty in obtaining any allowance even on the out-of-date appliances.

Lack of Interest.

Another reason that militates against the employment of electrical appliances in England is the lack of interest in the use to which the article is to be put. A school running its own laundry wished to install electric irons. The local electrical shop was approached and lent some irons for a week's trial. They were then returned, and no order was given, as the workers objected to them as giving so much work. Small irons of a pattern suitable for the householder who does the fine things at home had been provided instead of a heavier iron suitable for expert use. The latter are in use in many places, but in this case did not reach the possible user.

There is a great deal of distrust and conservatism to be overcome in the schools of domestic science in this country, but I believe if manufacturers would do more to help the schools by lending apparatus and helping to interest the students in their possibilities a greatly increased demand would follow.

The Wider Application of Electricity and Electrical Apparatus to Domestic Life.

By ALFRED WILLIAMS, F.R.I.B.A.

Great attention is being given at the present time to the question of "Domestic Economy." This, of course, includes the management of the house, especially in relation to domestic service, which in recent times has been radically changed, not only as to the manner in which the service is rendered, but also in the largely increased cost. Anything, therefore, that can be efficiently and permanently done with advantage to meet these new conditions will be a great public benefit.

Electricity an Immense Gain.

It is the writer's experience that the introduction of electricity into the dwelling-house has proved to be an immense gain not only in the increased cleanliness and in the preservation of decorations on walls and ceilings it permits, but financially, and also in promoting the personal comfort of the occupants and in economy and contentment in the service. Up to the present time, however, excepting in a few instances, the use of electricity has been almost entirely restricted to lighting, though I believe that a further extension of electricity for other purposes would substantially promote domestic economy.

Heating Problems.

The present system of warming a dwelling-house is generally by the open coal fire, which, though bright and cheerful, has the disadvantage of bringing in its train accumulations of dirt and smoke, causing damage and rendering necessary much labour in renovation. The use of a coal fire means that the materials for lighting the fire—wood, paper, and coal—have to be obtained, and then the coal for maintaining the fire must be easily available at all times, if not actually in the room. Even when the fire is alight, the hearth requires attention from time to time to keep it tidy. Afterwards the fireplace has to be cleaned out, the dust removed, the stove cleaned, and the fire relayed. This is all dirty and heavy work, involving considerable labour, whereas with an electric fire all that is required is to switch the current on. There is no preparation beforehand, and no cleaning up afterwards—a very great economy of labour in all ways.

Objections to Gas Fires.

Gas fires have been substituted in many cases, and, although convenient, are not free from fumes and the tarnishing of bright metal objects near them. They also injure decorations by the deposit of small dirt and an oily surface. A gas fire also compares unfavourably with a coal fire financially as regards the attainment and maintenance of a proper temperature in an apartment.

Electric Heating and Cooking.

The manufacturers of electric fires have introduced to the public many artistic and efficient forms of grates at a reasonable cost that can be most easily manipulated, requiring little or no service from the domestic, but at the same time giving a bright, clean, and efficient warmth in the room. As a system of warming, also, it strongly recommends itself for adoption by reason of its convenience and portability.

For cooking purposes useful stoves are on the market. They are very efficient and more cleanly than any other form. The labour in the kitchen is materially reduced. By the adoption of the numerous small appliances which can be placed on a sitting-room table for egg and water boiling and bread toasting, etc., service is again greatly reduced.

Advantages of the Vacuum Cleaner.

For carpets, curtains, chair seatings, etc., the electric vacuum cleaner is a great acquisition, more efficient in its work, is quicker, and effecting much saving of time. Here, again, a great gain to domestic economy. Where it is possible to have a laundry in or near the house remarkably efficient machines for washing and wringing clothes can be readily worked by electric power, and the electric iron cannot be too highly recommended. Electric power may also with great advantage be applied to a sewing machine, leaving both hands of the worker free, effecting a saving of time and improvement in the work executed. In cases where the kitchen is in the basement below the dining-room floor, electric power attached to a dinner lift would facilitate the service at the top and bottom.

To the above list may be added electric bells and internal telephones from sitting-room, etc., and the principal bedrooms, giving instant communication with the servant, economising her time and journeys for attendance. The introduction of automatic switches on all doors to dark storerooms or closets would avoid the loss of time in hunting for matches and candles.

Architectural Necessities.

Of course, to obtain all the advantages above described a complete installation must be made. The wiring should be duplicated and sufficient capacity as carrier of current to all the fittings, and care taken in all the connections for fittings.

The cost of current taken from a public main must, of course, be taken into consideration, and would probably be thought by many to be prohibitive to its adoption, yet it must be remembered that a very great saving in the housing, boarding and wages of domestic services would be effected, and in many cases halved. Should, however, current be obtained from a private dynamo the cost of the extension of its use would not be so largely increased.

In addition to the comfort to the occupants of a house completely installed by electricity as above enumerated, which would be great, the writer, who is much interested in the subject and has had considerable experience in dealing with residential property, has no hesitation in saying that in his opinion a medium-sized house suitable for occupation of members of the professional classes well and suitably equipped as indicated above would be more readily disposed of should it be placed on the market

The Use and Future of Electrically Equipped Furniture.

By EARL E. WHITEHORNE.
Commercial Editor, "Electrical World."

Electrified furniture is something new under the sun. It was talked about in 1915, but during the war there was no time to think of it. Last June, however, the subject was revived by Mr. J. F. Becker, sales manager of the United Electric Light & Power Company, New York. He exhibited a full set of miniature household furniture before a meeting of the N. E. L. A. Commercial Section executive committee at Association Island and discussed the situation. He was appointed chairman of a committee and received an appropriation to develop a set of specifications for wiring furniture. Mr. Becker thereupon, at the expense of his company, proceeded to purchase and electrically equip a complete set of household furniture, which was exhibited first at the New York electrical show last autumn and thereafter in the furniture departments of various large New York department stores. Electrified furniture, therefore, is not only being talked about; it has been produced.

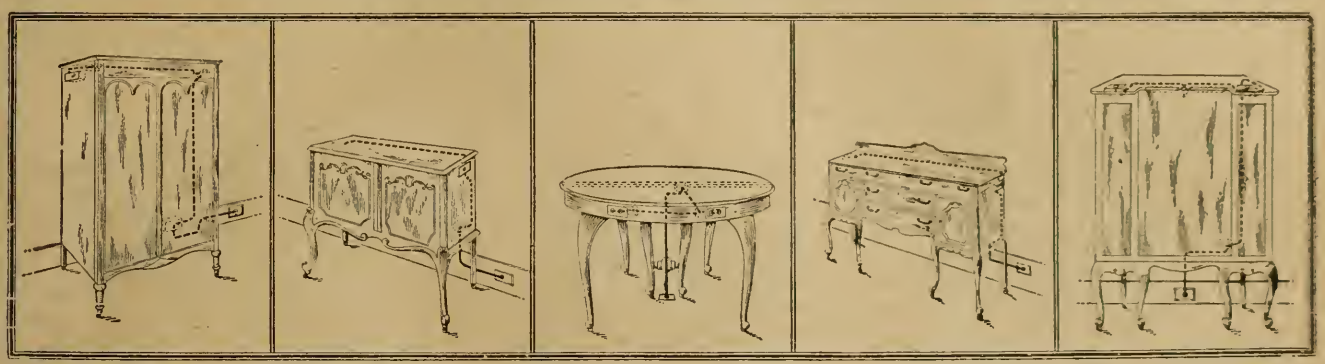


FIG. 1.—SCALE DRAWINGS OF THE "CHIFFEROBE," SERVING TABLE, DINING TABLE, BUFFET AND CHINA CLOSET.

What the Furniture Man Thinks of It.

Now, the point that interests me most about this idea is not what the electrical man thinks, nor even what a woman says when she first hears of it. It is the opinion of the furniture people. For they know furniture. And they have said that the electrical equipment of household furniture is a real inspiration which is going to win a great popularity. Mr. R. Braun, president of the New York Furniture Exchange, has put it this way:

There is no doubt in the world that electrified furniture will sell, provided only that the cost of electrifying it is brought down to a proper level. I believe that the furniture trade will welcome this innovation. It will provide a style appeal that should produce much business. I believe that electrified furniture has a big future.

The Right Idea.

Therefore, as far as the furniture aspect is concerned, the idea is apparently right. Electrified furniture will sell. And it will sell even though some men and women when they first hear about it are not enthusiastic. Furniture has never been electrified, and the thought is somewhat startling. They do not at once see the necessity for it. But, by the same token, the use of electrical appliances is in itself new, and this further step in making their use convenient will not be thoroughly understood until it is explained. It is an idea that at first will have to be "sold."

Inherent Inconveniences.

All electrical appliances, of course, have one inherent and unescapable feature of inconvenience. They must for ever be attached to the electric outlet while in use. If there are not an adequate number of conveniently located outlets to which the fan or toaster or heat pad may be connected, it is not easy to use them, and from the beginning that has been a serious obstacle to their habitual use and popularity. People naturally want to use these devices right where they happen to be sitting. The grill, the percolator and the other small cooking appliances are commonly used at the dining table or the sideboard. The vibrator, hair dryer and curling iron are commonly used at the dressing table. The fan is almost always standing upon a bureau or sideboard or table. The heat pad and bottle warmer are needed usually beside the bed. The convenience of the vacuum cleaner depends upon being able to plug it in at any point where you want to clean. But few houses, at present, have more than one or at most two outlets in the principal rooms, and most of these were installed before the furniture was in place and are not as handy as they should be.

Provides More Handy Outlets.

There is the condition. And the equipping of the furniture itself with convenience outlets is the best idea that has ever been suggested to relieve it. For in this way we can automatically provide a large number of additional receptacles exactly where they can be reached most easily at the precise point where they will always be wanted, no matter how the furniture is moved. Each piece of furniture connects by an attachment cord directly to the house wiring by plugging into a socket, and its own more accessible receptacles are used to connect the appliances by short cords. There is no stooping down therefore each time some device is to be used. The bed or the table remains plugged in.

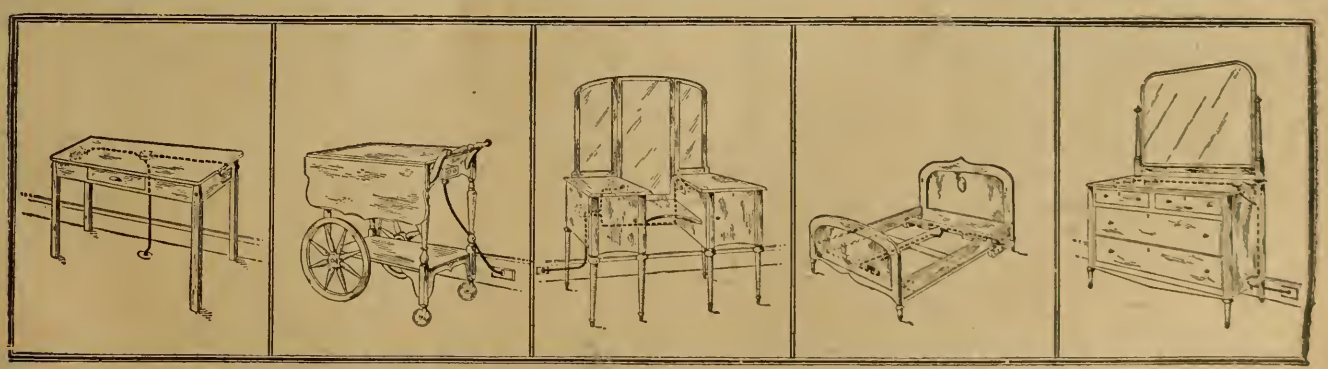


FIG. 2.—DIAGRAMS SHOWING HOW THE KITCHEN TABLE, TEA WAGON, VANITY TABLE, BED AND DRESSER WERE WIRED.

There are ten pieces of walnut furniture in the model set which has been prepared by Mr. Becker's company. The photographs and diagrams reproduced here show how the receptacles have been installed, although to make them visible in the half-tones it has been necessary to make these receptacles more prominent and conspicuous. The purpose in wiring each has been very definite:

The Bed.

The bed is provided with three receptacles, placed under the left-side board at the head of the bed to connect a heat pad, the bedside lamp, the fan, the baby's bottle warmer, or a grill for the bedside breakfast. In addition, a toggle switch operates a lamp beneath the bed which illuminates the floor sufficiently to make it comfortable to walk about without disturbing a sleeper or making the interior of the room visible from outside. All this equipment has been

attached to the one section of the bedstead, so that the bed may be taken apart without interference with the wiring.

Chifferobe and Dressing Table.

The "chifferobe" has two receptacles for the convenience of the man, and they are often needed when this piece of furniture accepts the darker corner in deference to the greater needs of the dresser. They provide for the connection of a boudoir lamp or a shaving lamp, a fan or an electric clock, and the warbrobe section is automatically lighted as the doors are opened.

The dresser has four receptacles to connect two candlesticks or a boudoir lamp, a violet ray, or vibrator or hair dryer or curling iron or fan.

Vanity and Sewing Tables.

The vanity table has two receptacles for use with any of the appliances mentioned in connection with the dresser. The wiring of the sewing table is also suggested where it is desired. Two receptacles can be installed for use in connecting a flat iron for pressing work, a lamp for evening sewing, the sewing machine motor, or a fan.

FIG. 3.—VIEWS OF "ELECTRIFIED FURNITURE" EXHIBITED AT THE NEW YORK ELECTRICAL SHOW.

The Dining Table.

The dining table is undoubtedly the one article of furniture most greatly in need of its own wiring. Although it is not usually possible to operate more than one table appliance at a time owing to the excessive load, as a matter of practice it is not necessary or customary. The percolator is started as soon as the first member of the family comes in to breakfast, or by the maid before that. By the time the fruit and cereal are finished the coffee is done and the grill or toaster has come into service. So only one appliance is needed at a time, but to be convenient it should be possible to disconnect the one and connect the other without getting up, and this is rarely possible where the table itself is not wired.

Too often an indirect-lighting fixture over the dining table makes it impossible to connect an appliance without running a tangled cord across the rug and risking an unwary foot that may jerk the toaster off the table ; and the attachment of table appliances to any type of lighting fixture on the table is an abomination because the hanging cords are both unsightly and troublesome. A wired table, however, may be connected to a floor receptacle through parted fibres in the rug, and the appliances, with shortened cords, are plugged into the receptacles in the skirt of the table. Meanwhile the lighting arrangements are not disturbed.

Buffet and Serving Table.

The buffet is fitted with two receptacles which may be used for connecting electric candles or any cooking appliance which might be operated by the maid at the sideboard or at the table. Also in summer a fan often stands here.

The serving table is equipped in the same way as the dresser as an alternative or supplementary convenience for attaching the same appliance or candles.

China Closet.

The china closet is wired to provide light with both an ornamental and a utilitarian purpose. Beautiful glass and china is most attractive when lighted and low-powered tubular lamps within a cabinet bring out the fire of cut and iridescent glass and the colouring of china most effectively and without undue display. This light also serves to prevent breakage when glass is being taken out or put back by making it easier to gauge the space and distance. On the top of the china closet are two receptacles to connect a fan or clock.

Tea Wagon.

The tea wagon is another case where wiring has a great practical value. The wagon is taken about the house to any room or on the porch, to be used beside the fireplace or at the chair where the hostess may be sitting. On it may be a samovar or percolator and also a chafing dish, grill, toaster, or waffle iron. Yet seldom is it convenient to connect two appliances and perhaps a little table lamp just at that point. With a wired tea wagon the attachment cord is carried to the nearest baseboard outlet and the appliances, with shortened cords, plug into the tea wagon's own two receptacles. A hook is provided to coil the wagon's cord when not connected.

Kitchen Equipment.

The kitchen table is the main domestic workbench, and more and more electrical equipment is becoming available for use on it. Two receptacles have been installed to connect the electric mixer, the grinder, the polisher, or the flat-iron. The kitchen cabinet has two receptacles for connecting the same devices listed above for use on the table and in addition a heating receptacle for attaching a flat-iron or a fireless cooker.

Future Developments.

In the equipment of this original set of electrified furniture, of course, it was necessary to use available standard fittings which are in many cases larger and more conspicuous than are appropriate. New fittings for furniture will undoubtedly be developed having smaller plates and other characteristics more suitable for this use, and this will naturally stimulate the wiring of furniture. One leading furniture manufacturer has said that if smaller fittings were available he would begin to electrify his dining-room tables, tea wagons and some other pieces at once, and other producers will follow suit. It offers both the maker and the dealer a new style in furniture, a new idea that can be talked about and advertised and sold. It is something that they all want and will gladly push. And every sale of wired furniture brings more outlets into some home. more places to use appliances, and nothing influences the purchase of more appliances so much as a handy waiting outlet. Such a piece of electrified furniture will add from one to four more outlets and increase the use of every kind of a household device.

A Big Idea.

It is a big idea, and it has a big future, and electrical men will do well to push it energetically. To-day it sounds like a radical innovation that will not have wide popular appeal, but the furniture man knows better than we do about that. Motor cars were considered complete before the first self-starter came, but we know now that a car was but half an automobile as far as convenience was concerned before that further refinement was introduced. We are going to find that wiring will bring just this kind of a convenience to our furniture and that people will adopt it gladly once they see how much it will do for them in comfort. And the electrical industry will benefit tremendously.

The Helsby Twin Wiring System.

The call, apparently, is still for surface wiring systems, and there are not lacking those who are willing and anxious to reply to the demand. Among the latest ways of surface wiring is the Helsby twin wiring system produced by the British Insulated and Helsby Cables, ltd. This system, of which the salient features are shown in the accompanying photograph illustrating a demonstration board, is, it is claimed, suitable for both direct and alternating current supply, and comprises essentially single, twin or three-core rubber insulated metallic sheathed wires and a range of fittings and accessories for fixing and using them. The single wire is of circular section, the twin and three-core having a flat section. In all cases the metallic sheathing is composed of a special metal alloy of considerable strength, which, without impairing flexibility, provides a good protective covering for the cable and prevents sagging. It is claimed that the whole system is quickly and cheaply erected with a minimum of labour and that no special tools are required.

Details of the System.

The fixing clips which can be seen in the left-hand top corner of the exhibition board are composed of tinned brass with countersunk holes so that the head of the fixing screw is flush with the clip. The fixing saddles which are shown below them are also of tinned brass drilled with holes to take a No. 3 wood screw. The junction box which is shown in its normal position at the right-hand bottom corner of the board and in an inverted position at the opposite bottom corner comprises a tinned brass back plate, an annular bonding clamp of special alloy and a tinned brass cover. The back plate is placed inside the annular bonding clamp, and the whole is secured to the wall by means of a screw through the whole of the plate. The bonding clamp has four slots, so that it may be used as a two, three or four-way fitting, continuity of the metal sheathing of the cable being secured by screwing down the small clamping pieces on to the sheath. The metal of the bonding clamp is of the same composition as that used for sheathing the wires, and cables and the slots can easily be opened out when it is necessary to use a larger cable than 7/0·079 flat twin.

An important point is that there are no loose screws or small loose parts to worry about, as the fittings are all supplied assembled, and it is never necessary to completely remove any of the screws. The covers for the fitting are simply sprung on to the base portion so that simplicity and easy erection may be said to be outstanding features of the system, among whose advantages the makers claim that it is inexpensive, easily and rapidly erected, needs no bolts and thoroughly efficient electrically, and requires no special tools.

How the Helsby Twin Wiring System Works.

Modern Wiring—The Surflex Safety System.

By L. M. WATERHOUSE.

For the past twenty-five years the screwed metal conduit system may be said to have been standard practice in this country, but owing to the high cost of material and increased labour charges wiring development has been very much restricted of late years, as would-be consumers are not in a position to pay the prices demanded. Undoubtedly there are many cases of installation work where the conditions demand mechanical protection of the high order afforded by metal conduits, but there are a much larger number where such protection is superfluous, and where a heavy metal system entails

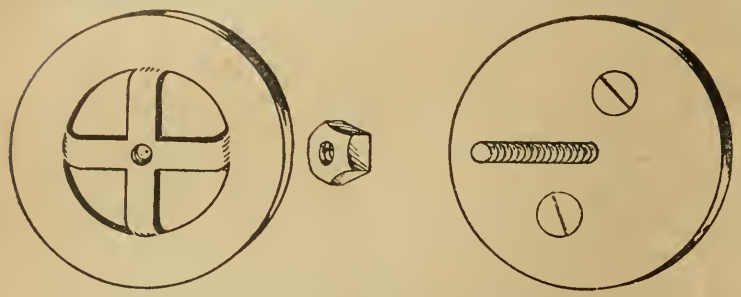


Fig. 1.—The Surflex Base and Pressure Plate.

an upheaval and upset of working conditions that is unnecessary. In the majority of private houses and business establishments considerable economy could be introduced without in any way adversely affecting efficiency.

The Economy View Point.

The question is how to bring the economy axe into operation without affecting efficiency. An analysis of wiring costs clearly demonstrates the increased cost of material as well as labour, but in reference to conduits themselves, the increase is not marked, but the many costly component parts which go to make up a conduit system render it almost prohibitive except where conditions demand solid mechanical protection. It is these boxes and fittings which affect the question to such a degree and inflate the wiring costs to such an appreciable extent. It is clearly in this connection that we must look to effect the saving, for, so long as high-class screwed conduit work remains in the vicinity of £3 a point, so long will development be retarded. Another factor that cannot be overlooked is the high price charged for energy by many supply companies. In most cases, a considerably lower scale is offered for heating, cooking and power circuits, but the present high charges for wiring practically prohibit such new circuits being installed, and consequently the development of domestic appliances

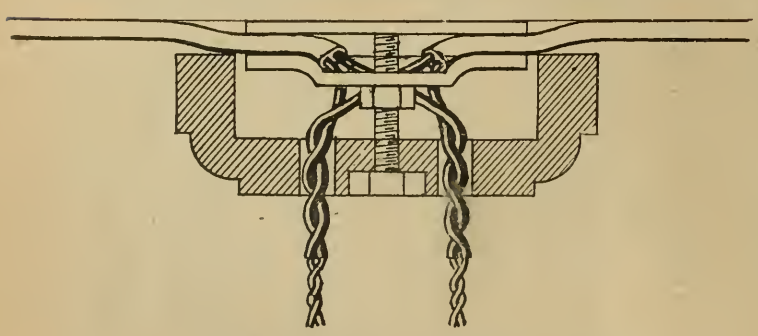


Fig. 2.—Wiring at a Lighting Point.

is retarded. I suggest that if the Electrical Development Association concentrated their attention entirely on the two factors—reduced installation wiring costs and reduced rates for energy both for lighting and heating circuits, they would do more effective service to the development of electricity in this country than by the consideration of methods of salesmanship, and by endeavours to educate a public which cannot afford to be educated so long as the present rates exist.

Slow Development of Surface Wiring.

For some years past, lead-sheathed and solid-rubber-sheathed wires and cables have been produced for surface wiring by some of our leading cable makers, and they have met with a measure of success owing to the marked economy of such methods of wiring, both in prime cost and in simplicity of erection. It is also found that the protection afforded is more than sufficient to meet most installation requirements, and they have the advantage of being free from all condensation troubles, are not unsightly or cumbersome and are easily and expeditiously erected without specially skilled labour and, a most important point, their erection causes a minimum of inconvenience and disturbance to decorations and interference with the work of a household, office or works. It is somewhat surprising that development along these lines has not been more rapid and pronounced, but whereas the conduit system has been elaborately developed, possibly too far extended in its large range and multiplicity of fittings, these sheathed-cable systems have, to a large extent, been neglected in the direction of useful accessories. It is true there has been no dearth of actual boxes, but the majority of them are not mechanical, being too often composed of thin metal stampings with separate bondings for each wire, with many small nuts and screws, and they have therefore not appealed to engineers as a sound mechanical proposition. The boxes for solid-rubber-sheathed cables being usually manufactured of moulded materials are also lacking in mechanical strength; in short, those wires and cables which possess marked advantages both as regards efficiency and economy have not been converted for want of sound accessories into a concrete system of wiring.

A New System.

To meet the present day requirements of economical yet efficient wiring, the Surflex Safety System has been introduced. Although still a staunch upholder of conduits for installations necessitating stout mechanical protection, I am of opinion that, for the majority of installations in private houses and public buildings, a decidedly less costly, yet nowise less efficient method of wiring can be installed

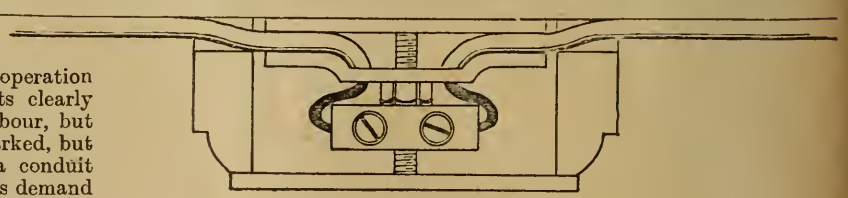


Fig. 3.—A Straight Through Connection.

either in its entirety or in conjunction with conduits, a pronounced saving being found in connection with all sub-distribution work.

Details of the System.

The Surflex Safety System consists of universal metal bonding and insulating fixing plates and boxes for use with all metal-sheathed or solid-rubber-covered wires and cables—single, twin or three core, circular or flat. The metal plates can be employed for both lead and solid-rubber sheathed, the insulating variety being for rubber sheathed only. In all cases wires can radiate to and from the plates at any desired angle relative to each other. The bonding is secured by direct pressure of a single nut on a central stud, and this pressure bond is lasting, so that all strain is taken off the terminals.

The base plate being fixed in position, the pressure plate when screwed down fixes the position of the circuits, the wires being held in position whilst the necessary connections are being made. Surflex plates form the basis of all points, whether they are lighting or switch points, junctions or connections. In the former case they are used in conjunction with an accessory mounting wood block for the 5 A type of fittings, and with a fibre box for the 3 A accessories.

Suspensions and Bondings.

Two other features of the Surflex System claiming attention are the Surflex adjustable suspensions and Surflex adjustable bondings. Surflex brass suspensions are small sleeves made from drawn brass tube, through which extruded lead strip is drawn in a bight after encircling the single or multiple circuits; the bight is then drawn tight and a screw through the centre of the sleeve secures the circuit in position. These suspensions can be used in a variety of ways, such as for multiple saddles. The Surflex bondings are a development of the suspensions, but the wood screws are replaced by No. 3 BA bolts, nuts and washers, and they can be employed with lead strip or tinned brass strip. The use of Surflex suspensions and bondings is not confined to lead and solid-rubber-sheathed wires and cables, but they can be usefully employed in connection with conduit runs and all metal circuits, and they form a very convenient method of bridging across a wood block used on a conduit run.

The whole system is condensed into a few parts, the idea being to provide the contractor with a complete outfit to carry out his installation wiring with a minimum of stock outlay, to enable him to save time so often expensively lost in these jobs and to complete any installation according to contract.

The Home Idealised.

(*Concluded from page* 349.)

Fresh Falkirk Apparatus.

The electrical part of the FALKIRK IRON COMPANY'S stand consisted of a model electric kitchen which contained their No. 5 280 domestic cooker, together with a wash boiler, kettle and iron. This cooker, of which we give an illustration (Fig. 11), has been designed to meet the needs of the modern home occupied by a small or medium-sized family, and it has already received a wide application,

FIG. 11.—THE LATEST FALKIRK COOKER.

especially in Glasgow, as will be seen from Mr. Hardie's article which is published on another page of this issue. It has ample oven accommodation, two radiant type boiling burners and a griller and hotplate with switches and fuses, thus forming, it is claimed, a compact and reliable cooker at an extremely low price. It is worth noting that the head is hinged at the back and so can be easily lifted to expose the whole wiring. The oven is ready for toasting or baking within twenty-five minutes of turning on the high heat.

Another interesting piece of apparatus on this stand was the double ray heater and toaster. This transmits heat over an angle of 100 deg., thus distributing rather than concentrating the heat. It effects this with a small loading of 600 W, and from it not only can room heat be obtained, but toasting can be easily effected with good results. Moreover, it is a handsome piece of apparatus, being made wholly of polished copper, with brass trimmings, ebonised handle and fibre legs. It weighs less than 2½ lb. and can be readily attached to any lamp socket and conveniently placed in the trunk for travelling.

Western Washers.

The star turn on the WESTERN ELECTRIC COMPANY stand was the combined dish-washer and kitchen table. This equipment consists essentially of a sheet-iron chest mounted on legs so as to be at a convenient height for the worker. The top of this chest is divided into two parts, the larger of which is hinged and acts as a lid which can, however, be held securely in the open position when dishes are being placed in the interior. The lid is very thin and flexible, so that there is no danger of kinking, and the whole is finished in enamelled iron, and is therefore easy to keep clean.

The electrical portion of the apparatus consists of a motor-driven paddle which sprays two gallons of hot water over the crockery in three directions. The dishes must be scraped before they are put into the washer, and are then kept separate from each other in wire racks, so that there is no danger of chipping or cracking owing to mutual contact. Separate holders are provided for the silver-ware. When washing is completed a continuous spray of hot water rinses, the articles; if the water is hot enough drying takes place automatically. The washer is provided with a drain so that the plates can be left in the trays to dry.

Washing Day Simplified.

The Western clothes washer was also prominent on this stand. It consists essentially of a hard maple revolving cylinder, which is perforated round its periphery so that soapy water is driven on to the clothes inside. This cylinder is operated by a ¼ H.P. motor through an ingenious arrangement of gearing and dog clutches, which cause it to reverse its direction of revolution once every 6½ revs. A friction clutch ensures that if the cylinder is overloaded the motor runs free and no damage is caused. A safety device is fitted within easy reach, so that if any accident occurs the motor can be immediately shut down. Combined with this washing machine is a wringer which is driven from the same motor, the latter being of sufficient size to allow both wringer and washer to be operated simultaneously. This wringer can be operated in any direction.

The motor is tucked away under the washer, and is well protected against damp or drips. Incidentally it is provided with a spare pulley so as to allow it to be used to drive a small unit for other work. The washer is mounted on castors and can easily be moved about for filling or emptying.

The Western ironer consists of a 46 in. roller, which can be either electrically or gas heated, and there is, in addition, a ruffling attachment for dealing with collars and cuffs that cannot easily be operated on a straight roller. The ironer has both foot and hand control, one of whose features is that the roller can be entirely disconnected from the driving circuit and moved round easily by hand for the preliminary arrangement of material. After the material has passed through the ironer it falls in even folds on to a special dropping board underneath.

Touchbutton House Translated.

Aladdin's genie has been at work, and for the time being Touchbutton House was transferred to Olympia, and in a very creditable, though condensed, form attracted numerous visitors to

FIG. 12.—A NEW "MAGICOAL" FIRE.

No. 106 stand. This is not surprising, because Touchbutton House the Second contained a very complete display of electric heating, cooking, and plate-washing and clothes-washing apparatus of the

FIG. 13.—THE "MULPARVO" WASHING MACHINE.

kind with which BERRY'S ELECTRIC, LTD., have long tempted the electrical and lay public. It is hardly necessary to add that the Magicoal fires, one of which we show in Fig. 12, and the Colex

system of house heating were given considerable prominence among most artistic surroundings.

In addition was to be found the Mulparvo electric servant, an apparatus which will do practically everything that is required in the kitchen and its subsidiary places, from plate washing to laundry work, including brass polishing, batter mixing, cake making, ice cream freezing, meat chopping, and boot polishing. This machine is very compact, being 41 in. by 24 in. by 34 in., and is illustrated in Fig. 13.

Another new invention which was on show is that devised for table glass decoration for fruit and flowers. This brings into play all the beautiful coloured effects of the solar spectrum in their proper sequence so that the illuminated fruit and flower vases are continually changing their appearance.

The "Ventiheta."

The Ventiheta, which was shown by the Ventiheta United Kingdom, Ltd., is an apparatus for supplying a constant stream of fresh warm air to the interior of a building. It is claimed that those who use it will not only escape draughts, but have the pleasure of living in an even temperature. It seems worth trying not only from this point of view, but because it gives no obnoxious fumes or smells. We can understand this when the electric model is used, but we beg leave to doubt it if gas or oil is the heating agent. As our illustration (Fig. 14) shows, the whole apparatus is strongly constructed in sheet iron, which is finished artistically to comply with various forms of decoration. The height is 4 ft. 6 in. and the base measures 13½ in. by 10 in. The electric model is fitted with four Genii glowers with regulating switches adjusting the consumption from 0·5 to 2 kWh per hour. It is stated from 2 000 to 5 000 cub. ft. of fresh-warmed air are induced hourly by convection.

Fig. 14. A Typical "Ventiheta."

The Blue Bird washing and ironing machines shown by the Blue Bird & Simplex Electric Company at least has an attractive name, and if their operation is only half as attractive from the point of view of the company the exhibition should have been an entire success. It is claimed for the Blue Bird that it washes clothes spotlessly white. Perhaps this is because the tub is very large and is made of copper tinned inside. This tub is given an oscillatory motion and cleansing is effected entirely by the action of water and soap. The tub is controlled by one lever alone and can be drained by pulling up a flexible rod. It is stated that it is possible to wash £1 sterling worth of laundry in fifteen minutes, while the equivalent of 120 table napkins can be ironed in the course of one hour without fatigue.

Hotpoint Appliances.

The Hotpoint Electric Appliance Company's stand should have appealed strongly to the housewife who is interested in time and labour-saving appliances. Here was to be found a range of all the well-known Hotpoint domestic electric appliances, including electric irons for all sorts of uses, and one we especially noticed was adjustable to any voltage. Turning to a rather more attractive question we find many elegant designs of Hotpoint electric tea kettles, teapots, and coffee percolators all fitted with automatic safety switches which are self-operated if the apparatus is inadvertently left on circuit, and can be re-set merely by pressing a catch. We must not forget electric toasters, grills, immersion heaters, bed warmers, fires, sewing machines, &c., all equipment tending to make the home more comfortable and the housework lighter. This being the aim in view, a special display was somewhat naturally given to the latest model of Premier electric suction cleaner which embodies a sensitive beater device by means of which the carpets are beaten gently and rapidly at the same time as they are cleaned by powerful suction. Then there is the Acrobell electric clothes washer, which embodies the vacuum comb principle whereby the soapsuds are forced through the clothes, thus loosening and removing the dirt without scrubbing, and then again, there is the Walker dish washer, which not only saves labour but breakages as well—altogether a representative exhibit of how electricity can assist in solving the domestic problem.

What "Z" Means.

The "Z" Electric Lamp & Supplies Company, Ltd., had a very complete exhibition of their indirect lighting bowls, panels, friezes and plaques. The bowl fitting exhibited has been introduced to overcome the dead and unsightly effect of the ordinary metal indirect lighting fittings. It is formed from plaster castings to which, by a patent process, the property of translucence is given. The casts are reinforced by fabrics, and consequently any flower or other colours desired can be introduced into the fitting. By day the bowl has the appearance of white marble, but when illuminated the colours become visible with very beautiful results. The bowl retains a soft degree of opacity to prevent the coloured rays entering the room so that a perfect white soft diffused light is, it is claimed, obtained. The panels and friezes, which are also translucent, are highly artistic, and when illuminated the results are most effective, especially for the decoration of cinemas and public halls, &c.

Panel Warming.

Richard Crittal & Co. had on view examples of their panel system of warming, which has been designed to obtain the full effect of radiant heat with all its advantages in contradistinction to local warming by convection. It is claimed that by this method not only may walls, floors, and ceilings be heated in a simple and unobtrusive way, but that curtains, screens, footstools and quilts, and even chairs and settees may be used as heat transmitters, and so form an efficient and convenient supplement to other methods of heating. Only extremely low temperatures are employed, and the maintenance of the apparatus is therefore claimed to be negligible.

More Washing Machines.

The Northern Steel & Hardware Company were showing their "Laundry Queen" electric washing machine which, it is claimed, will wash all the clothes of an ordinary household at a cost of under 2d. for electrical energy and, what is more, wash them better and cleaner than can be done by hand; while, thrown in as a sort of makeweight, it will wring, rinse them and blue them—in fact, do everything but place them on the line. All these wonderful things are done without damage to the clothes, owing principally to the gentle action of the dolly, which passes hot soapy water through the mesh of the clothing.

The wringer which is fitted has an automatic adjustment so that it will take any thickness of material, and can be swung to any position, so that the wringing of one batch of clothes can be done whilst the second is being washed.

Also on this stand was the Northern electric vacuum cleaner, which performs all sorts of useful cleaning operations. It works not only by suction, but when reversed blows dust from heavy pieces of furniture such as wardrobes and sideboards.

Floor Polishing.

The Electrolux floor polisher is, as its name implies, a useful piece of apparatus, which has been particularly designed to do away with a particularly back-breaking form of domestic labour in medium-size houses. Its loading is only 140 W and it can therefore be run from any lighting circuit. The power of the motor is ⅛ h.p., and the speed is 7 000 revs. per min. Two sets of brushes are provided, one with hard bristles and one with soft bristles, and in both sets there are two parts which run in reverse directions, the outer brush running at half the speed of the inner brush.

Spring Cleaning Simplified

The Electric Suction Cleaner Company (proprietors, Scholey & Company, Ltd.) were exhibiting their well-known Croydon electric vacuum cleaner, which, it is claimed, provides an example of one of the latest features of electric vacuum cleaners, which is wholly British made. The machine is standardised for all voltages, and demonstrations, which attracted a good deal of interest, were held at frequent intervals.

The Hoover Suction Sweeper Company were showing their well-known equipment, a distinguishing feature of which is that it beats the carpets as they lie on the floor, sweeps them electrically, and cleans them by air. Its utility is not confined to carpets, however, and it will with equal effect clean curtains, hangings, upholstery, clothes, etc., without raising any dust. In these spring days a cheap way of getting one's carpet cleaned is to register your name with the Hoover Suction Cleaner Company, and they will give you a free demonstration in your own home on your own carpet. How they make a profit out of it we don't know.

Gillespie & Beales were showing a number of their "Nilfisk" electric suction cleaners; while an excellent range of electric labour-saving appliances, including several types of electric vacuum cleaners and a fine range of portable electric cleaners for all purposes, were shown by Duncan, Watson & Company. On this stand were also to be found the "Rotapex" electric clothes washer and double ironer and the Alafort electric gramophone. Play a tune while you wash—not a bad idea!

The Aster Engineering Company were showing one of their 25 V British light semi-automatic country-house lighting plants complete with 170 A hour 13 cells storage battery, the engine in this case being arranged to run on town gas. Automatic pumping sets for country house work were also to be found.

Studebaker, Ltd., were exhibiting the well-known Lalley power plant, of which many thousands are in operation to-day in country houses and other similar places.

Electrically-driven sewing machines were to be found with many interesting attachments on the stand of the Singer Sewing Machine Company, Ltd.

The Eureka vacuum cleaner, which is distinguished by having 2 mile a min. suction and thereby is capable of doing all household cleaning of carpets, hangings, beddings, &c., was shown by the Electrical Appliances Company.

An Electric Conduit and Pipe Clearing Device.

By E. GEORGES CHEUVREUX, Jr.

Few effective methods are available for blowing down obstructions in pipes, particularly electrical conduits, that are placed in the walls or other positions during the construction of a building. Most of these conduits are laid in position before the cementing or plastering is completed, and during the time that such work is being accomplished. Experience shows that it is not practical to cap the ends of these pipes, although sometimes wooden plugs or waste rags are placed in the exposed ends, but oftentimes these plugs or rags, or cement are forced into the tube to such an extent that when the pipe is sealed into position by the completion of the walls, the pipe is practically useless, until a great deal of labour has been employed to extract these obstructions.

There is no tool made at present that can be placed in the tool kit that will work effectually against all clogging in pipes. In many cases, conduits have had to be abandoned and others erected.

An American Device.

A device has, however, been patented in the United States, and will probably be placed on the market in the near future, that will blow down any foreign matter in conduit, such as wooden plugs, waste, cement, plaster, and even ice. On a test it blew through 200 ft. of conduit, and round the elbows, and carried before it all the obstructing material. The principle of the device is concussion, and the tool itself is simple in construction, easily handled and safe. Conduit is usually provided with screw threads on the exposed ends to which fittings are screwed. It is on these exposed threaded ends that the device is attached.

Details of the Device.

Fig. 1 shows a fitting which may be a casting finished in black enamel or galvanised, or it may have its exterior knurled. Fig. 2 shows a sectional view and details of the device. The interior of one end has screw threads (2) while the other end is reduced and provided with screw threads (3) and (4). Communicating with (2) is a small bore (5). Member (6) is similar to member (1) and is also provided with screw threads (7) into which member (1) is screwed. Member (6) is provided with a reduced portion (8), having a longitudinal passage through which the firing pin (10) passes. The firing pin consists of a knob (12) and a firing point (11). The knob or firing plate is screwed (13) to the pin itself. The pin operates freely

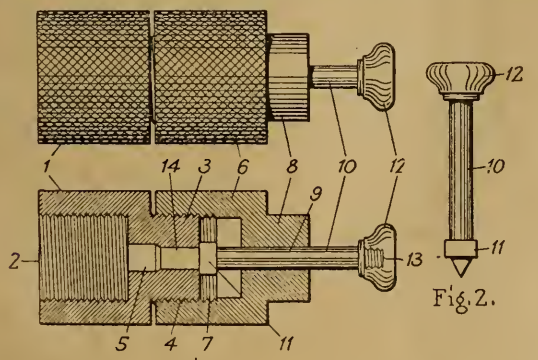


Fig. 1.—Diagram of Pipe Clearing Device attached to Pipe.
Fig. 2.—Sectional View and Details.

in the passage (9), so that there is no effective pressure until it is required. There is also a spring used on the firing in, so that it rebounds after discharging cartridge, but this is not shown in the sketch.

The Operation.

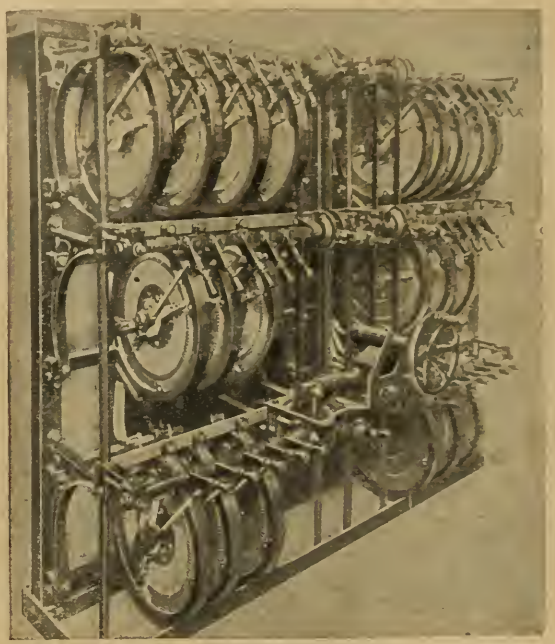
The device is operated as follows: Member (1) is screwed to the pipe, and this member can be made any size to suit the diameter of the pipe, and can be used on two sizes of pipes by means of reducers, and also on elbows or any fitting attached to the pipe. A blank cartridge (14) of 0·32 calibre is then placed in the passage (5) with its flanged end resting on the face of the passage. Member (6) is then firmly screwed to this, and a blow of a hammer on the knob will explode the cartridge. The explosion in the pipe will cause sufficient pressure to blow out all foreign matter. If a single cartridge does not accomplish the work effectually, a second or even a third cartridge may be used, but as a rule it will be found that one will do the work.

A committee of Liverpool citizens has been formed to make preparations for the 1923 meeting of the British Association which will be held in that city. The council of the Association has decided to nominate Sir Ernest Rutherford as president for 1923.

"Igranic" Theatre Dimmers.

Igranic theatre dimmers have been used ever since electricity was first employed for stage lighting. Stage electricians will remember the large and heavy "Igranic" dimmers first used for electrically illuminated stage effects. Subsequent developments, however, resulted in the production of a circular plate dimmer, known as the "Igranic" Simplicity dimmer. With this type of dimmer it was possible to secure much better and more convenient control, and the present day "Igranic" dimmers are of the same type, with various improvements. One installation of the old type, however, has not only been continuously in service since 1900, but on one occasion was submerged entirely by a flood.

The latest design of dimmer plate has a great many more contact segments, so that the resistance of the plate can be cut in or out of



A Recent Theatre Installation.

the lamp circuit in smaller quantities, thus allowing much smoother and more gradual variations and graduations in the lamp brilliancy. Instead of having resistance on one side of the plate only, as in the earlier type, the new plates can be provided, where necessary, with a resistance on each side of the base. This really makes one plate equal to two of the earlier type. Each side can be used as a dimmer for a separate group of carbon filament or tungsten lamps. Or one of these plates may be used as a complete two-wire or a complete three-wire dimmer.

The contact buttons are of punched copper and ground smooth, so that there is very little friction between them and the contact lever. Operation is consequently very easy. The terminals are of brass, mounted on the circumference of the plate, and are easily accessible. The wires connecting the terminals to the resistance are arranged in grooves in the soapstone base under the malleable iron frame. The contact lever is bolted to an insulating disc, which in turn is mounted on the shaft carrying the operating pinions. All current carrying parts are therefore perfectly insulated from operating levers, shafts, rack rods, pinions, iron base frame, and the frame work in which the plates are assembled.

The terminals for making the connections are accessibly located, and the well-known rack and pinion drive, first employed on "Igranic" dimmers, is used for moving the brushes over the contact segments. The length of the operating levers makes it possible to obtain very gradual movement, eliminating jerky motions and consequent poor dimming effects.

Osram Axial Type Lamps.

The Osram axial type lamp is specially designed for use where a concentrated downward light is required. The filament is mounted at right angles to the axis, and the light is therefore thrown downward instead of horizontally.

This downward illumination is increased by the use of an opal reflector, which fits closely to the upper half of the bulb, and is held in position by a brass ring. With the opal reflector, a 30 W Osram axial type lamp gives a maximum of nearly 50 c.p. at angles up to 30 deg. from the vertical. Lamps of 30 and 60 W are obtainable in all standard voltage ranges between 100 and 250 V.

The General Electric Company have just issued an illustrated leaflet, No. O.S. 2544, in which these lamps are fully described and priced.

All-Electric Houses at Glasgow.

Mr. R. Hardie, of the Glasgow Electricity Department, sends us some details of the "all-electric" houses at Riddrie which were open for public inspection between Feb. 15 and March 8. During that period the houses were visited by 28 000 people, the average daily attendance being 1 470. The lowest attendance on any one day was 366, when a heavy snowstorm took place, and the highest 2 316.

Riddrie is situated in the north-east of Glasgow about 3 miles from the centre of the city, and the only public advertisement of the exhibition was an announcement which was placed on all the tramcars.

General Details.

Fig. 1 affords some idea of the interest created in these houses, and, in fact, it was found physically impossible to deal satisfactorily with the large numbers on a few of the busiest days, especially as something more was desired than merely allowing the people to pass through the houses. Endeavours were made to give sufficient time for the visitors to become interested not only in the general get-up of the houses, but in their special features, such as the absence of fireplaces in the bedrooms, the advantages of electric fires, &c. The kitchenette or scullery, containing the electric cooker, clothes and dish washing machine, electric hot water circulator, ironing table and electric iron, was perhaps the most attractive apartment in the house, the dish washer somewhat naturally making a special appeal to the ladies. This kitchen is illustrated in Fig. 2.

Installation Features.

It may be mentioned that the two houses on view were semi-detached, each containing five apartments and including on the ground floor a living room, parlour, commodious scullery, larder, pram house, and on the upper floor three bedrooms and a bathroom. The houses were not especially designed as "all-electric" houses, but were similar to those now being erected at Riddrie with the exception that the fireplaces and the necessary flues and chimney-heads were omitted from the parlours and bedrooms, but were retained in the living rooms. One of the houses had a complete installation for lighting, cooking, heating, hot water supply and washing by electricity. The other house was similar, with the exception that a coal fire was provided in the living room with a copper boiler behind it which was connected to a copper hot water tank in the scullery for providing a hot water supply. In the case of the "all electric house," the hot water supply was given from a calorifier set, comprising a 20-gallon copper storage tank and a 3 kW circulator..

In the second house, an open fire was fitted to heat the living room and provide hot water. Smokeless fuel was used in this open fire, and unlike some smokeless fuels of former days, this was literally smokeless, and confirmed the claim that if all houses were equipped

Fig. 1.—Queues Waiting Admission to House.

after the fashion of either of the Riddrie houses Glasgow would be a cleaner and healthier place in which to live, and the perpetual smoke pall which overhangs Glasgow, like most large cities, would be a thing of the past.

The Omission of Fireplaces.

The omission of fireplaces was one of the features that received favourable comment from the visitors. Convention dies hard, but it was demonstrated, Mr. Hardie thinks, beyond argument that the provision of fireplaces with grates, flues and chimney-heads is an unnecessary expenditure, quite uncalled for in a modern dwelling. The argument that the coal or gas-fire flues are indispensable for ventilation or changing the air of the room received its quietus. The rooms were ventilated satisfactorily by means of small openings in upper part of walls.

The lighting fixtures throughout were of the latest type, and in addition a choice selection of floor and table standard lamps were on view.

Justified by Results.

Proof of the wide interest created is evidenced by the large numbers who travelled from all parts of the city, often in inclement weather, and departed obviously delighted with their visit.

As to permanent results, the department is justified in considering the Electric House Exhibit one of the best propaganda efforts made by them, and certainly the cheapest. The department set

Fig. 2.—Scullery showing Washing Machine, Wash Boiler, Cooker, &c.

out to prove the claim previously made by them, that a modern electric house, although worth infinitely more, costs no more to build than the average house with its coal fires and other relics of former days. They are satisfied that the majority of the visitors left with the conviction that an electric house is the ideal, their only obstacle being the difficulty of securing one, Many of the visitors regretted the fact that they did not at present enjoy electric service, but the department are content in the knowledge that they have in many cases induced dissatisfaction with their present environment, a very necessary first step to reform.

Women nowadays are desirous of reducing housework to a minimum, and to this end electricity has no rival. The electric house idea will in all probability extend. When one reads of the experience of American towns where in one year eighty electric homes in as many cities were built, equipped electrically and opened for public inspection and visited by close on 1,000,000 visitors, Mr. Hardie points out that many within the electrical industry do not even now appreciate the magnitude of this achievement.

Houses v. Showrooms.

As a result of close personal observation of the Glasgow experiment, Mr. Hardie is of opinion that such an exhibit is bound to be productive of a growing desire for electric service in many homes. No matter how well laid-out the showroom may be, no matter how seductively the various pieces of electrical apparatus may be displayed therein, nothing can compare for direct appeal with the electric home exhibit, in which all the appliances are shown in actual working operation, each in its proper place.

As is fitting, both houses are now being rented by members of the Glasgow Corporation Electricity Department Staff, and careful comparative records will be taken to ascertain actual running costs of all apparatus. The houses will also be open at any time for interested visitors.

L. G. Hawkins & Company have issued a descriptive leaflet of their new Vio Ray high-frequency outfits. This describes the "Baby" model, which is supplied complete with one surface electrode, and is specially manufactured for use in the home. Various other applicators are available for such complaints as pyorrhœa, catarrh, throat troubles, nervous disorders, &c.

Correspondence.

"A BRIGHTER INSTITUTION."

To the Editor of THE ELECTRICIAN.

SIR,—I wish, as a result of my recent experience, to endorse in general the remarks you make. I suggested, when I knew that three subjects were to be taken in one evening, that my Paper be taken as read, but was told by the secretary that was not allowed, and I was forced to attempt in ten minutes a hurried and breathless survey.

I would like to correct the report of my reply. I think I said, and I intended to say, that starting conditions were infinite (not indefinite as reported), and to attempt to set up standard rules to meet infinite conditions was ridiculous. That is why any rules drawn up by the B.E.S.A. will be ignored in practice unless they confine themselves to a statement regarding temperature rises for various classes of material and a statement regarding the information to be given the starter maker.—I am, etc., J. ANDERSON.

Birmingham, March 25.

THE INSTITUTION BUILDING.

To the Editor of THE ELECTRICIAN.

SIR,—Immediately following the Faraday Celebrations you inserted my letter calling attention to the bad illumination of the lecture hall.

Since then the member of Council who, together with our immediate past-President, was responsible for the alterations announced at an ordinary meeting of members, has informed me that at the Faraday Celebrations the top lights were not turned on, and showed me the details of the altered illumination which was used at last Thursday's meeting.

It is good to know the council were not satisfied with the illumination when we returned "home," but it is to be regretted that the altered lighting cannot be called a real improvement or form an object lesson in good practice. The cove lighting, above the Council table, has been abolished and the illumination of the side coves tapered from zero to maximum in the 10 or 15 ft. adjoining it. The back cove is fully illuminated. To compensate for the resultant lack of light around the President, four high candle-power half-watt (inert gasfilled) lamps have been fixed above the glass ceiling so that the President is fully aware of "the fierce light that beats upon a throne," for he suffers from glare both from the opposite cove and especially from the direct rays of the ceiling-hid lamps. The improvement is a shuffle and not radical.

The illumination in other parts of our home is apparently having attention, for newly erected milk glass hemispheres of an obsolete and inefficient type are being tried in one room apparently regardless of the fact that this form of semi-indirect illumination is already dying out.

As destructive criticism should always be supported by constructive suggestions, I am sending to the council a scheme that will be an improvement on what we have at present in our lecture hall, and the object of this letter is to get others who have the interests of correct illumination at heart to do the same so that the whole question can be reconsidered and a model up-to-date illumination be obtained.—I am, &c., JUSTUS ECK.

Chiswick, March 25.

RENTAL WIRING AT EASTBOURNE.

To the Editor of THE ELECTRICIAN.

Sir,—The editorial notes on the rental wiring at Eastbourne appearing in your issue of March 10th have interested me considerably, but I note that the figures which you quote as the cost for wiring these houses are based on some preliminary estimates and not on the actual figure for which the wiring contracts have been let. The cost of £9 per house for wiring a group of six-light houses with the simplest possible fittings is clearly on the high side, even allowing for the contractors' profit and an overhead charge by the Corporation. The actual price, however, at which the successful contractors, Messrs. A. C. Burton & Sons, have quoted for the work was 18s. per point, including a pendent, opal shade and lamp and ironclad D.P. combined switch and fuses for each house into which the Corporation will lead direct.

This extremely low price is partly accounted for by the fact that the Ediswan wiring system will be employed.—I am, &c.,

F. CHARLES RAPHAEL,
Manager, Cable and Wire Department,
Edison Swan Electric Co., Ltd.

Ponders End, March 22.

MECHANICAL AND ELECTRICAL EFFECTS OF LARGE CURRENTS ON H.-T. SWITCHGEAR.

To the Editor of THE ELECTRICIAN.

SIR,—While we have no desire to carry on a lengthy discussion in your columns, there are one or two points on which we feel comment on Dr. Garrard's letter of the 20th inst. is desirable.

We cannot agree that the wooden operating rod is a type now abandoned in face of the fact that it is used in the apparatus built by both the Westinghouse Electric & Manufacturing Company and the General Electric Company in America, certain Continental Companies, and to some extent by ourselves. The prejudice which exists in some quarters is entirely due to experience with wood rods which have been improperly treated. It seems hardly fair to imply that the practice is obsolete in face of the above examples to the contrary.

In regard to the type of contacts this is entirely a matter of opinion, since each type has its advantages and disadvantages. The space question is so often the determining factor that the brush type of switch appears to be increasingly popular, especially for the heavier currents. It is certainly not possible entirely to eliminate either the brush or the controller fingers when considering the wide range of designs now demanded.

In conclusion, we would like to state that contacts similar to Dr. Garrard's Fig. 3*b* have been known to freeze together. This is due to the arc between the moving wedge and the tips of the two contacts which are drawn together by reason of the current passing through the two parallel flexible paths.—We are, &c.,

METROPOLITAN-VICKERS ELECTRICAL COMPANY, LTD.

Trafford Park, March 27.

Institution Business.

The business at the special general meetings of the INSTITUTION OF ELECTRICAL ENGINEERS on Thursday, March 23, was performed fairly quickly before a meagre audience.

Financial Matters.

The first of these special general meetings was called to pass a resolution authorising a formal transfer of the debt of the old Institution to the new chartered body. This was passed without either remark or dissention.

The By-Laws.

The second general meeting, which immediately followed, was called to consider and, if thought fit, to pass draft by-laws. It was opened by the PRESIDENT formally moving the adoption of the by-laws as submitted. In doing so, Mr. Highfield referred to the excellent work of Mr. Atkinson and Sir James Devonshire in securing the Royal charter and exhibited copies of the Institution's new seal.

The Proposed Changes.

Mr. LLEWELYN B. ATKINSON, in seconding the adoption of the draft by-laws, gave a detailed account of the proposed changes and their probable effects. In dealing with by-law 9, which sets out the initials that may be used by the different classes of members, he remarked that it had been hoped to bring in the words "chartered electrical engineer," but the Privy Council were averse to this, and it appeared that the historic case of the term "chartered accountant" being permitted was a mistake, as it was the members as an institution which received the charter and not the members individually. With regard to by-law 41, which deals with the expulsion of members, Mr. Atkinson pointed out the great difficulties of the whole question. If the general body of members were the deciding authority in matters of this kind, as had been the case, it was obvious in equity that a detailed statement would have to be issued to each member, a course which presented obvious difficulties. While as the most crowded meeting could only represent a small proportion of the membership it might be easy more or less to pack the gathering on the behalf of the member concerned. If the Council used proxies to carry their resolution, as they were perfectly entitled to do, they might be accused of prejudicing the defendant's case. The Council, in such matters, were really a court and not the prosecutors, and under the new by-law there would still be an appeal from them to a special body of three past-presidents. In detailing the new policy for the nomination and election of the Council, he mentioned that the nomination of associate members need not be done by associate members alone, but by members and associate members together, so long as the nomination paper was not signed by more than ten people.

The Expulsion Dilemma.

Dr. S. P. SMITH commented adversely on the proposed alterations in the by-laws with regard to expulsion. He was afraid that by the procedure suggested the Council might place itself in an invidious position. For, subsequent to their decision, the offending member might obtain sufficient support to call a special protest meeting or a feeling might arise that injustice had been done so that ultimately a vote of no confidence in the Council might be passed. Even if an offending member could obtain sufficient support at a general meeting to keep him in the Institution he (Dr. Smith) thought that would be the less of the two evils.

Mr. C. LE MAISTRE, however, supported the Council's proposal on the grounds that in such cases there were often reasons for expulsion which it would be impossible to give at a general meeting. This line was also taken by Mr. P. M. BAKER, who said that the

procedure followed by various medical associations was very similar to that now suggested by the Council.

Election Difficulties.

Mr. F. C. Raphael also endorsed the remarks of Mr. Le Maistre and Mr. Baker. He, however, objected to the retrograde step which the Council proposed to take on the election question. During Dr. Ferranti's presidency it had been proposed that members should send in nominations from which the Council could fill the vacancies. There was an outcry against this because as a result the existing rule had been adopted. The Council could not be expected to place its finger on every likely candidate, and he was afraid that unless there was a distinct statement that outside nominations would not only be tolerated but welcomed, the Council's nominations would be regarded more or less as having the force of election and no one would care to put up any opposition.

The Official View.

The President, in replying to the criticisms, said that the question of expulsion was a most delicate one, but it was better for the person expelled that there should be no publicity.

Mr. Atkinson said that the nomination of suitable members for the Council by those outside the Council was certainly welcomed. It was one of the ways in which the new and unsuspected merit might be found, particularly from the territorial centres.

The resolution was then put and carried unanimously.

Electricity Supply to a Garden City.

A little disturbance was caused in these columns some time ago by criticisms of the supineness of the Welwyn Garden City and the North Metropolitan Electric Power Supply Company in providing a supply of electricity for the inhabitants of Welwyn. This difficulty has for some time now been overcome by the supply of energy from the North Metropolitan station at Hertford to a special and very handsome sub-station on the land of the Welwyn Garden City through a 20 000 V cable. The cabling, which was carried out by the British Insulated & Helsby Cables, Ltd., consisted of the laying and jointing 6½ miles of 0·05 sq. in. three-core

Fig. 1.—A Typical Joint.

single-wire armoured 20 000 V cable and the same length of combined screened pilot and telephone cable, both laid in the same trench. The feeder so formed is protected by means of the Merz-Beard protective system. The cable, besides supplying the Garden City, forms part of an inter-connector between Hertford and the North Metropolitan Company's generating station at St. Albans. Both cables were laid direct in the ground with a protective covering of creosoted boards. The normal depth of trench gave 24 in. of cover throughout. One mile of the route lies alongside the Great Northern Railway Company's branch line to Hertford, and includes three river crossings, for which special girders had to be provided. The remainder of the route follows the Hertford-Welwyn road and hence across arable land to the sub-station.

The whole work took nine weeks exactly to carry out, the average number of men in all gangs employed amounting to sixty and the maximum to seventy-nine.

Vernier copper braid and Vernier patent baffle plates were

Fig. 2.—Laying the Hertford-Welwyn Cable.

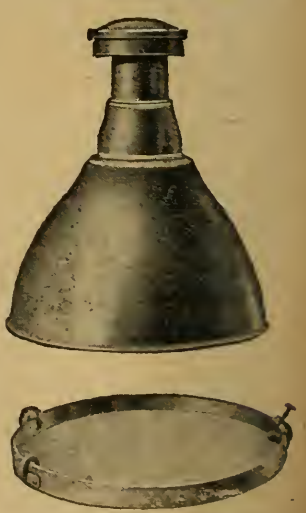
used for jointing, the joints being protected by creosoted boxes with sheet iron tops. The cable was tested for fifteen minutes by means of a Delon unidirectional testing set, with 80 000 V between the cores and 60 000 V between cores and earth.

B.T.-H. "Trutint" Colour-Matching Unit.

The "Trutint," Unit, recently produced by the British Thomson-Houston Company, consists of a Mazdalux reflector fitted with a special daylight glass screen, and equipped with a Mazda gasfilled lamp. This screen, by absorbing most of the red and yellow rays, produces an illumination which, to all intents and purposes, is identical with daylight from a north sky.

The success of the "Trutint" Unit depends of course upon the composition and colour of the glass screen. The development and production of this glass have involved a large amount of research and experiment spread over a long period. The actual apparatus is simple enough—so simple, indeed, that many people might think it possible to achieve the same results by filtering the light through an ordinary piece of blue-tinted glass. Although artificial light modified in this way might have the appearance of daylight, the colour test would immediately expose its inaccuracy.

The British Thomson-Houston Company have fitted up demonstration cabinets to prove this point. Each cabinet consists of several compartments, one compartment being lighted by a bare carbon lamp, another by a bare metal filament lamp, a third by a gasfilled lamp in a reflector fitted with ordinary blue glass, and a fourth by a Mazda gasfilled lamp in a "Trutint" unit. Ribbons of various colours are stretched along the floor of the cabinet, and one may see at a glance how the colours are affected by the different forms of lighting equipment. The variations are startling, and there is a very perceptible difference between the effects produced respectively by the "Trutint" unit and the ordinary blue glass.



B.T.-H. "Trutint" Unit for pendent use, showing special daylight glass screen detached from reflector.

"Trutint" units are made in two forms. One consists simply of the reflector and screen, which is contained in a metal ring secured by thumbscrews to the reflector. This form is for pendent use in industrial and commercial establishments, and it is supplied in three sizes, for 100W, 200W and 500W Mazda gasfilled lamps. The other unit is only made in one size—for a 100W lamp, and consists of the reflector and screen fitted to a standard equipped with a switch in the base, the entire unit being finished in antique copper. This standard type of "Trutint" is intended for use on counters, desks, &c., where it is desired to have local daylight illumination without interfering with the general lighting scheme.

One of the most interesting of the many "Trutint" installations that have been carried out was the temporary equipment of sixty large "Trutint" Units employed to light the Royal Gardens at the Ideal Home Exhibition, referred to in our issue of March 10

Showroom Displays and Demonstrations.

The fifth and last of the Salesmanship Conferences to be held this season by the E.D.A. took place recently, when Mr. A. C. Bostel, of Croydon, read a paper on "Salesmanship in Relation to Showroom Displays and Demonstrations." Mr. H. Marryat occupied the chair.

Mr. Bostel dealt with the subject from the central station engineer's point of view, and assumed a case where the authority had full powers to hire, sell and hire-purchase. Although he was firmly of the opinion that all supply undertakings, however restricted their powers might be, should have a showroom to demonstrate the uses to which electricity could be put. A large number of showrooms for the display of electrical apparatus, he said, were very poorly equipped, and even in some large stores he had found an amount of shoddy apparatus offered for sale and the assistants quite at a loss to give definite information of the cost of running them.

Window Display and Arrangement.

Dealing with window display and arrangement, Mr. Bostel said that the space inside the window of a showroom should be such as to allow one or two of each article which was of use to be shown, so arranged that everything could be seen from outside. Each article should have a card, stating what it was, its price, and the cost of running per hour or per operation. The display should be as varied as possible and not overcrowded nor mixed up with wiring accessories. He emphasised the importance of maintaining the lighting up till about eleven o'clock at night, so that the display should not be hidden from the public when the showroom was closed. A simple and inexpensive time-switch controlling a few lights in each window gave an attractive advertisement. The inside lighting of the window should be so arranged that different systems might be switched on. Outside lighting could also be demonstrated, but the outside lamps should only be switched on for demonstration purposes, as otherwise they would seriously contrast with the window display.

Showrooms should be divided up into sections, each section being devoted to a particular purpose. For example, one section to take cookery, toasters, grillers, kettles, &c.; another section showing heating apparatus, vacuum cleaners, and so on. The power section should have one or two direct-driven machines. Most manufacturers would be pleased to loan these machines, provided their representative could bring his prospective client in. It was important to have a comfortable chair for a client, because once he was in this the salesman's art was easy.

Avoidance of Too Many Makes of Apparatus.

It was a mistake to show many different makes of apparatus, and a salesman should carefully investigate the various makers' goods, thoroughly test them, and decide which was best.

Another section of the showroom should be devoted to lighting, and a darkened partitioned cupboard showing the effect of various reflectors fitted, as well as different types of fittings. Each section should be wired on a different system, giving some idea of the effect of each, and each section should have a wattmeter, calibrated in pence per hour, fixed so that the consumption of any apparatus could be given. Then, if space permitted, a hall containing 200 or 300 people should be set aside for talks and demonstrations.

Coming to the selection and management of a showroom staff, the greatest care should be exercised in this connection. He had found that girls possessing the necessary personality, appearance and address made ideal assistants.. For selling domestic appliances in a showroom they were far more efficient than men, were more eager to please, and showed unlimited patience.

The Showroom Staff.

Mr. Bostel then went into the question of keeping records. All sales and monies received should be kept distinct from the accounts for energy sold, so that an accurate record of the results of a department might be maintained. All goods bought should go into stock in the stores and be given a serial number, and each class of apparatus should have a distinguishing letter. He favoured the American system of carton packing for small accessories. Particulars of each sale should be recorded, with the name and address of the purchaser, for the benefit of the outside staff, so that, when working a road, they could see what each householder had. At Croydon he used cards arranged in roads, numerically, giving the name of each householder, the installation existing, apparatus used, &c., so that the outside staff practically knew what apparatus each householder had.

Careful Investigation of Complaints.

Dealing with the investigation of complaints, the author pointed out how necessary it was to deal carefully with each one. To satisfy a consumer was just as important as obtaining new business. They should not be afraid of showing how economies might be effected, because although revenue might be lost on that particular consumer, it came back two or three-fold in other directions.

DISCUSSION.

Mr Seaman spoke from the point of view of the ordinary contractor. It was often beyond the contractor to have a showroom of the size dealt with by the lecturer, and he suggested the stimulation of public interest by holding popular lectures on electricity and its uses, especially if accompanied by lantern slides or kinematograph displays. Something might be done by manufacturers, contractors and supply authorities, through the E.D.A., in the direction of running such public lectures during the winter in large public halls. Apparatus could be loaned, and demonstrations given. He also suggested that contractors in various districts should combine together and run a sort of permanent exhibition, supported by the supply companies in the districts. He was very much against manufacturers opening showrooms themselves, and also urged that supply authorities should supply current to contractors at a nominal rate, because the authorities would reap any reward from the sale of apparatus for which current had to be used.

Contractors' Difficulties.

Mr. Young complained of the difficulties contractors had to face through manufacturers giving discounts to the public; such a policy on the part of manufacturers was short-sighted. If the industry were to develop as it should, then the retailer must be encouraged.

Mr. Mann agreed that saleswomen should be encouraged; they were a help in dealing with their own sex. He also disagreed with wholesalers having showrooms, because if they sold to the public direct they were earning two profits.

Showrooms for Education.

Mr. W. A. Gillott pointed out how many contractors were albe thoroughly to demonstrate all classes of cooking and heating apparatus in their showrooms. In his opinion there were very few. His firm (Jackson Electric Stove Co.) had a showroom, and it was mainly used for educational purposes. If anyone came into it he was asked for the name of his contractor, and if the client paid cash for whatever he had purchased the contractor was informed that a discount had been placed to his credit. No purchasers, except those connected with the trade, were allowed discount. He was not sure that he was in favour of exhibiting the price of each article, because, in the case of a washing machine, if a client saw it priced at £50 or £60 he would not consider it. It was better to tell a customer how much a machine would cost to run. With regard to saleswomen, from the domestic point of view they were the best sellers, and there was a peculiar understanding between women in this connection.

Mr. F. W. Leevers referred to the difficulty that some contractors would not carry stocks. As to saleswomen, he would like to know whether Mr. Bostel had tried older women, because if a woman were too young she did not carry sufficient weight with a householder.

Mr. Hughman pleaded for more co-operation, especially among contractors in their own districts. He believed the day of the small man was rapidly passing.

Window Display Questions.

Mr. Bush advocated the changing of window displays frequently, and also the dealing with one kind of article at a time. It was also advisable to make a display look seasonable by concentrating on radiators, &c., in the winter, and fans in the summer. With regard to manufacturers loaning goods to contr ctors, he did not see why they should. There seemed to be an idea in the industry that manufacturers should set contractors up by lending them goods, but if that were done all over the country it would mean sinking a lot of money. Again, he maintained that if a contractor bought a thing he would exert himself more to sell it, whereas if it were merely loaned to him he would not be so keen. Contractors did not carry enough stock, and he was quite sure that in his own district the contractors had not an iron in stock between them.

Organisation of Public Lectures.

The Chairman, dealing with the organisation of public lectures, &c., to further public interest in electricity, said that the E.D.A. was considering this matter at the present time, and hoped to do more. It chiefly remained for contractors, manufacturers and supply authorities to provide the wherewithal. He also referred to the activities of the Electrical Contractors' Association with regard to the opening of showrooms. As to the recording of the names of householders and the apparatus used by them, he mentioned that in Cincinnatti an electrical firm had mapped out every house in the city, so that any man who entered the showroom could be told within a very few minutes exactly what it would cost to wire his house.

The Author's Reply.

Mr. Bostel, replying to the discussion, said it had not been his experience that inspectors, &c., were more enlightened than the salesmen and could deal with consumers better. At Croydon they had inaugurated a scheme whereby these men were given commission on any new business they might introduce, but the business obtained was very small and the information given by the men was bad. He would like to see something done to prevent manufacturers supplying goods at trade price to those not connected with the trade. He asked contractors to get it out of their heads that supply authorities wished to sell apparatus. They were really not a bit interested, but merely wanted to see people buying electricity.

Electrical Freemasonry.

Mr. J. W. Beauchamp, responding to a vote of thanks, said there was one feature in everything the E.D.A. undertook, and that was that all associations in the industry were represented. He wanted the Association to be used as a machine for goodwill in the electrical industry; it was out for what he described as a sort of electrical freemasonry.

Licences of Right have been granted to N. E. Dufty, for Patent No. 122 290 (2 549/18), for "centrifugal type of mercury cut-out for dynamo electrical machines"; and to Constructions Electriques de Belgique, Soc. Anon., for Patent No. 148 569 (20 573/20), for "an improved process for regenerating energy in d.c. electric motors."

Troughton & Young's New Showrooms.

The interest shown by the public in the exhibition of domestic electrical apparatus at Troughton and Young's new showrooms in Knightsbridge, indicates the value of such an exhibition, and we are very glad to hear that the initiative of this firm of contractors has met with success. It required a little courage and a great deal of thought to launch out on expensive premises in the West End just now when rents are very high, rates nearly as high, and profits on electrical apparatus are smaller than those on goods usually shown in the West End. But we understand that as a direct result of this exhibition, many inquiries have been received, and apparatus has been sold to chance customers in various parts of the country, and in Wales and Scotland as well as London. The firm state that their experience is that most manufacturers give fair and reasonable discount to the retailer, and that the few who do not will either have to change their ways or lose business.

Popularising Electricity in Home.

The object of the new showrooms was, of course, to popularise the use of electrical appliances in the home, and the firm took a very great deal of trouble in selecting those which they considered the best all-round articles and the most likely to suit their prospective customers. This was no easy task. Many points had to be considered, including bulk, weight, consumption, amount of labour required to keep clean, and, above all, the price.

The accompanying illustration shows some of their choice, though the Jackson stoves and A B C and Elko washers cannot be seen. The Hoover vacuum cleaner is visible in the forefront. The number of "Universal" appliances on view was a splendid testimony to their popularity. Among the other exhibits were Berry's "Magicoal" fire, Henley's wiring system, Armstrong-Whitworth lighting sets, Crompton switchboards, Tudor accumulators; and a glance at the photograph will give some idea of the variety of fittings exhibited. The hot water radiators for heating the premises are prominently shown, but the firm point out that the heating was included in the rent and they cannot spend an additional £50 a year on electricity.

Corner of Troughton & Young's Showrooms at Knightsbridge.

"Maconite." A New Insulating Material.

One of the features of the current year has been the commencement of the production, on a commercial scale for general purposes, of cable insulated with a dielectric known as "Maconite." "Maconite" dielectric, we are informed, possesses some remarkable properties which have not previously been found in combination in any one substance, and cables insulated with it have been used for some years by one of the principal railway companies in this country in long tunnels, where corrosive fumes and fluids are always present.

"Maconite" is a compound of specially selected materials scientifically blended, and is the outcome of many years' experiment and research on the part of the Macintosh Cable Company, Ltd., and their parent firm, Chas. Macintosh & Company, Ltd., Manchester. In appearance and texture the material resembles a black rubber. In toughness, according to grade, it varies from something rather stronger than ordinary vulcanised insulating rubber up to a point not far short of that possessed by the tough rubber known as C.T.S. It must not, however, be confused with these productions, in which mechanical strength is the predominant factor. Whilst the strength of "Maconite" may approach that of the rubbers referred to, its elasticity and durability is, it is claimed, much greater.

Mechanical Strength and High Insulation.

For many years attempts have been made to modify rubber compounds so as to get increased mechanical strength and elasticity without sacrifice of insulating properties. Likewise, many attempts have been made, both by the design of special coverings and modification of the structure of the rubber insulator, to obtain immunity from the attacks of acids and alkalies. From a study of the recorded causes of cable deterioration, it will be realised that the first requisite is that the cable covering, insulating or external, shall be absolutely non-hygroscopic. It is, of course, preferable that the insulating material itself should have these properties in addition to a high degree of dielectric resistance.

The difficulty of the problem is discussed at length in Mr. C. J. Beaver's classic Paper on "Cables," read before the Institution of Electrical Engineers in December, 1914.* In this paper the author states that with the vulcanised rubbers, in the present state of the art, maximum strength and elasticity are not compatible with maximum insulation resistance or dielectric strength. He states that this is especially true as regards the former, and gives quantitative illustrations, besides drawing attention to the way in which hardened vulcanised rubber is affected by immersion in water. It is well known that even the softer insulating qualities of vulcanised rubbers are hygroscopic to some degree.

Properties of "Maconite."

Now, whilst the measurable insulation of "Maconite" is lower than that of some vulcanised rubbers, this insulation resistance is constant, and is unaffected by prolonged immersion in water or in a saturated solution of caustic soda. Furthermore, its dielectric strength, *i.e.*, resistance to breakdown pressure, is high under ordinary, and many extraordinary, conditions of use, and it is becoming recognised that it is by dielectric strength and resistance to physical change over a long life that insulating materials must be judged. Its resistance to the action of a wide range of chemical reagents must appear to be remarkable to anyone familiar with ordinary rubbers.

Some details of the tests to which "Maconite" has been satisfactorily subjected will perhaps better indicate the degree of success which has been obtained. It must be understood that, except where specifically mentioned, no tests of less duration than some thousands of hours have been considered.

Extremes of Temperature.

To test its resistance to extremes of temperature "Maconite" cable was frozen in a block of ice for several days, and tested at 1 000 V a.c. for thirty minutes. It was then thawed out in running water and again tested at 1 000 V a.c. Subsequently it was boiled in water and for three hours in a weak solution of caustic soda, and exposed for several months in temperatures of 100° F. above boilers and brass furnaces. In all these cases, not only did the cable withstand the tests, but its flexibility was found to be absolutely unimpaired.

Exposure to Chemical Action.

"Maconite" was also immersed in dilute uric acid, in copper pickling acid, in a 50 per cent. solution of sulphuric acid, in a 5 per cent. solution of nitric acid, in a 50 per cent. solution of hydrochloric acid, in slaked slag water, in two samples of corrosive pit waters, in a saturated solution of caustic soda, a saturated solution of common soda, a 10 per cent. solution of ammonia, a saturated solution of common salt, and in sea water. In all these cases the cables were carrying direct current at 250 V, two cables being on test in each solution, and being connected to the positive and negative poles of the system respectively. This was done in order to be certain that the material would withstand osmotic action.

These tests, and others too numerous to mention here, serve to indicate that a most useful material has been produced.

Uses of "Maconite."

To those responsible for the installation of cables in such places as chemical works, steel works, dye works, long railway tunnels, &c., where corrosive fumes or liquids are always present, it is felt by the makers that "Maconite" will be of the greatest interest.

It is obvious that a substance such as this, in addition to forming a valuable dielectric covering for small cables to take the place of V.I.R. in bad or difficult situations, possesses great possibilities as a sheath for other classes of cables in the place of lead alloys or bitumen. It is already being used as a sheath for a surface wiring system which requires no bonding or earthing, in addition to other advantages.

Experiments are also being conducted with a view to using "Maconite" sheath on paper-insulated cables.

* See The Electrician, Vol. LXXIV., p. 186.

Flood Lighting and Holophane Reflectors.

A good deal of interest has recently been centred on the attempts that are being made with flood lighting in this country. Whilst some of the results have been fairly creditable there is much still to be done before complete success is achieved from both the architectural and artistic points of view, and especially from the point of view of uniformity.

A serious drawback to some forms of flood lighting projectors is the difficulty of varying the light distribution curve over sufficiently wide limits to ensure uniform lighting over the area to be treated. Often, if the focus is altered to improve this factor, the efficiency of the equipment suffers in consequence. In many cases, also, the flood lighting projectors have to be placed fairly close up to the building to be illuminated, with the result that the units do not possess sufficient covering power to ensure uniformity of illumination.

An installation which is worthy of notice, because these disadvantages have been overcome, is the lighting of Alders' premises at Croydon, a photograph of which we reproduce. The scheme was carried out by J. and T. Robinson, electrical contractors, of Croydon, in collaboration with the Holophane Company. The way in which the architectural features of the building are emphasised is obvious, as are the uniform results obtained over the entire surface of the stonework.

The equipment comprises six units mounted in a trough and placed on each side of the building. These units are equipped with 200 W gasfilled lamps, and Holophane reflectors mounted horizontally, the

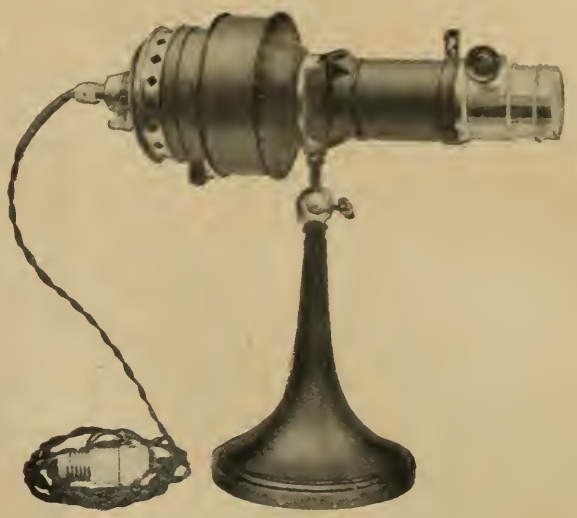
Flood Lighting applied to Shop Premises.

angles and setting being carefully calculated and adhered to, so that there is no perceptible diversity in the intensity. By changing the character of the distribution curve it is possible to reproduce similar results from greater or lesser distances (which is generally governed by circumstances), thus meeting all requirements in this direction. A further fact worthy of mention is the few points necessary to achieve such results, and the energy consumption, *i.e.*, 2·4 units per hour, represents a very economical figure for this class of spectacular lighting.

The "Practical Engineer" Electrical Pocket Book and Diary, 1922, published by the Technical Publishing Company, contains a revised section on electric traction. This matter is of such importance at the present time that it is as well that close attention should be given to it, even in pocket books, and we are glad to see that further additions are to be made next year. This is necessary, as traction to the authors of the pocket book apparently connotes tramways alone, and little space is given to the more important subject of railways and the allied problems of the electric vehicle.

The "Atrax" Projector.

The Atrax Projector is a new advertising device recently put on the market by the General Electric Company, by which a brilliantly-coloured illuminated image can be projected in any direction without the use of a screen, the image being derived from an inserted slide on the principle of the magic lantern. Hitherto the



The "Atrax" Projector.

problem of creating a sufficiently powerful light behind the lens by simple means has baffled all attempts at solution, but this difficulty has now been overcome by the introduction of a new type of Osram gasfilled electric lamp, which is rated at 100 W. The apparatus can be connected up to any convenient lamp-holder or wall-plug, and calls for no skilled attention or special technical knowledge. It is equally effective on alternating or direct current circuits, and a universal adjustment is provided so that the direction of the beam can be varied at will.

The image thrown by the Atrax Projector is so brilliant that it is visible in diffused daylight. At night, even when surrounded by other artificial lighting, it commands instant attention. The diameter of the image can be varied between 5 in. and 4 ft. approximately, but the best results are obtained by adjusting the projector to give a picture of moderate size, when the concentration of light gives great brilliance and clear definition. The possibilities of such a handy and simple device as an aid to publicity are innumerable.

Attractive Table Standard Lamps.

A standard lamp is usually a predominant feature of a room in which it is placed, and the decorative possibilities of such lamps have only recently begun to be realised. In the circumstances, the range of genuinely beautiful table standards recently placed upon the market by the British Thomson-Houston Company represents an important and welcome development.

The four standards comprised in this new range are made of metal, beautifully chased and finished in antique bronze. One of them is a reading desk lamp, and is fitted with a metal shade, key-switch lampholder, flexible cord, and a combined plug and lampholder adapter. The other three are more ornamental in design, and are equipped with shades formed of amber-glass panels fitted into a metal framework. Three pull-chain switch-holders are fitted in the largest standard, which is 22¾ in. high, and has a shade diameter of 19 in. The middle-sized standard has two pull-chain holders, and the smallest a single pull-chain holder. All three patterns (they differ in design as well as in size) are provided with bronze-coloured flexible cord to match the metal work, and a combined plug and lampholder adapter. There is a dignified charm in the contour and embellishment of the metal work, while the illumination, reflected, transmitted and subdued by the amber-glass shade, is rich and restful in its effect. For the many householders who are looking for something better and more distinctive than the usual type of domestic lighting equipment, this new line of table standards should provide a welcome relief from the polished brass-cum-silk shade convention.

We have received a useful booklet on "Electrical Installation Rules and Tables," by Mr. W. S. Ibbetson, which has been published by E. and F. N. Spon, Ltd. These tables are intended to provide a ready and convenient means of reference for architects, contractors, engineers and wiremen in the preparation of specifications and the carrying out of electrical installation of all kinds. The scope of the book is necessarily limited, and, while it does contain information which is usually found in electrical pocket books, it also contains details, such as the sizes and capacity of wood casing, which are not often found elsewhere. It is a matter for consideration on a future occasion whether it would not be as well to enlarge the format, as, though convenient in its present size, it necessarily means the use of very small type.

The "Anti-Break" Lamp Economisers.

Various spring devices have been put on the market to counteract the effect of vibration on metallic filament lamps; but, instead of lengthening the life of the lamp, they often accentuate trouble, which is not surprising when the hair-like nature of the filament, which is at white heat, is compared with the dimensions of the springs used to support the lamp-holder.

The "Anti-Break" lamp economiser, produced by the Engineering and Lighting Equipment Company, is claimed to have overcome all the difficulties in this connection. It does not depend upon springs, but consists of a number of strips of phosphor-bronze gauze, cut on the bias with the warp and weft strands disposed obliquely so that the diagonal of the mesh runs in the direction of the length of the strip. A suspension is thus provided which is inert to the transmission of vibration, as there are no wires running direct from the outer fitting to the suspended lamp through which vibration can pass; in other words, the interrupted mesh of the gauze strips destroys or damps out the waves of vibration before they reach the fragile filament. At the same time, the lamp is held rigidly in place, and even under the most severe shock the natural resilience of the disc damps the swing or rebound owing to the interwoven mesh, and so prevents the filament being destroyed.

The device possesses the further advantage that it is not affected by the heat of the lamp or atmospheric conditions. It has been tested under the most severe conditions, viz., under vibration from running machinery in engine rooms, over propellers on board ship, and under vibration set up by a pneumatic hammer on a steel plate, to which the fittings have been attached, and in no instances have the metal filament lamps been broken, although metal and carbon lamps placed under the same tests without the device have been destroyed.

West of England Firm's New Premises.

In spite of the serious difficulties of the past year, the business of Simpson, Baker & Company, electrical manufacturers and suppliers, of Bristol, has grown to such an extent that the firm have recently acquired extensive new premises in Nelson-street, where

Simpson, Baker & Company's New Premises.

they have opened a fine showroom, some idea of which can be seen from the accompanying illustration. The electrical industry in the West of England generally seems to be in a flourishing condition.

New Submarine Telephone Cable.

Telephonic communication with Northern Ireland will be considerably improved within the next few days by a new submarine cable which has been laid by the telegraph ship "Monarch." The landing places of the cable are at Port Mora, Scotland, and Port Patrick, Donaghadee, Ireland, and its length is approximately 22 nautical miles, equal to about 25½ land miles.

Tests are now being carried out on the cable, and if they are satisfactory, the land lines will be joined up at once and two additional trunk circuits provided between Glasgow and Belfast.

The laying of the cable has been greatly impeded by the bad weather during the past three months; but the "Monarch" was held in readiness to complete the work at the first favourable opportunity, and the task is now finished.

Telephone cables laid previously were of the "coil-loaded" type, but the new one is "continuous-loaded." It contains four copper wires, each weighing about 170 lb. per nautical mile. The wires are insulated by balata, weighing nearly 200 lb. per nautical mile. The four wires will provide two "physical" circuits. In addition, a "phantom" circuit will be added when required. It is anticipated that the new cable will be found suitable for the provision of further independent trunk channels in the future by the method of "high-frequency carrier-wave" telephony.

"Kingsway" Combined Switch and Plug.

For the control of radiators, motors, banks of lamps, and other appliances which necessitate the use of a temporary connection to the mains, a combined switch and plug is undoubtedly the most satisfactory apparatus.

The "Kingsway" automatic combined interlocked switch and plug (patent No. 136 006), recently introduced by the General Electric Company, is strongly made, and is capable of dealing with currents up to 15 A. The mechanism consists of a rapid rotary action double pole switch interlocked with a substantial plug.

The "Kingsway" Switch-Plug.

On the plug being inserted and turned in a clockwise direction the circuit is made, and the switch is automatically locked in the "on" position. The switching off may be carried out either by withdrawing the plug (when the switch automatically breaks the circuit before the plug pins leave the socket tubes) or by pressing the small plunger on the front of the socket cover, when the switch flies rapidly off. The latter method allows the plug to be left in the socket in the "off" position, often a great convenience.

Earthing connections on both plug and socket and a third pin for earthing are provided, the latter ensuring correct polarity, as the plug can only be inserted in one particular way. Two patterns are supplied, one for surface fixing and one for sinking flush in the wall or skirting board.

Full particulars can be obtained on application to Magnet House or at any of the provincial branches of the General Electric Company.

The Meta Electric Copper Kettle.

The Metallic Electrical Engineering Co. have placed on the market a new electrical copper kettle, which they are able to supply for either a 600 W or a 1 000 W rating and for the usual voltage ranges. It is strongly made and beautifully finished in polished copper. The capacity is 2½ pints, and the 600 W kettle boils in fifteen minutes and the 1 000 W in nine minutes. Made on mass production principles it is eminently suitable for firms who require heating and cooking appliances in large quantities.

The two years' electrical guarantee, which goes with each kettle turned out, should be sufficient evidence of the makers' confidence in

The Meta Electric Kettle.

the quality and efficiency of this line. Incidentally a two years' guarantee creates, we believe, something of a record in guarantees, most domestic electrical appliances not carrying more than a twelve months' certificate. The construction and design have been so arranged that the makers particularly recommend it for export purposes, and point out that it is unaffected by extreme climatic conditions.

The accompanying illustration gives a good impression of the kettle, the price of which is competitive.

It is expected that the plant for the electric lighting of Rawalpindi (India) will be ready to commence working in a few months. Poles to carry the overhead cables for public lighting have been erected in several roads.

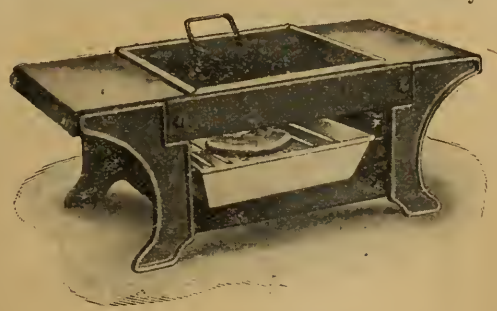
"Utility" Cooker-Radiator.

The accompanying illustrations show the "Utility" cooker-radiator, both as a radiator and as a griller or toaster. The manufacturers, ELECTRICAL UTILITIES, LTD., claim that when used as a radiator it heats a room of 2 000 cub. ft. It measures 12 in. by 6 in. by 4½ in., and weighs only 4½ lb. The cooking space is 8 in. by 6 in., and the grilling space 6 in. by 6 in. The consumption is 750 or 1 000 W, and it can be used on all voltages.

AS A RADIATOR.

The frame is of sheet steel with cast iron feet, and is fitted with polished aluminium plates on top. The small amount of metal employed ensures that the normal working temperature is quickly reached and produces the maximum amount of radiant heat. The heating coil is mounted on a set of eyeleted mica supports which are supported in mild steel channels. A movable reflector plate of polished aluminium is provided, which throws the heat outwards or upwards but which can be drawn out and placed above the element when "downward" heat is required for grilling, etc. This cooker-radiator is the forerunner of a series of heating and cooking appliances to be produced by this firm.

This cooker-radiator seems to form one of what may be called

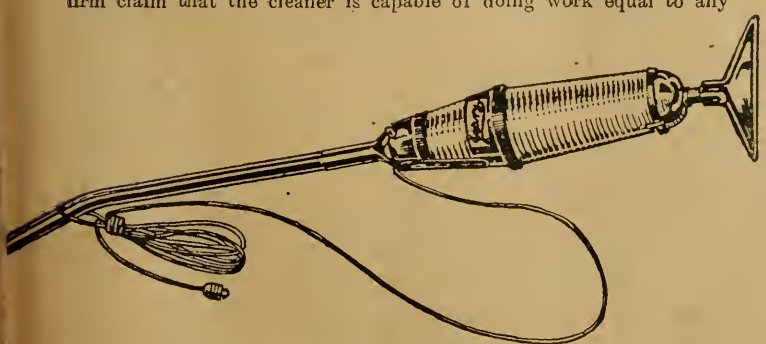


AS A COOKER

the propaganda class of apparatus, containing in one piece of equipment several features which combine to illustrate the part that may be played by electricity in the home.

New Electric Suction Cleaner.

By putting on the market an electric vacuum cleaner at ten guineas, the JEARY ELECTRICAL COMPANY are meeting a long-felt want, and there will, undoubtedly, be a great demand for this appliance. The firm claim that the cleaner is capable of doing work equal to any



THE "JEARY" ELECTRIC SUCTION SWEEPER.

machine costing double the price. It weighs only 6 lbs., and there is no exposed dust-bag to contaminate the air when the cleaner is in use. The loading is 150 W, and, as will be seen from the illustration, there are no cumbersome hose for the upholstery attachments.

Fuller's Safety Lamp.

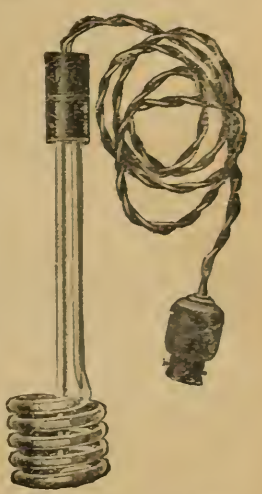
The FULLER PATENT ELECTRIC SAFETY LAMP has been in demand for many years, and the latest type embodies the practical experience of electrical and colliery engineers of repute in addition to the company's own staff. The development of the lamp has been in the direction of simplification, the number of destructible parts being reduced to a minimum and their replacement being rendered extremely simple. Its constructional design includes the best features of those Fuller lamps already in use, together with numerous improvements. The lamp has passed H.M. Home Office tests, and has been approved by that office for use in collieries and mines.

The steady brilliant light given by the Fuller lamp is an outstanding feature; the illumination it gives is claimed to be superior to that of any other lamp at present on the market.

An important structural feature of the lamp is its massive, strong construction, combined with extremely low weight (5 lbs.) and freedom from projections liable to catch in the clothing of those carrying it. The light is switched on and off by turning the top of the lamp relatively to the bottom, a perfectly smooth and positive action being obtained. The contacts have a large area, and no objectionable variation in light, due to imperfect contact, is possible. Lamps can be supplied for issuing from the lamp cabin already lighted and locked in that position, a procedure which prolongs the life of the cells by ensuring that they are maintained in a level condition by receiving uniform discharges and charges.

"Genii" Genius.

The latest electrical device to emanate from the brain of GEORGE NOBBS, LTD., is the miniature "Genii" immersion heater which we illustrate herewith. This device, which is a small edition of the large coil immersers that the firm used to produce some ten years ago, is intended as a substitute for the deadly and inconvenient gas ring in living rooms, nurseries, bedrooms, and kitchens when small quantities of water or other liquid are required to be boiled or heated up. By its employment shaving water can be heated in 30 sec. on the coldest mornings, and glasses of water, milk, or plates of soup may be prepared in the shortest possible time. No better means, it is argued, can be devised for boiling water for the early morning cup of tea, while still reclining in bed, or for the preparation of the hot water-bottle so beloved by the luxurious before retiring at night.



"THE GENII" IMMERSION HEATER.

The apparatus is fitted with an adjustable voltage connector, which allows it to be connected to any lighting circuit with a pressure between 100 and 250 V. As will be seen from the illustration, the heating coil is compact, being 2 in. in diameter by 2 in. high, so that it will go into an ordinary teacup, hot water jug or small kettle. The heater is seamless, no solder being used at all, and the radiating surface, it is claimed, is equivalent to about twice that of the ordinary electric kettle and four times that of most other makes of immersers. As regards current consumption, it is very economical, as not only is its efficiency 98 per cent., but it is only rated at 450 W. The element is in the coil portion only, and consists of nickel chrome wire for the high voltage circuit and of copper nickel wire for the low voltage circuit.

Financially the apparatus is equally desirable as its price is only 21s., and there should, therefore, be a great demand for it in the ideal home.

Universal Combination Bell.

The Universal Combination Bell, which has just been put on the market by MASON & BROWN, has been designed to provide a reliable complete electric bell at a low cost, and at the same time one that can be cheaply and quickly recharged without tools or previous experience.

The bell consists of an enamelled iron frame, with the parts fitted under the dome, which is 3 in. diameter, mounted on a polished walnut-coloured pattress, having an aperture at the back with metal contacts on the sides, to contain the battery. The aperture has a fibre cover to exclude dust. The battery is the one used for flash lamps, which for ordinary work will ring the bell a considerable time. The only fixing required is to connect the wires from push or contact to the two terminals on the bell frame.

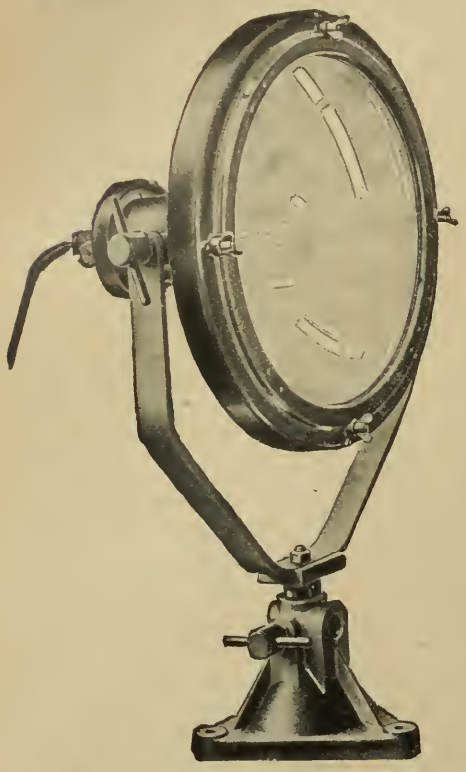
THE COMBINATION BELL.

The method of recharging is to remove the cover on the pattress, bend the two brass strips on the battery outwards. This is then slipped into the aperture, and the bell is again ready for use. The whole operation can be done under a minute without any tools. The pattress, as will be seen from the illustration, is provided with two ears for fixing on the wall, or the bell can be used for portable purposes, ringing well in any position.

The firm supply for export, if required, inert batteries, which are more suitable than ordinary flash lamp dry cells, especially for hot climates, a small quantity of water being added to the battery when required for use.

Flood-Lighting at the Maypole Works.

One of the most interesting of the many sign installations employing B.T.-H. FLOODLIGHT PROJECTORS is that recently carried out at the Maypole Margarine Works, Southall. The sign is simply a painted board—white letters on a black ground—measuring 100ft. long by 6ft. deep. It is illuminated by means of three type 793 projectors, each containing a 500 W Mazda gas filled projector lamp. These three projectors are fixed 50ft. away from the sign.

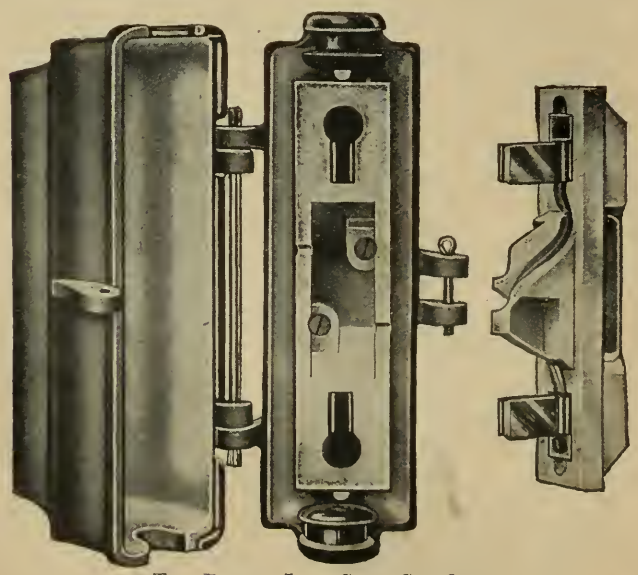


B.T.-H. FLOODLIGHT PROJECTOR.

In the ordinary way, the beam of light from a projector is circular in section. To attempt to light a sign 100ft. long by 6ft. deep with three circular beams of light would be absurd. This difficulty has been surmounted in the case of the Maypole sign by the use of special spreading glass fronts on the projectors, which give an elliptical form to the beam. An illustration, which has been reproduced from an untouched photograph, taken by the unaided light of the projector installation, shows that there is no waste, and that practically all the light is confined within the limits of the sign-board. A typical projector is shown herewith.

The "Priory" Iron-Clad Cut-Out.

We have received from the PRIORY ELECTRICAL ENGINEERING COMPANY particulars of the "Priory Iron-clad Cut-out," which embodies the following new features:—(1) The complete unit can be



THE PRIORY IRON-CLAD CUT-OUT.

mounted direct on a switchboard or wall without dismantling the porcelain interior. (2) The case can be supplied with cover to open in either direction—right or left—thus making it possible to arrange two cut-outs side by side, so that only one cover can be opened at a time. As will be seen from the illustration, the interior comprises the well-known Priory fuse.

The case is strong and neat in appearance, being finished in rich brown unchippable enamel. Three capacities are at present made, 15, 30 and 60A, and the cut-out can also be supplied in water-tight patterns if desired.

G.E.C. Cardiff Showrooms.

The accompanying illustration illustrates the main fittings showroom at the Cardiff branch of the GENERAL ELECTRIC COMPANY. These premises, which comprise offices, warehouses and showrooms, are situated in the centre of the city, entrance being

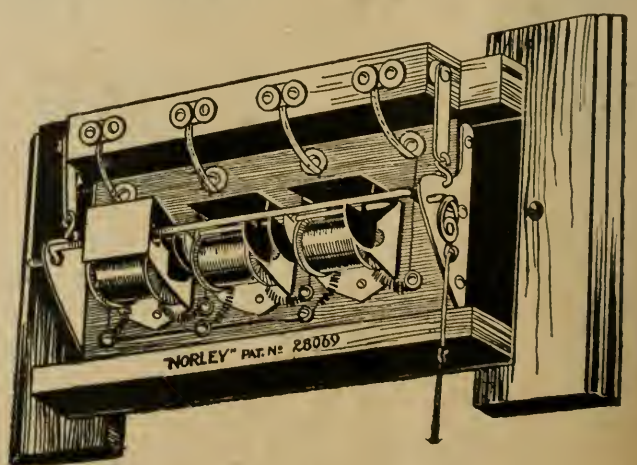
MAIN FITTINGS SHOW-ROOM AT G.E.C., CARDIFF BRANCH.

gained either from Womanby-street or from the Castle-arcade. The warehouse occupies one section of the building, and its five floors are served by a lift manufactured by the Express Lift Company. Anyone interested in electrical plant or appliances is cordially invited to visit these showrooms.

The Norley Bell Indicator.

An improved type of electric bell indicator has recently been placed on the market by NORRIS & HOLLEY. It is claimed for this apparatus that mechanical details have been cut down to a minimum, with a result that the usual troubles experienced are entirely eliminated. The illustration which we reproduce herewith shows that the indicator has one moving part, which is absolutely free from latches and springs of any kind. This moving part serves the double purpose of armature and flag, and is placed on an axis above and parallel to the bobbin of the electro-magnet, with armature members in planes at right agles to the flag member, so that when the electro-magnet is energised the attraction of the armature members tilts the flag into a position in which it can fall over the bobbin into the position of rest. The magnetic core operating this armature is completely enclosed in the bobbin, in a way which so limits the action of the field that both sides of it are equally operated on, the armature being thereby rendered extremely sensitive to electrical influence.

Owing to the arrangement of the flag the indicator is unaffected by shock or by vibration, and, as no screws or studs are used in its



THE NORLEY BELL INDICATOR.

construction, the parts are not liable to become loose and fall out. The case in which the indicators are contained is fitted with an iron back to render it damp-proof, and the movements are individually fitted to an apron which hangs vertically and clear of the base. Resetting is effected by a downward pull, which allows the indicator to be fixed out of harm's way.

Auto-Caution Signal Device.

The accompanying illustration shows the auto-caution signal device for night driving which has recently been produced by HARVEY & SPENCER, LTD., who are prepared to negotiate the manufacturing and sales rights for Great Britain, the Continent, and for British Empire territory. The device, which is simplicity itself, has received the approval of the London Safety First Council, who are of opinion that, if generally adopted, a reduction in traffic accidents at night should follow.

The device consists of a light metal casing, which can be incorporated in the back of a driving glove or attached with a flexible spring clip to the back of the hand. This casing contains a small battery, reflector, and lamp, illuminating the caution signal, and is

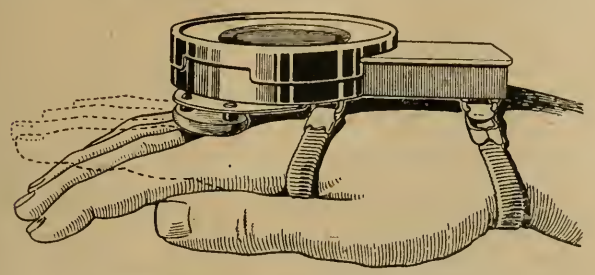


DIAGRAM OF AUTO-CAUTION SIGNAL DEVICE.

fitted with an auxiliary switch to prevent accidental discharge of the battery when the device is taken off the hand. To operate the signal it is only necessary to open the hand and extend the fingers out straight, which is the natural and intuitive method of signalling. By doing so the back of the fingers press against a switch-plate, causing the lamp to illuminate the signal word or colour.

This little device is very light and convenient, and can be supplied in different capacities, the smallest of which is not much larger in diameter than a full-size watch.

Metropolitan-Vickers Company and Contractors.

The policy of the Metropolitan-Vickers Electrical Company of opening showrooms in various parts of the country has raised the question of the attitude to be taken towards electrical contractors and others in regard to supplying the public. Speaking at an inspection of the showrooms last week, MR. P. F. CRINKS, the London manager, said he wished to make it clear that the policy of the company in opening showrooms was to help the trade. He invited electrical contractors and others to regard the company's showrooms as an extension of their own showrooms, and to send their customers there. Cards of introduction would be supplied, and the electrical contractors would get the full 25 per cent. discount off list price if sales were effected. Where the customers of electrical contractors came to the showrooms, even though they were not directly sent by the electrical contractor, the company was prepared to allow, say, half the discount off the list price to the contractor. In no case would the ordinary public be supplied at anything below list price. Electrical contractors, added Mr. Crinks, need have no fear that the company would endeavour to make sales direct to any customer whom they might send to the showrooms, and so deprive the contractor of his discount.

Telephone Committee's Report.

The REPORT OF THE SELECT COMMITTEE on the Telephone Service, of which Sir Evelyn Cecil is chairman, has been issued, and makes various recommendations for the improvement and cheapening of the telephone service. Over 100 pages of the Report are devoted to a memorandum on the visits of the chairman and Mr. W. W. Cook to Sweden, Norway and Denmark, and of Mr. Cook to the United States and Canada, to statistics of the telephone service in those countries, and to a record of the proceedings of the Committee.

Subject to approval of their conclusions, the Committee recommend "an immediate reduction of 10 per cent. on subscribers' accounts provisionally, and without prejudice to any subsequent rearrangement to carry out our recommendations."

The following is a summary of the recommendations :—

Reorganisation on more commercial lines, and separation of the telegraph and telephone departments from that of mails, and constitution of an administrative board of heads of departments under the Postmaster-General or Minister of Communications.

Division of the country into telephone areas for healthy competition and financial comparison, with local consultative committees and co-ordination as far as possible of community of interests.

Greater encouragement of co-operative enterprise where the Post Office do not see their way to develop, notably in rural areas, under Government supervision, with sanction in each case of the Railway and Canal Commission.

Telephone charges should be reduced with the reduction in the cost of living and cost of materials.

The setting aside of £200 000 annually for *extra* depreciation should be discontinued, and the charge for ordinary depreciation should be revised, which would result in a further reduction in 1922-23 of £276 000, with proportionate reductions in future years; salaries and overhead charges for new construction work, and for renewals should be debited to capital and to depreciation accounts, not to revenue, which would have meant savings on revenue account of about £400 000 and £186 000 in 1920-21. These changes represent £1 062 000 a year, or at least 8 per cent. off existing charges.

The telephone accounts should be kept in a more commercial form.

The basis of the method of charging should be the message rate. The flat rate, although theoretically objectionable, may be admitted as the means of accelerating development in very small places or for residences in certain restricted areas.

The extra mileage rate should be reduced from £10 to £5 a mile.

A certain differentiation or elasticity of rate is sometimes advisable where it assists development, and there should be a lower annual installation rental for residences than for business premises.

Judicious extension of automatic telephony; more trunk lines and less steeply-graded scale of trunk rates for the shorter distances; more latitude in standard of materials to allow of cheaper extension into rural districts.

Following on reorganisation (*a*) disappearance of the office of surveyor from the telegraph and telephone department, (*b*) transfer of the Holloway and Birmingham factories from the Department of the Controller of Stores to that of the Engineer-in-Chief, and (*c*) special care not to detail an unnecessary number of men on one piece of work or to put it through a needless multiplicity of channels.

Extension of public call-boxes. Fuller permisison to the public to employ existing Post Office telephone wires when not in use officially.

Other recommendations include the use of hand-mirco telephones for Press-reporting purposes; retention of telephones on changes of tenancy; lower charges when no night service is given: reduced charge on trunk calls on Saturday afternoons and Sundays; and prolongation of interrupted trunk calls.

Birmingham National Trades Exhibition

The accompanying illustration is a reproduction of a photograph and shows the stand which has been organized by the CITY OF BIRMINGHAM ELECTRIC SUPPLY DEPARTMENT at the National Trades Exhibition, Bingley Hall, Birmingham, to which we briefly referred in our issue last week.

A large selection of table lamps, domestic electric apparatus, accessories and fittings is on view. Among the articles exhibited are a variety of electric radiators, fires, ovens, grills, hot plates, toasters, kettles, saucepans, irons, fans, water heaters and vacuum cleaners. The exhibits also include medical violet ray apparatus, electric drills, electric blower for blacksmiths' hearths, "Fors" batteries, high tension insulators, Kaleeco cables, specimens of various grades of electric cable, and a board showing different systems of electric wiring.

The apparatus has been loaned by the British Thomson-Houston Co., Callender's Cable & Construction Co. and Metropolitan-Vickers Electrical Co.

There are several additional exhibitors of electrical apparatus at the Exhibition, including the General Electric Co., which has a representative display.

The Exhibition will remain open until the beginning of May.

BIRMINGHAM ELECTRIC SUPPLY DEPARTMENT'S STAND AT THE N.T.E.

Legal Intelligence.

Ratcliff v. Shard.

Last week Mr. Pollock, Official Referee, heard an action in which Mr. George Frederick Ratcliff, electrical engineer, sued Mr. W. J. Shard, of Bracknall, Berks, for £350, balance of charges amounting to £565, for work and labour done and materials supplied in connection with an electrical installation at defendant's house.

Defendant admitted having employed plaintiff, but pleaded that he failed to do the work properly and had charged unreasonably. Defendant also counter-claimed £20, the value of certain fittings removed from his London house and not accounted for, and £63 for money alleged to have been paid to make good and complete certain alleged defective work.

Plaintiff's case, as stated by his counsel and disclosed by his evidence, was that, having done a great deal of work for defendant extending during a period of over twenty years, he was asked in January, 1916, to carry out the installation work in respect of the present claim. The work occupied from January, 1916, to January, 1917, when, owing to the war conditions, it was difficult to obtain labour or materials, which would account for the higher charges. Defendant was one of plaintiff's best customers, and had never entered into any formal contract with him. There had never previously been any dispute, and it was left to him to do what he thought proper. The installation in the house was very old, and much of it had to be renewed. He was not told to put in an entirely new installation, which would have cost about £1 000, but to make as much use of the old as possible, and the work was made more difficult because the house was full of furniture and he had to keep the light going. He experienced great difficulty in getting materials and obtaining delivery. Some he got from the Simplex Company, and the cable he got from the Indiarubber Company. In consequence of the difficulties in getting materials, and in order to carry out the job, he had to sacrifice other customers. All the principal fittings were removed from defendant's London house.

In cross-examination, the plaintiff said that the old electric lighting was working satisfactorily, but he had to put in new work in consequence of an increase in the number of lights. According to tests he made, he did not think there was any danger of fire. He denied having told defendant that it would be a £400 job.

After the men who had done the work had given evidence, the Official Referee expressed the opinion that plaintiff's charges were excessive, and gave judgment for him for £104, and for defendant on his counter-claim for £10 for lamps taken away. He gave plaintiff costs on the High Courts scale.

Breach of Wireless Telegraph Regulations.

At the Glasgow Sheriff Court on Monday, William Harris, master of the s.s. "Clan Malcolm," was charged, at the instance of the Board of Trade, with having failed on the night of Oct. 8 last to have a wireless operator or watcher on watch, contrary to Rule 7 of the Rules made under the Merchant Shipping (Wireless Telegraphy) Act, 1919.

Defendant pleaded guilty, and his legal representative explained that just after midnight on Oct. 8 the "Clan Malcolm" ran into a fog off Corsewell Point. At once she reduced speed to slow, and two minutes after the lights of the s.s. "Rowan" were observed, and the helm was put hard aport in an endeavour to avoid collision. It was learned later that prior to the "Clan Malcolm" striking the "Rowan" the latter had been in collision with an American vessel, the "West Camak." The time of the sending out of the S.O.S. by the "Rowan" was 12.17 a.m. The collision with the "Clan Malcolm" took place at 12.19. Had the watcher been on duty on the "Clan Malcolm," the wireless room on the vessel was so situated that it would have taken him four or five minutes to get the operator to take off the message, and then it would have taken the operator seven or eight minutes to have got the messages and communicate with the bridge. It was, therefore, obvious that the failure to receive the message on the "Clan Malcolm" could have had no effect in avoiding the collision. Sheriff Fyfe imposed a fine of £25.

American Patent Litigation.

Major-General George O. Squier, of Washington (D.C.) has filed a suit in the United States District Court for the Southern District of New York against the American Telephone and Telegraph Company for infringement of his patents for "wired wireless" or "line radio." It is alleged that the American company is using the system of transmission revealed in Squier's patents Nos. 980 356, 980 357, 980 358 and 980 359 of Jan. 3, 1911. General Squier's invention applies the radio art to telegraphy and telephony over wire systems; by it the messages, instead of being "broadcasted" into space as in ordinary radio, are guided by the wire. Under the old system of telegraphy and telephony only one telephone message could be transmitted over a wire at one time, but by the use of General Squier's system many messages (telephone, telegraph, or both) can be transmitted over the same wire at the same time.

A Motor Generator Dispute.

In the King's Bench Division, Dublin, last week, Mr. Justice Pim made an order for the discovery of documents in the action brought by the Irish Kinematograph Company (1920) Ltd., against Wm. Coates & Son, Ltd., for damages for breach of a contract made in March, 1920, for the sale by defendants to plaintiffs of motor generators (with accessories), and for damages caused to plaintiffs by the defective character of the generators, for breach of warranty, and for the return of the purchase money. A sum of £500 is claimed as damages in consequence of decreased takings at plaintiff's box-office.

Parliamentary Intelligence.

South Wales Electrical Power Bill.

The South Wales Electrical Power Distribution Company's Bill came before a Select Committee of the House of Lords last week, the Earl of Kintore presiding. The Bill, among other things, seeks authority to reduce the ordinary capital of the company from £610 120 to £152 530.

Mr. Tyldesley Jones, K.C. (for the promoters), said the Bill would also enable local authorities who were authorised to supply electrical energy, and who entered into an agreement to take energy from the company, to contribute to the company's capital. The local authorities were satisfied, and the only opposition was from certain gas companies. The capital originally authorised was £1 000 000, three-quarters by shares and a quarter by borrowing. Ordinary capital of £600 000 was issued and also debentures of £200 000. From the start the company was overburdened with capital. In 1907 the company was in great difficulties, and large consumers came to the rescue and formed a company called the Treforest Electrical Consumers Company. They entered into an agreement with the Power Company and the debenture holders by which in substance the undertaking was to be carried on by the Consumers' Company for the benefit of the consumers, who agreed to find the money. The Bill would be the means of saving a large amount of money to local authorities, who would otherwise have to provide their own supply.

Mr. Clode, K.C., for eleven gas companies, said his clients took exception to the ratepayers' money being put into an alien concern over which they had no control.

The Chairman said the circumstances were unusual, and the Committee were of opinion that the Bill should proceed.

Railway Electrification Loan.

In the House of Commons last week, Mr. Hilton Young, replying to Mr. Gilbert, said the agreement between the Treasury and the Underground Electric Railways of London (for the extension and improvement of the tube railways) was not yet finally completed, and full details could not therefore yet be published. In substance, and subject to various conditions, the Treasury guaranteed principal and interest of issues of debentures to be made by the company and the City and South London Railway Compnay up to a total amount of £5 000 000. There was no question of a capital advance by the Government, which would be outside the terms of the Trade Facilities Act.

The I.M.E.A. and the Bill.

The Council of the Incorporated Municipal Electrical Association, representing undertakings that have capital involved to the extent of some £80 000 000, have sent a letter to all members of the House of Lords, containing the following resolution: "That, in the opinion of the Council of the Incorporated Municipal Electrical Association, the Electricity (Supply) Bill, 1922, should be carried into law at the earliest possible date in the interests of the industry."

Electricity Supply Bill.

The House of Lords committee stage of this Bill will be taken on Tuesday, April 4.

I.E.E. Manchester Dinner.

The annual dinner of the North-Western Centre of the Institution of Electrical Engineers was held at the Midland Hotel, Manchester, on Friday last, Alderman W. Walker being in the chair.

In responding to the toast of "The Institution of Electrical Engineers," proposed by Mr. Clare Lees, president of the Manchester Chamber of Commerce, Mr. J. S. Highfield said they were all proud of the Institution and the way it was getting in touch with the commerce of the country. The passing of the new bye-laws was now accomplished, and it was gratifying that so large a change in the history of the Institution had taken place so smoothly. The Council much appreciated the help which had been given by the local centres in preparing the new bye-laws.

The Foundation of the Industry.

Continuing, Mr. Highfield remarked that electricity supply was the foundation of the whole industry. If it flourished, the whole industry flourished, and it was interesting to see at the recent commemoration, which had made the Institution known all over the country, how speaker after speaker had referred to the hampering effect of legislation. Now the Institution had a larger voice it was their duty to see that hampering legislation should not be an obstruction to future development. In South-East Lancashire, when suggestions were made for improving the electricity supply by setting up a Gilbertian authority consisting of all sorts of people, responsible neither to the ratepayers nor to the shareholders, they had said no, and he thought they were right. Electricity to-day had a better chance than ever, not perhaps of riches, but of keeping its head above water.

The Lock Out.

Ald. W. Walker, who proposed the toast of "The Visitors," referred to the engineering lock-out. Speaking with some knowledge of both sides of the dispute, the trouble arose, he said, largely from a misunderstanding of the true facts. There was no doubt that a large number of men sincerely believed that an attempt was being made to injure the trade unions, but he could assure them that such a thing had never entered the heads of the employers.

To this toast Dr. H. F. Parshall, chairman of the Lancashire Electric Power Company, briefly replied.

Electricity Supply.

Last week CARDIFF City Council approved the recommendation to place £5 000 of the estimated profits of the electricity department to relief of rates.

The outstanding debt on the HOYLAKE electricity undertaking is only £28 000, and when this has been paid off the profits will be available for rate reduction.

The new 12 000/15 000 kW turbo-generator at BRADFORD Electricity Works was formally opened last week by Mr. J. W. Longley, deputy-chairman of the Electricity Committee.

Mr. ARTHUR ELLIS, of Arthur Ellis & Partners, consulting engineers, Cardiff, has been appointed by the HULL Corporation Electricity Committee to report upon the efficiency of their undertaking from a technical and commercial point of view.

MILNROW URBAN COUNCIL have applied for a Special Order to authorise the Council to generate and distribute electrical energy in Milnrow. Any objections should be sent to the Secretary, Electricity Commission, Gwydyr House, Whitehall, S.W. 1, by April 8.

TYNEMOUTH Electricity Department shows a surplus on the past year's working of £2 895, against a loss of £293 in the previous year. The number of units sold has increased by 1 700 000. The average charge for electricity for all purposes is 1.62d. per unit sold.

NEWTON ABBOT Urban Council have applied to the Minister of Transport for a further extension, until July 31, 1923, of the time within which they may give notice to the Urban Electric Supply Company of intention to exercise their right to acquire the company's undertaking in the district. Any objections must be sent to the Ministry of Transport by April 17.

LIVERPOOL Corporation have applied for a Special Order to extend their area of electricity supply so as to include the Borough of Bootle and the Urban Districts of Litherland, Waterloo-with-Seaforth, and Great Crosby; to acquire the electricity undertakings of Bootle Corporation and the Liverpool District Lighting Company, &c. Objections must be sent to the Secretary, Electricity Commission. Gwydyr House, Whitehall, S.W. 1, by April 22.

New Schemes and Mains Extensions.

ST. MARYLEBONE Borough Council has received sanction to borrow £15 000 for mains and services.

ASHFORD (Kent) Urban Council has decided to apply for a Provisional Order for electric lighting.

ORMSKIRK Electric Supply Company have extended their cable to Greetby Hill, a point near the Lathom boundary.

READING Electric Light Company have been asked by Twyford Parish Council to extend their mains to that district.

GRAYS Urban Council has applied to the Electricity Commissioners for sanction to a loan of £3 500 for additional generating plant.

BRAILES Rural Council has granted permission for the erection of overhead wires for the supply of electricity to the parish church at Pillerton Hersey.

In connection with the proposed electric supply scheme for AXMINSTER, Johnson & Phillips have informed the Urban Council that the cost of the plant and mains would be £5 000. The Council have decided to offer no opposition to the scheme.

BRISTOL Electricity Committee have decided to apply for sanction to a loan of £4 275. Owing to the number of house connections being 50 per cent. greater than estimated, the sum of £36 000 sanctioned in 1920 will be exhausted next month. It is calculated that the new loan would meet requirements to March, 1925.

PRESTON Town Council have approved of application being made for sanction to borrow £305 000 for the purchase of the undertaking of the National Electric Supply Company, Preston, in pursuance of the agreement already made, and authorising a scheme for the Mid-Lancashire district, to be prepared jointly by the Blackburn and Preston Corporations.

THE CANNOCK CHASE COLLIERY COMPANY are offering facilities to the residents of Chasetown and Brownhills by which they may be supplied with current. Last week demonstrations of electric lighting were given, and different types of wiring, lamps and fittings were exhibited and explained, and the various uses to which electricity could be put were demonstrated. Mr. Sopwith (general manager of the Cannock Chase Colliery Company, Ltd.) said that at the recent electricity enquiry at Wolverhampton the Commissioners were surprised and pleased to find there was such a big electricity plant on Cannock Chase. He thought that if anything from 100 to 200 consumers were secured that the local council would be justified in adopting electricity for public lighting.

Alteration of Charges.

BATH Electricity Department has decided to reduce the price of electricity to private consumers from 9d. to 8d. per unit.

SEVENOAKS and District Electricity Co. has introduced a new two-part domestic tariff as an alternative to the flat rate, namely, a fixed annual charge, payable in quarterly instalments, plus 2½d. per unit.

PORTSMOUTH Council have decided to supply cinema theatres with electricity for their lanterns at half the cost specified in the tariff for lighting purposes, the charge to vary in accordance with the scale.

DUBLIN Corporation has adopted recommendations of its Electricity Committee by which it is hoped the charge for electricity may be reduced by 10 per cent., and by 20 per cent. for exceptional lighting and power consumers.

Users of electricity at STREATHAM, tradesmen in particular, are complaining that there has been no reduction since the war in the price of electricity, and the matter is being taken up by the local Chamber of Commerce.

HOYLAKE Town Council have decided to reduce the price of electricity for lighting from 9d. to 8d. as from the end of this month. The price for heating and cooking will remain unaltered, namely, 4d., but for power the rate will be slightly reduced on a sliding scale.

The following reduced scale of charges for electricity has been adopted by BEDFORD Town Council :—Lighting, flat rate, from 9½d. to 8½d., less ½d. per unit discount; two-rate systems, 8½d. and 6½d., less 1½d. discount; pre-payment meters, 10d., less 1½d. discount; all lighting accounts to be subject to a minimum charge of 5s. per quarter. The charge for heating has been reduced from 1½d. per unit net to 1½d. for the first 250 units per quarter, 1¼d. for the next 500, and 1d. beyond. For power the maximum price is now 2½d., less 5 per cent., and cinematographs and photographers will be allowed ½d. per unit off the price figure.

Electric Traction.

READING Corporation Tramway receipts from April 1, 1921, to Feb. 2, 1922, amounted to £69 431, compared with £73 187 for the corresponding period of 1920-21.

A NEW TYPE OF TRAMCAR, having overhead trolley arms in addition to the underground connection, is being run by the London County Council on the Clapham, Balham and Tooting route.

After a heated discussion, HULL City Council last week adopted the minutes of the Finance Committee, in which it was recommended that £10 000 from the tramways profits should go towards the relief of the rates.

NEWCASTLE TRANSPORT & ELECTRICITY COMMITTEE, which has been considering taking over the Gateshead and District Tramways with a view to the through running of the cars between the city and Gateshead, has decided against the purchase.

The strike of employees at the NEWCASTLE-ON-TYNE Tramway Department is now completely ended. The remaining 240 strikers—skilled and semi-skilled men employed in the maintenance department—returned to work on Monday, but not until their places were being rapidly filled from the ranks of the unemployed did they accept the 47-hour week.

At their meeting last week CHESTER Town Council decided that the tramways should be maintained as at present laid out for a period of seven or eight years, when the full life of the track would have been obtained, and that the recommendation set out in Mr. Fearnley's report be carried out, and that the surveyor be authorised to proceed with the work at a cost of £12 000.

A fresh agreement has been entered into by the London County Council and the Metropolitan Electric Tramways, Ltd., for the THROUGH RUNNING OF TRAMCARS. All short-running cars turning at Finsbury Park have been withdrawn and through services substituted. The company will pay to the Council 10·5d. a car mile in respect of the car mileage run by the Council in excess of its proportion under the existing through running arrangements. The arrangement will remain in force for six months and be terminable on Sept. 29, 1922, on one month's notice on either side, or thereafter on three months' notice on either side.

The strike of the SUNDERLAND AND DISTRICT TRAMWAY COMPANY, which started on Feb. 22, is still no nearer settlement. A conference, which was called last week at the instance of the Industrial Relations Department of the Ministry of Labour, between the managers of the company and the men's representatives, broke down. Alternative terms were offered by the manager, Mr. J. Stratton, to the men's representatives, and a meeting was immediately called, and the terms submitted. On a vote being taken, the men refused to accept them by a large majority. The conference broke up without any arrangements being made to continue negotiations.

The LONDON & NORTH-WESTERN RAILWAY are conducting trials on a turbo-electric locomotive constructed by Armstrong, Whitworth & Company for the Ramsay Condensing Locomotive Company. The engine, the "Times" states, has a length overall of 69 ft. 7 in., and weighs 130¾ tons, including coal and water. The front part contains the boiler (which generates steam at 200 lb. pressure and 300° F. superheat), the main three-phase turbo-alternator, and the auxiliary exciting turbo-generator. The current is taken to four 275 H.P. electric motors, two of which drive the wheels of the front part and two those of the back part or tender. In both cases there are six coupled wheels. The exhaust steam is conducted to the tender, where it is condensed in a condenser of special construction. The hot condensed water returns to the hot well and thence to the boiler. The object sought by the designer, Mr. D. M. Ramsay, is economy of coal and water.

The Industrial Welfare Society is now arranging the second of a series of annual conferences, to be held in the society's offices at 51, Palace-street, Westminster, on Friday April 28, to discuss the ESSENTIALS FOR SUCCESS IN WORKS AND STAFF JOURNALS. It is estimated that more than 200 firms now publish such magazines.

Personal and Appointments.

Prof. K. Vickers has been appointed principal of the University College, Southampton.

Mr. Hurst has been appointed engineer, manager and secretary of the Teignmouth Electric Lighting Company.

Mr. R. S. Johnson has been appointed managing director of Cammell, Laird & Company's works at Birkenhead.

Mr. J. A. Forde, engineer and manager of the Isle of Thanet Electric Tramways & Lighting Company, Ltd., has been appointed a Justice of the Peace for the Cinque Ports Division of Kent.

Mr. C. Mitchell has resigned his position as works manager of the Marconi Wireless Telegraph Company at Chelmsford, and Mr. H. B. Tilley, who for nine years has been assistant works manager, has been appointed to succeed him.

Owing to the closing of the Naval Signal School at Devonport, Lieuts. Abel F. Alston, port wireless telegraphy officer, and H. Watts, visual signalling officer, have been reappointed to the "Vivid," additional, for port duties.

The King has appointed Sir Gerald Edward Chadwyck-Healey, Bart., to be a member of the Royal Commission on Awards to Inventors, to fill the vacancy caused by the resignation of Lord Rayleigh.

Mr. A. G. Marsh informs us that as from the 31st inst. he is retiring from the board of directors of the Z. Electric Lamp & Supplies Company in order to start business as a wholesale electrical supplier and manufacturers' agent. Further details will be announced later.

Business Items, &c.

Mr. Harold Parr, electrical engineer, has opened new premises at 1, Back Jane-street, off Station-square, Harrogate.

A partnership has been entered into between E. H. Phillips and Kent Brothers Electric Wire Company as from March 1, and has been registered under the title of Kent Brothers Electric Wire Company & E. H. Phillips, for the manufacture and supply of silk, cotton and enamel covered copper wires. Their London office is at 37, King-street, Covent Garden, W.C. 2.

F. W. Brackett & Company have been appointed buying agents in England for a very large and important group of mines in South America. Their clients wish to have complete catalogues of mining machinery, general engineering plant machine tools, electric motors, woodwork tools, and general stores, and interested firms are asked to send same to the company at Hythe Bridge Ironworks, Colchester, for fowarding to the mines.

Institution Notes.

Mr. S. Chadwick has been elected chairman and Mr. B. M. Burt vice-chairman of the North-Western Students' Section of the Institution of Electrical Engineers.

The March meeting of the council of the Electrical Wholesalers Federation was held in Birmingham recently at the invitation of the members of the Midland Section. Mr. A. G. Beaver (Sun Electrical Company, London) was elected president and Mr. A. Holman (Holman & Company, Glasgow) vice-president for the ensuing year, 1922-3. The members of the Federation were specially invited to the British Industries Fair at Birmingham, and were entertained at lunch by members of the executive council and the electrical exhibitors.

Educational.

The Chair of Civil and Mechanical Engineering in the University of Leeds will shortly be vacant owing to the resignation of Prof. J. Goodman, who has held the chair since 1890. Prof. Goodman proposes to give his time to research, and the University Council have assigned to him accommodation for this purpose. A committee has been appointed to recommend a successor to the post.

The Governors of the University of Nancy have arranged for a summer holiday course in electro-technics to be held from July 18 to Aug. 22, provided at least twenty students join. The fee for the course and practical work is 150 francs. Further particulars may be obtained from the hon. secretary, British Bureau, Office National des Universités, Engineering Dept., 45, Great Marlborough-street, London, W. 1.

The Wimbledon Appointment.

Mr. A. E. Mackenzie, of Messrs. C. P. Sparks & Partners, has been appointed borough electrical engineer of Wimblodon in succession to Mr. H. Tomlinson Lee, as from June 1, at a salary of £1 000 per annum. It will be remembered that Messrs. Sparks & Partners were called in as consulting engineers to report on the condition of the electricity undertaking at Wimbledon recently, and that this report was among the matters at issue in the dispute which arose between Mr. Tomlinson Lee and the Council. Before his connection with Messrs. Sparks and Partners, Mr. Mackenzie was for some time with Manchester Corporation electricity department.

Wireless Notes.

An International Wireless Telegraph Conference opened at Cannes on Tuesday under the presidency of Signor Marconi.

A Reuter's message states that in connection with the proposal to establish wireless telephone communication between Norway and England, a prominent official connected with the telegraph service stated on Saturday that, as the Government had a monopoly of the telegraph and telephone in Norway, it could not allow private companies to establish a wireless telephone service in competition with the telegraph.

It is reported from Santiago that the Chilean Navy are instituting a wireless zone in the southern territories of Chile for the assistance of merchant shipping. Wireless stations are to be erected at Castro (Chiloe), Huafo Island, Rio Aysen, Cape Raper, Puerto Bories, Evangelistas Island, Faro Felix (Felix Light), Punta Arenas (Lena Dura Inlet), and Mocha Island. Three of the above are already operating, Huafo, Raper and Bories; one, Faro Felix, is being constructed; those at Evangelistas, Porvenir, Rio Aysen, Castro, and Punta Arenas (Lena Dura) are without their installations owing to lack of necessary funds.

The agreement between the Federal Government of Australia and the Amalgamated Wireless Limited has now been signed, and provides that the Commonwealth shall subscribe £500 001, thus securing a controlling interest. The company takes over the existing Australian radio stations. Three high-power stations are to be erected within two years in Britain, Australia, and Canada, to provide direct communication, also feeder stations to connect capital cities. Rates are not to exceed per word, for full-rate messages 2s., deferred messages 1s., week-end messages 6d., Government messages 1s., Press messages 3d. The company is always to remain an independent British business, and is to give preference to goods manufactured in Australia and preference in employment to ex-soldiers.

Writing from Nairobi on Feb. 27, the "Times" correspondent states that tests in connection with the Kenya link in the Imperial wireless chain have begun with the arrival in the country of Commander Watson, R.N., and Major Ward, R.M.A. These officers have taken with them apparatus for the preliminary investigations, but will be more concerned at the outset with the physical geography of this part of Africa. They state that, in addition to the known difficulties of wireless work in the tropics, the presence of Mount Kenya and Mount Kilimanjaro and the obstructive effect of large deposits of ironstone in Uganda will cause the selected site on the Thika River to present many additional difficulties (more especially in the work of picking up messages) as compared with the other links in the chain. It is understood that it will be about two years before active operations will be possible, although it is not anticipated that the physical difficulties will be in any way insuperable.

In a letter to the "Times," Mr. A. A. Campbell Swinton states that, in addition to David Hughes' notebooks, containing an account of his experiments in wireless telegraphy in 1879, recently bequeathed to the British Museum, the Museum has even more recently acquired a further set of these notebooks, containing Hughes' own illustrated account of his invention of the microphone. Still more interesting, he states, is the fact that a search, suggested by himself to Colonel H. G. Lyons, of the Science Museum, made amongst the contents of a room full of Hughes' personal effects that for the last twenty years have been stored in a furniture repository in London, has revealed the existence of a number of electrical instruments, comprising the original first microphones invented by Hughes, and the actual apparatus with which he made his early wireless experiments, all obviously constructed with his own hands. The several instruments can easily be identified by the illustrated descriptions in the notebooks.

The collection is on view in the Western Hall of the Science Museum, South Kensington.

Telegraph and Telephone Notes.

It is reported from Copenhagen that the Jutlandic Telephone Company have accepted an offer of a loan of half a million sterling from a London financial house.

A message from Peking states that the Trans-Siberian telegraph traffic has now been opened. The regular commercial messages to Europe from Tientsin take one hour and twenty minutes.

Trade Inquiries.

An old-established Johannesburg house, specialising in mining material, desire to secure agencies for electrical machinery and electrical cables and fittings. Particulars may be obtained from the Department of Overseas Trade. Ref. No. 330.

H.M. Trade Commissioner in Winnipeg reports that a Western Canadian company desire to receive from United Kingdom manufacturers full particulars and illustrations of (*a*) electric cranes and other unloading and loading equipment for docks; (*b*) steel conveyor belting (for conveying hot clinkers), 18 in., 20 in., and 24 in. wide, thickness of metal 0·035; (*c*) H type sawmill chains and buckets. All purchases made by the firm, it is understood, are for cash. Particulars may be obtained on application to the Department of Overseas Trade.

Imperial Notes.

An electric tramway and electric supply scheme for WANGANUI (N.Z.) has been approved by the ratepayers. The Council have received sanction to a loan of £50 000 for these purposes.

The Tasmanian Division of the Council of the Institution of Engineers, Australia, have decided to submit to the Council a resolution urging support by the Institution of proposed legislation making REGISTRATION OF ELECTRICAL CONTRACTORS AND WIREMEN compulsory.

Amongst amounts recently voted by the Tasmanian Parliament were £930 000 for the TASMANIAN STATE HYDRO-ELECTRIC DEPARTMENT, and £3 000 as a first instalment of the £33 200 required for an ELECTRICALLY-PROPELLED FERRY BOAT to ply between Hobart and Bellerive.

The MELBOURNE Tramways Board has authorised the preparation of plans for the conversion of the whole of the cable lines to electric traction, and the first portion to be undertaken will be the extension of the present electric termini to the city. Statutory powers for the work will have to be first obtained.

NEWCASTLE (N.S.W.) City Council have passed a resolution that they are of opinion that the £58 000 which was placed recently on the estimates of the State Parliament towards the cost of the ELECTRIFICATION OF THE NEWCASTLE TRAMWAYS is totally inadequate. The Mayor stated that as the work would cost considerably more than a million pounds, the amount voted was too small to convince anyone that the Government were in earnest.

New Companies.

A. P. Maglen.

A. P. MAGLEN, LTD. (180 562). Private company. Reg. March 24. Capital, £100 in £1 shares. Manufacturers, importers, and distributors of electric lamps, electric light fittings, electrical appliances and apparatus, &c. Subscribers: W. R. Preston (first and permanent director) and S. H. Buckland. Registered office: Sicilian House, Southampton-row, W.C.

Automobile & Electrical Equipments.

AUTOMOBILE & ELECTRICAL EQUIPMENTS, LTD. (180 460). Private company. Registered March 21. Capital, £1 000 in £1 shares. To take over the business of suppliers and repairers of motor and electrical equipment for motor engines, cars, and craft of all kinds carried on at 1 and 2, Marylebone-passage, Wells-street, Oxford-street, W., as the Automobile Electrical Equipment Company, and to adopt an agreement with C. de Winter and R. A. Roberts. First directors: R. Herbert-Smith and R. Cooke-Jones (joint managing directors). Secretary (*pro tem.*): R. Herbert-Smith. Registered office: 1 and 2, Marylebone-passage, Wells-street, W. 1.

Butler, Spragg & Company.

BUTLER, SPRAGG, & COMPANY, LTD. (180 430). Private company. Registered March 20. Capital, £30 000 in £1 shares (10 000 7½ per cent. cumulative preference and 20 000 ordinary). To acquire the undertaking of Butler & Spragg, Ltd., and to carry on the business of mechanical, electrical, hydraulic, and general engineers, &c. First directors: A. Spragg, T. Butler, A. Harris, J. Crouch, and H. N. Whittington. Registered office: 128, Cambridge-street, Birmingham :.

Engineers (Penge) Ltd.

ENGINEERS (PENGE), LTD. (180 466). Private company. Registered March 21. Capital, £5 000 in £1 shares. Manufacturing, electrical engineers, &c. Subscribers: F. J. Pyne and E. G. Pyne. Secretary: F. H. Briggs. Registered office: 50, Croydon-road, Penge, S.E.

L. C. Engineering Supplies.

L. C. ENGINEERING SUPPLIES, LTD. (180 472). Private company. Registered March 21. Capital, £6 000 in £1 shares (3 000 preference and 3 000 ordinary). Electrical, hydraulic, mining, mechanical engineers, contractors, &c. Subscribers: L. Contamin and W. L. Watkins. Solicitors: Wansey, Stammers & Company, 52, Coleman-street, E.C.

Motolite Dynamos.

MOTOLITE DYNAMOS, LTD. (180 416). Private company. Registered March 18. Capital, £3 000 in 2 000 preference shares of £1 each and 4 000 ordinary shares of 5s. each. Dynamo manufacturers, electrical engineers, electricians, &c. First directors: L. S. Challis, H. C. Pontet and H. C. H. Smyth. Office: Landor-road Works, Landor-road, Askew-road, Shepherd's Bush, W. 12.

Norchard Syndicate.

NORCHARD SYNDICATE, LTD. (180 553). Private company. Registered March 23. Capital, £1 000 in £1 shares. To construct, maintain, and work electric generating stations, to produce and use electrical energy, and supply the same to towns, collieries, buildings, factories, mines, railways, tramways and others, &c. Permanent directors: W. T. Kerr and G. C. Woods. Registered office: 3, Newcourt, Lincoln's Inn, W.C.

North-Western Electrical.

NORTH-WESTERN ELECTRICAL COMPANY, LTD. (180 477). Private company. Registered March 21. Capital, £100 in £1 shares. Electrical engineers and contractors, &c. First directors: T. C. Hartley and J. T. Storey. Secretary: J. T. Storey. Registered office: 55, Strand, Barrow-in-Furness.

The DYNAMICABLES' ANNIVERSARY DINNER will be held on Tuesday, April 4, at the Trocadero Restaurant, London, W. Mr. A. A. Campbell Swinton will preside.

Foreign Notes.

The capital of the COMPAGNIE FRANCAISE DES CABLES TELEGRAPHIQUES, of Paris, has been increased from 16 to 24 million francs.

According to the "Iron Age," of New York, out of 22 409 tons of STEEL CASTINGS PRODUCED IN CANADA last year, 13 984 tons, or 62·4 per cent., were made in electric furnaces. The best record in the production of electric steel castings in the United States was in 1920, when the castings made in electric furnaces were only 12·4 per cent. of the total.

From Jan. 1 last the METRIC SYSTEM has been employed in official transactions of the Russian Soviet Government, and from the beginning of 1924 it must be adopted for all commercial transactions. On the 1st prox. the system will be introduced into Japan, and after five years it must be used in towns, and after fifteen years in the rural districts of the Empire.

It is stated that the railway system of GUATEMALA is being extended by the construction of an electric line into the highlands of Los Altos. The current will be derived from hydraulic power. The cost of the undertaking is estimated at about £450 000, and this sum is to be raised by means of a special excise duty on arguardiente—a spirit distilled in the Republic.

At RADOM, in Poland, there are electricity supply works of 913 kW capacity, and electric current is supplied on the d.c. three-wire system at 220 and 440 volts. The plant is practically all German. There are two 235 kW and four 40 kW A.E.G. and one 283 kW Siemens-Schuckert dynamos. There are two Diesel engines of 350 and 400 H.P. respectively, two Wolf locomobiles and one Borsig steam engine. The total connections are about 2 040 kW, and the price of electricity for lighting is 140 marks and for power 94 marks per unit.

In an article in the "Times Trade Supplement" on the development of Palestine, the writer states that the Government of PALESTINE has already granted a provisional concession for the use of the falls of the Upper Jordan and its affluents and of the river Tarmuk for the generation of electrical power, and for its distribution throughout the country. Preliminary work, it is stated, is likely to be begun within the next few months. When fully executed it should, if the anticipations of the engineers are realised, furnish Palestine with an abundant supply of cheap power, as well as with a surplus of water for irrigation.

The permanent Commission of the SWISS FEDERAL RAILWAY ADMINISTRATION has decided to return to the Council of Administration, for its favourable consideration, the plans for the enlargement of the electric power station at Amsteg, which will be fed to an equal extent by the mountain torrents Kerstelen and Etzeli. According to the "Gazette de Lausanne," the credit required for the execution of these plans amounts to 6 000 000 francs.

Plans for the ELECTRIFICATION OF THE LINE LUCERNE-OLTEN-BASLE (for which a credit of 28 300 000 francs has been asked) have been approved by the permanent Commission and have been transmitted for approval to the Council of the Administration of the Federal Railways.

There appears to be an abundance of water power in PARAGUAY, according to a correspondent of the "Times" Trade Supplement, but so far there has been no hydro-electric development. It is thought 40 000 H.P. could be obtained from the river Acaray at Puerto Embalse, and there are several other sites available. There are few manufactures in the country, but cheap hydro-electric power would greatly assist the mining, saw milling and logging industries, and there would also be a steady demand for electric traction. Transport and railway facilities are very poor, and it is anticipated that futuro railway construction would be designed for electric working, so that there are reasonable prospects for any electricity supply schemes.

Statistics of electrical progress in FRANCE show that in 1920 the capacity of manufacturing firms had greatly increased over that of 1913. The number of persons employed was 170 000, compared with 50 000 in 1913, and the relative value of manufactured goods had been doubled. In electricity supply 2 230 million francs were invested, against 1 350 millions in 1918, the number of employees being 15 000 against 9 000, the length of the distribution lines over 12 000 km., and the capacity of the plant 820 000 kW. In hydro-electric schemes over 1 700 million francs have been sunk, against 1 514 millions at the end of 1920, and the plant installed, which totals 1 100 000 H.P. (against 965 000 in 1920), supplies districts with a population of over five millions, and the undertakings have over 19 000 km. of transmission and distribution lines.

Exhibition Notes.

Arrangements are being made to hold an EXHIBITION OF WIRELESS TELEGRAPHY shortly in Rome. Eighteen firms will be represented, and different types of instruments, including the latest developments, will be shown working.

An ELECTRIC VEHICLE SHOW is to be held in New York from April 3 to 15 under the auspices of the Automobile Bureau of the New York Edison Company. The first week will be devoted to a display of pleasure cars, trucks and batteries, and the second week to an exhibition of industrial trucks and batteries.

COMMERCIAL INTELLIGENCE.

County Court Judgments.

[Note.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

B J. O. ELECTRICAL SUPPLY COMPANY, Pershore-street, Birmingham, electrical goods manufacturers. £28 5s. 9d. Jan. 19.

BURGE, A., & COMPANY, 300-304, Garratt-lane, Earlsfield, electrical engineers. £18 3s. 7d. Jan. 17.

HURWORTH, W., 41, Town-street, Horsforth, electrical engineer. £20 0s. 10d. Jan. 26.

LONGBRIDGE ENGINEERING COMPANY, Great Darkgate-street, Aberystwyth, electrical engineers. £16 8s. 9d. Jan. 18.

MASKELL, WILLIAM, University Laboratories, Downing-street, Cambridge, electrical engineer. £16 10s. Jan. 25.

ROBINSON, David, 65, Hockley-hill, Birmingham, master electrician. £25 18s. 9d. Jan. 25.

Mortgages and Charges on Limited Companies.

[Note.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

BOURNE END & DISTRICT ELECTRICITY CORPORATION, LTD. Registered March 13, £1 102 8s. 10d. debentures, dated Feb. 28, 1922, part of £20 000; charged on land at Bourne End, also general charge. *£15 122 8s. 10d. March 2, 1922.

EVANS (ELECTRICAL), LTD., London, E.C. Registered March 17, £300 first debentures; also registered March 17, £1 040 second debentures; general charge. *£1 100. Dec. 31, 1921.

Satisfactions.

EVANS (ELECTRICAL), LTD., London, E.C. Satisfaction registered March 17, £1 100, registered Jan. 3, 1922.

OLDHAM, ASHTON & HYDE ELECTRIC TRAMWAY, LTD. Satisfaction registered March 14, £15 800, registered from Nov. 11, 1901, to April 7, 1905.

Private Meetings.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

KNIGHT, W. L. (trading as W. L. KNIGHT & SON), 6, Oak-end-way, Gerrard's Cross, electrical engineer. A circular has been issued to creditors stating that a meeting was recently held, and an investigation into the position has now been completed by Corfield & Cripwell, accountants, Balfour House, Finsbury-pavement, E.C. The statement of affairs showed liabilities of £806, while, after allowing £46 for preferential claims, the assets were estimated to realise £331, or a deficiency of £475. Assets comprised cash at bank, £2; stock at cost, £274, expected to produce £100; book debts, £393, estimated to realise £150; work in progress, £20; plant, machinery and loose tools, £100, valued at £50; and office furniture, £5. With regard to the stock, this is stated to be of a very miscellaneous character, and at a forced sale might realise poorly. The book debts were owing from some sixty or seventy customers, and were all for small amounts. In accordance with a resolution adopted at the meeting, the debtor had executed a deed of assignment with Mr. W. A. J. Osborne as trustee. Mr. Osborne reports that the business is being carried on for the time being, pending an offer being made for the concern.

THANET ELECTRIC COMPANY, LTD. (in voluntary liquidation), Margate. At a meeting of creditors held recently in London, it was reported that an extraordinary general meeting of the shareholders had previously been held in London, when a resolution in favour of voluntary liquidation was passed, and Mr. H. Kirby, of 840, Salisbury House, E.C. 2, was appointed as liquidator. The liquidator stated that the liquidation was a formal matter, and the business had been purchased by a well-known trader at Margate, who intended to carry it on. The whole of the liabilities have been or would be paid in full.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Winding-up Petition.

SWIFT ELECTRICAL, LTD. A petition for winding-up has been presented by Watshams, 33, King-street, Covent Garden, London, electrical engineers, and is to be heard at the Royal Courts of Justice, Strand, London, W.C. 2, on Tuesday, April 4.

Bankruptcy Information.

DICKEN, William John (trading as W. DICKEN & SON), 2, Upper High-street, Bargoed, Glamorgan, electrical engineer. Receiving order, March 21. Debtor's petition.

RAWCLIFFE, Frank (trading as FRANK RAWCLIFFE & COMPANY), 8, Nun-street, Newcastle-upon-Tyne, electrical engineer. Receiving order, March 21. Creditor's petition.

Partnership Dissolved.

KINGHAM, William Allan, and PURCELL, Samuel, electrical engineers and contractors, at 75, Pasture-road, and 176, Boothferry-road, Goole, York, under the style of KINGHAM & PURCELL, by mutual consent as from Nov. 26, 1921. Debts received and paid by S. Purcell.

Books Received.

"Isotopes." By F. W. Aston, M.A., D.Sc., F.R.S. (London: Edward Arnold.) Pp. viii.+152. 9s. net.

"Manuale per il Collando delle Macchine Elettriche." (Milan: Ulrico Hoepli.) Pp. xiv.+463. L.18:50.

"Chemistry and Civilisation." By Dr. A. S. Cushman. (Boston: The Gorham Press.) Pp. 151. $2.50 net.

"Mechanical World" Electrical Pocket Book, 1922. (Manchester: Emmott & Company.) Pp. 326. 2s. net.

"Report on Series in Line Spectra." By A. Fowler, A.R.C.C., F.R.S. (London: Fleetway Press.) Pp. 183. 12s. 6d.

"Analogies Mecaniques de l'Electricite." By J. B. Pomey. (Paris: Gauthier Villars et Cie.) Pp. xiv.+150. 15fr.

"Principles of Alternating Currents." By R. R. Lawrence. (London: Hill Publishing Company.) Pp. xiv.+432. 20s.

"Sharing Profits with Employees." By J. A. Bowie, M.A. (London: Sir Isaac Pitman & Sons.) Pp. ix.+222. 10s. 6d.

Forthcoming Books.

Benn Brothers are publishing almost immediately "The Structure of the Atom: Notes on Some Recent Theories," by Dr. Stephen Miall. This little book sets forth in a popular and breezy style, but not the less scientifically, some modern ideas, which should prove of great interest, not only to the scientist, but also to the general reader.

The firm will also shortly publish a "Life of George Westinghouse," by Henry G. Prout. This volume is a record of a life of wonderful activity, an intimate disclosure of heretofore unrevealed industrial episodes, and an interesting analysis of the engineer's part in modern civilisation.

Prices of Metals, Chemicals, &c.

Tuesday, March 28.

		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£62 10 0	—	£1 10 0
Electro Wirebars ..	„	£65 15 0	—	£2 0 0
H.C wire, basis	per lb.	0s. 10 1/16d.	—	1/16d.
Sheet	„	0s. 9 11/16d.	—	—
Phosphor Bronze Wire (Telephone)				
Phosphor-bronze wire, basis	„	1s. 2 1/16d.	—	1/16d.
Brass 60/40—				
Rod, basis	„	0s. 7¼d.	—	—
Sheet, basis	„	0s. 9¾d.	—	—
Wire, basis.....	„	0s. 10¼d.	—	—
Pig Iron—				
Cleveland Warrants .	per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 SWG	„	£19 0 0	—	—
Lead Pig—				
English	„	£23 0 0	—	—
Foreign or Colonial ..	„	£21 12 6	—	—
Tin—				
Ingot	„	£143 15 0	—	—
Wire, basis	per lb.	1s. 1½d.	—	¼d.
Aluminium Ingots	per ton	£120 0 0	—	—
Spelter	per ton	£25 5 0	£2 10 0	—
Mercury	per bottle	£11 0 0	—	—

Salammoniac.—Per cwt. 65s.-60s.
Sulphur (Flowers).—Ton £10 10s.
„ (Roll-Brimstone).—Per ton £10 10s.
Sodium Bichromate.—Per lb. 5½d.
Sodium Chlorate.—Per lb. 3½d.
Sulphuric Acid (Pyrites, 168°).—Per ton £9 17s. 6d.
Copper Sulphate.—Per ton £26 10s.
Boric Acid (Crystals).—Per ton £60
Rubber.—Para fine, 10½d.; plantation 1st latex, 8d

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

Companies' Meetings, Reports, &c.

British Insulated & Helsby Cables Ltd.

The twenty-sixth ordinary general meeting of shareholders of British Insulated & Helsby Cables, Ltd., was held on Monday at the Exchange Station Hotel, Liverpool, Mr. James Taylor, J.P., chairman of directors, presiding.

The chairman, in proposing the adoption of the report and balance sheet, said the year's profit of £502 524 was an increase of £161 811 over the previous year, a result which the directors considered highly satisfactory. This amount of profit was the largest in the history of the company, but in view of the present unfavourable business conditions it was perhaps needless to say that it would be difficult to maintain this high level. At the last annual meeting he told the shareholders they had to face very large capital expenditure in order to reorganise their works after the war to bring them completely up to date. This expenditure, he claimed, had been fully justified.

There was a special demand to-day for high-tension cables, and no firm in the country was in a better position to supply this demand. Not only were they the largest manufacturers of high-tension and other cables in the country, but they had many subsidiary industries which also had been brought up to date. The facilities provided by the company's large capital expenditure in 1920 enabled them during the last year to execute important orders on their books a year ago, and further promptly to execute other orders subsequently received. The profits were largely due to the improvements carried out in the factory, to the completion of old contracts, and to the judicious purchase of raw material. Two years ago the directors were empowered to raise fresh capital should this be considered necessary. Shareholders would be pleased to note the company had passed through the exceptionally trying intervening period without exercising these powers. They were fortunately one of the comparatively few companies which had not required to increase capital at a time when the rate of interest was high.

The addition of last year's carry forward of £116 863 to this year's profits gave a total balance of £619 388 on profit and loss account. After the payment of debenture interest, preference and interim ordinary dividends, directors', trustees' fees appopriation of £30 000 to depreciation account, and £5 000 to debenture stock redemption fund, there remained a balance of £474 723. From this a further dividend of 6¼ per cent. on the ordinary shares, together with a bonus of 5 per cent., was recommended, making with the interim dividend already paid a total distribution of 15 per cent. for the year. This would absorb £112 500, leaving a balance to carry forward of £362 223. The sum placed to depreciation was £20 000 less than a year ago, but in view of the large amount spent on repairs and renewals, the works were in first-class condition, and the lesser appropriation was adequate.

A year ago, under the heading of Stocks and Work in Progress, an increase of £269 000 was recorded; this year there was a decrease of £404 000, accounted for by the smaller volume of trade and the decline in the value of materials. A decrease of £423 813 in sundry debtors represented a great falling off in trade, as also did the fact that they owed their bankers nothing and had in hand £519 893, but the latter figure indicated the company's strong cash position. Referring to concerns in which the company had large holdings, the chairman said the Midland Electric Corporation had done well during a trying year; the Electric Supply Company of Victoria, Ltd., was conducting negotiations with the Corporations of Bendigo and Ballarat, with favourable hopes of a settlement; and the Automatic Telephone Manufacturing Company, Ltd., was, in his opinion, steadily strengthening its position.

Nothing was to be added to the reserve account, which stood at the substantial sum of £250 000, but the carry forward was being increased in order to consolidate the company's position financially. The opinion of the board was that 1922 probably would be a year of difficulties, not only in their own special trade, but in that of the country generally. Under such circumstances they felt that a firm which had ample cash resources was in the best position to face the unknown future, and they trusted the shareholders would approve of the policy of carrying forward the large sum of £362 223, which the board believed to be entirely in the company's best interests.

Sir Harmood Banner, M.P. (vice-chairman), seconded the adoption of the report and balance sheet, and after brief speeches by shareholders expressing satisfaction at the company's position, the motion was carried unanimously.

A resolution declaring a further dividend of 6¼ per cent. on the ordinary shares and a bonus of 5 per cent., making, with the interim dividend already paid, a total distribution of 15 per cent. for the year, was also carried unanimously.

On the motion of the chairman, seconded by Mr. J. Carlton Stitt, Sir Harmood Banner and Sir Alexander Roger were re-elected directors.

The meeting closed with a cordial vote of thanks to the chairman and directors.

Midland Electric Corporation.

In moving the adoption of the report and accounts at the annual meeting of the Midland Electric Corporation for Power Distribution, Ltd., on Monday, Mr. James Taylor (the chairman of the company) said that the profit of the company this year amounted to £105 857, against last year's record of £109 419. The gross revenue for current sold was down about £51 000, but against this they had earned in interest on cash in hand of £15 600, the one being gross, the other net. To the net profit of £105 857 was added £18 517 brought forward, making a total of £124 375. The reserve account had been increased from £20 000 to £45 000. The addition was in respect of the usual item of £5 000 which was being provided in each year, and £20 000 transferred from credit balances. This was in respect of an amount which had in previous years been set aside for sundry liabilities which might have had to be met, but which would not be required. The directors recommended a further dividend on the ordinary shares of 6 per cent., which, with the interim dividend of 4 per cent., made a total of 10 per cent. for the year, leaving £30 604 to be carried forward. He would like to point out that the ordinary dividend of 10 per cent. last year took £17 711, against £28 000 this year. This was owing to the new shares issued last year being now entitled to a full year's dividend. On capital account, during the year they had spent £193 946, and this would have been heavier had the new plant ordered been delivered to date.

The year had been one of great difficulty. First, early in the year they had a serious breakdown at the generating station, but, thanks to the forbearance of their customers and the hard work of the engineers, they kept running, but with a reduced load. Then came the coal strike; again they kept running, but at a very heavy cost, and supplied all the demands made upon them. Then came bad trade, the result of which all were still feeling. Taking those facts into consideration, he trusted the shareholders would consider the results satisfactory. He was afraid that, owing to heavy taxation, labour charges, &c., it would be a long time—if ever—before they could come back to pre-war rates. The inquiry by the Electricity Commissioners into the delimitation of the South-West Midlands area, which included a portion of the company's districts, was successfully opposed, but at rather heavy cost in legal expenses. The inquiry into the scheme for the North-West Mdilands area, in which the company would be included, had recently been held. Under that scheme it was proposed to set up a joint authority to control the supply of energy for the whole area, and it might be necessary for the company to transfer its generating station to that body, on terms and conditions to be agreed, but the distribution of supply energy would remain in the hands of the company. The directors were watching the company's interests, and if and when the scheme took definite shape full particulars of the steps to be taken would be laid before the shareholders.

Davis & Timmins.

The annual meeting of Davis & Timmins was held last week under the presidency of Sir Henry C. Mance (the chairman). The chairman having dealt with the report and accounts (see The Electrician, March 17), Mr. G. E. Davis (managing director) spoke at length on the present strike in the engineering industry. Their works, he said, were closed for the first time since the business was started in 1876. The firm was on the most amicable terms with their employees and the employees with the firm. They (the employees) belonged, of course, to a union, and the firm as employers also belonged to a union—the Engineering Employers' Federation. The dispute was a very clean-cut one. It was not a question of wages or bonus or overtime, or a desire on the part of employers to smash the union, but simply one of whether works should be managed by skilled and expert knowledge in the shape of the employers or by a committee of employees who, collected together at random, had no qualifications for the task of management.

Out of 400 000 members of the Amalgamated Society of Engineers only 50 000 voted—just one-eighth of the whole—and this number plunged the entire 400 000 out of work, not to mention an even larger number of more or less affiliated or sympathetic members of other unions. The general opinion of the men themselves—and their employers in particular—was against this suicidal policy. Fortunately the majority in this country was composed of men and women of sterling common sense, and it was up to the labour leaders to relieve their members from the influence of hotheads who in no way represented labour. It was absurd to suggest that the employers were out to smash the unions. The employers were out to manage their own works, and nothing more. Since the Armistice there had been no fewer than 4 000 strikes, with a loss to the nation of 180 000 000 working days.

With regard to the future, his opinion was that they had touched rock bottom as far as the slump was concerned. Their financial position was particularly sound. They had the sinews of war in the shape of liquid cash, and they had valuable stocks at their disposal. All they required were trade winds set fair, and their recovery would, if slow, be sure and, he hoped, lasting.

Waste Heat and Gas Electrical Generating Stations Ltd.

The report of the Waste Heat & Gas Electrical Generating Stations, Ltd., for the year ending Dec. 31 last shows a profit, after deducting administration expenses and interest on loans, of £35 620, compared with £34 439 in 1920, less £16 000 (£14 000), which has been transferred to reserve. The sum of £12 603 (£17 764) was brought forward from the previous year, making profits available of £32 222 (£38 203). The directors recommend a dividend at the rate of 6 per cent (8 per cent.) for the year, amounting to £19 200 (of this an interim dividend of 1½ per cent. was paid in August, 1921, amounting to £4 800), leaving a balance to be carried forward of £13 022 9s. 9d., against £12 603 last year. The amount standing to the credit of the reserve account is now £143 851, including the amount transferred from the profits of the past year. The redemption funds in respect of plant supplied on hire-purchase terms amount to £21 360. Capital expenditure during the year amounted to £20 664, £15 001 of which was in connection with the new power station at Horden. A further sum of £10 000 will probably be required finally to complete this station and the extensions in connection with the gas engine plant at Weardale. To meet

the above expenditure it has been necessary to borrow temporarily from the company's bankers, and this arrangement will continue from time to time during the current year. The results of the past year were greatly affected by the miners' strike, the whole of the stations being closed down during the three months from April to June, 1921. The plant at the Horden power station was put into operation again in August, and the Teesbridge and Ayresome power stations started up in September, since when these three stations have been running satisfactorily. It is hoped that the Newport plant will be running again at the end of this month. Both the Clarence and Weardale stations are still completely shut down. The aggregate output from all the company's generating stations showed a reduction of 59 per cent. on the previous year.

Tyneside Electrical Development Company announce a final dividend on the preferred ordinary shares of 3 per cent., less tax, making 6 per cent. for the year.

The directors of the South Staffordshire Tramways Company recommend a dividend of 4 per cent. on the preference shares for the past year, carrying forward £462.

Reading Electric Supply Company announce a dividend of 4 per cent. on the ordinary shares for the year. The sum of £5 500 has been placed to depreciation and reserve, leaving £1 779 to be carried forward.

The Isle of Wight Electric Light & Power Company have declared a dividend of 10 per cent. on the preference shares for the two years ended April 30, 1920. The sum of £10 000 has been placed to the renewal fund and £583 carried forward.

The report of Rotherham Tramways Committee for 1921 states that recent economies have resulted in a saving of £23 000 per annum, but owing to a loss of £10 000 per annum previous to 1910, and extra charges for rates, current, &c., this sum is not available for use.

The accounts of the Swansea Improvements & Tramways Company for 1921, after setting aside £20 000 for renewals, show a surplus of £11 913. The sum of £2 099 is brought forward, making £14 012. It is proposed to pay a dividend on the ordinary shares for the year of 6 per cent. and to carry forward £3 613.

The directors of the Singapore Electric Tramways state that since the offer from the Municipality of Singapore for the purchase of the company's undertaking was submitted to a meeting of debenture holders on Feb. 17 last, and rejected, negotiations with the Shanghai Electric Construction Company have been commenced, and are now proceeding.

The annual report of the Siemens Elektrische Betriebe states that the company has been severely hit by the appreciation of foreign, especially Swiss, exchange. The company's debts on this account, the report states, amount to 183 000 000 marks, part of which can be covered from the reserve fund, but there remains an uncovered loss of more than 162 500 000 marks.

The net profit of P. & W. Maclellan for 1921, after debiting bad and doubtful debts, directors' remuneration, and various other charges, making provision for taxes and contingencies, and including £29 578 brought in, was £81 080. The directors recommend a dividend of 8 per cent. on the ordinary shares, payable 4 per cent. on March 31 and 4 per cent. on Sept. 30 next, carrying forward £27 039.

The net profit of the British Engine Boiler & Electrical Insurance Company for 1921, after paying an interim dividend of 7s. 6d. per share (less tax), reserving £1 241 for income and corporation taxes, and adding £5 030 to pension fund, was £24 126. The directors recommand a final dividend of 11s. per share and the usual bonus of 4s. (both less tax), carrying forward £13 416.

The report of the Clyde Valley Electrical Power Company for 1921 shows profit of £106 389, plus £69 693 brought in. After transferring £50 000 to the contingency fund, the directors recommend a final dividend at the rate of 10 per cent. per annum on the ordinary shares, making 7½ per cent. for the year, transferring to second preference share special reserve £1 000, writing down cost of second preference share issue £6 463, and carrying forward £51 547.

Presiding at the annual meeting of the Newcastle & District Electric Lighting Company last week, Lieut.-Col. F. R. Simpson, T.D., said that the total receipts showed a decrease of £16 954, which was accounted for by the three months' coal strike and the general trade depression. The net profit for the year, after allowing £14 000 for depreciation, was £8 100, and with the amount brought forward from 1920 there was an available balance of £22 055. For the first two months of the current year the figures showed an improvement on the latter part of 1920. A dividend was declared at the rate of 4 per cent., less tax, for the year.

Referring to the adverse conditions of the past year at the annual meeting of the Llanelly & District Electric Lighting & Traction Co. last week, Mr. Alfred R. Holland (chairman), who presided, said it spoke volumes for the recuperative power of the business that they were again able to recommend payment of the same rate of dividend upon the ordinary shares as in the preceding two years—namely, 7 per cent., and to place to the credit of reserve accounts approximately £2 000 more than in the previous year. The total units sold during the year 1921 amounted to 9 296 518, as compared with 6 760 839 in the previous year, an increase of 2 535 679 units. The results of the current year, so far as they had gone, showed an improvement, and with a revival in trade and a return to more normal conditions the directors looked forward with confidence to the future progress of the business. Details of the accounts appeared in our last issue.

Arrangements for the Week.

FRIDAY, March 31st (to-day).

Institution of Mechanical Engineers.

6 p.m. At Storey's-gate, London, S.W. Paper on "The Milling of Screws, and Other Problems in the Theory of Screw-Threads," by Prof. H. H. Jeffcott.

Institution of Electrical Engineers.

London Students' Section.

7 p.m. At Savoy-place, London, W.C. Address by the President, Mr. J. S. Highfield.

Junior Institution of Engineers.

8 p.m. At Caxton Hall, London, S.W. Lecturette on "The Steel-Melting Shop," by Mr. D. P. Dickinson.

MONDAY, April 3rd.

The Farmers' Club.

4 p.m. At 2, Whitehall-court, London, S.W. Paper entitled "Electric Power as an Aid to Agriculture," by Mr. B. Matthews.

Royal Society of Arts.

8 p.m. At John-street, Adelphi, London, W.C. Cantor Lecture, "The Constituents of Essential Oils," by Mr. G. Radcliffe. (Lecture III.)

TUESDAY, April 4th.

Institution of Civil Engineers.

6 p.m. At Great George-street, London, S.W. Paper on "Corrosion of Ferrous Metals," by Sir Robert Hadfield, Bart., F.R.S.

Institution of Electrical Engineers.

South Midland Centre, Students' Section.

7.30 p.m. At the Grand Hotel, Colmore-row, Birmingham. Lecture on "With the Wireless Signal Company, R.E., in E. Africa, 1916-1918," by Mr. J. A. Cooper.

Röntgen Society.

8.15 p.m. At Savoy-place, London, W.C. Paper on "Electrical Measuring Instruments Commonly Employed by Radiologists," by Major K. Edgcumbe.

WEDNESDAY, April 5th.

Institution of Electrical Engineers.

Wireless Section.

6 p.m. At Savoy-place, London, W.C. Paper on "Provision of Power for Wireless Telegraphy," by Capt. J. H. Whittaker-Swinton, R.E.

THURSDAY, April 6th.

Institution of Electrical Engineers.

6 p.m. At Savoy-place, London, W.C. Paper on "Protective Apparatus for Turbo-Alternators," by Mr. J. A. Kuyser.

FRIDAY, April 7th.

Institute of Cost and Works Accountants.

7.30 p.m. At the Chamber of Commerce, New-street, Birmingham. Public Lecture on "The Functions of Works Accountancy," by Mr. J. A. Lacey.

Royal Institution.

9 p.m. At Albemarle-street, London, W. Discourse on "The Evolution of the Elements," by Sir Ernest Rutherford, F.R.S.

Tenders Invited.

UNITED KINGDOM.

Midlothian and Peebles District Asylum, Rosslynlee. April 1.—Six months' supply of electric fittings and fittings for machinery. Forms of tender from the Clerk and Treasurer, 19, Heriot-row. Edinburgh.

Birmingham Electric Supply Department. April 7.—Electric motors, approximately 100. Tenders to include starting panels and sundry spare parts, the sizes of the motors ranging from ½ B.H.P. to 15 B.H.P. Particulars from the City Electrical Engineer, 14, Dale-end, Birmingham.

Edinburgh Corporation. April 8.—Contractors are invited to apply for inclusion in the list of firms with whom orders may be placed for engineering work and maintenance of telephones during the ensuing year. Forms of offer from the City Architect.

Ashton-Under-Lyne Corporation. April 12.—Eight e.h.t. equipments for 6 600 V three-phase 50-cycle system. Specifications from the Borough Electrical Engineer.

Wolverhampton Guardians. April 12.—Installation of electric cables and mains at the Poor-Law Institution, Heath Town. Particulars from the Clerk to the Guardians, Poor Law Offices, Wolverhampton.

Wandsworth Guardians. April 12.—Installation of electric lighting at the Intermediate Schools, Swaffield-road, Wandsworth. Particulars from the Clerk, Mr. F. J. Curtis, Union Offices, St. John's Hill, Wandsworth, S.W. 18.

Walthamstow Urban Council. April 12.—Extra high-tension feeder cable and low-tension distributor and public lighting cables. Specifications, &c., from Mr. G. R. Spurr, Electricity Works, Priory-avenue, Walthamstow.

Dundee Corporation. April 20.—One 12-panel d.c. switchboard, four 3 000 A d.c. circuit-breaker panels, and three starting panels for rotaries. Specifications, &c., from the City Electrical Engineer.

Dumbarton County Council.—Electric wiring and fitting work in the County Buildings, Dumbarton. Specifications from Mr. J. Weekes, 88, College-street, Dumbarton.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Complete Specifications.

147 046 Compagnie pour la Fabrication des Compteurs et Materiel d'Usines à Gaz. Testing-sets, including electric current transformers, for use with measuring instruments. (30/6/19.)
147 602 Körting & Mathieson Akt.-Ges. Electricity meters for indicating the wattless consumption in alternating-current and three-phase current installations. (11/12/18.)
147 699 Ges. für Drahtlöse Telegraphie. Wave telephone systems. (17/1/19.)
147 758 Latour, M. Thermionic tube amplifying devices. (4/12/18.) (Addition to 127 318.)
147 884 Siemens-Schuckertwerke. Voltrametric electricity meters. (11/3/19.) (Addition to 147 879.)
147 934 Signal Ges. Receiving device for subaqueous sound signals. (16/12/14.)
147 939 Signal Ges. Submarine sound transmitting and receiving apparatus. (10/3/17.)
147 942 Signal Ges. Submarine sound-producer. (25/2/18.)
147 943 Signal Ges. Device for preventing disturbing noises in polarised electro-magnetic sound apparatus. (4/5/18.)
147 944 Signal Ges. Device for preventing disturbing noises in polarised electro-magnetic sound apparatus. (30/5/18.) (Addition to 147 943.)
147 948 Signal Ges. Arrangement for avoiding disturbing noises in listening devices caused by changing circuits associated therewith. (20/4/17.)
148 129 British Thomson-Houston Co., Ltd. Means for obtaining unidirectional potential differences or current of constant value. (22/12/15.)
169 007 Macrorie, A. K., & Shearing, G. Transmitting circuits for wireless telegraphy and telephony. (15/6/20.)
169 008 Larsen, A. Sinding-. Process for obtaining an increased light electrical effect in light electrical cells with alkali metal cathodes and other cells of a similar nature. (15/6/20.)
169 032 Rushen, P. C. (Knorr-Bremse Akt.-Ges.). Automatic compressed air-brake controlled electrically and by compressed air, particularly for trains composed of several motor-vehicles. (26/6/20.)

APPLICATIONS FOR PATENTS

February 7, 1922

3 482 E. Y. Robinson. Generation of high frequency currents.
3 521 T. McKenna (Dictagraph Products Corporation). Telephone signal service.
3 522 T. McKenna (Dictagraph Products Corporation). Signal systems for telephones.
3 523 T. McKenna (Dictagraph Products Corporation). Sectional switchboard frame.
3 524 T. McKenna (Dictagraph Products Corporation). Battery carrier and connector.
3 529 Electrical Apparatus Co. & E. N. Bray. Switch mechanism.
3 532 W. J. Webb. Cleaning inside of lamp bulbs.
3 534 W. R. H. Tingey. Inductance coils for currents at radio frequency.
3 553 Western Electric Co. & G. Deakin. Telephone call distribution system.
3 554 Western Electric Co. Telephone exchange systems.
3 555 W. L. Hoffmann, C. E. Funnell & A. O. Garrett. Storage battery grid.
3 575 Peters, Ltd., G. B. Petter & T. G. Grundey. Electric heating of engines of hot-bulb-type before starting.
3 593 M. H. Petersen. Effecting automatic continuous operation of copying telegraphs. (17/2/21, Norway.)
3 594 Akt. Ges. Brown, Boveri et Cie. Anodes for mercury vapour rectifiers. (18/2/21, Switzerland.)
3 611 & 3 612 F. H. Robinson. Single phase induction motors.
3 616 G. Boudou. Electrically heated air waving appliances.
3 630 Martingnoni. Accumulators.

February 8, 1922.

3 645 L. B. Turner. Wireless telegraph receivers.
3 653 S. George (J. H. George). Rotary contact devices for electric ignition.
3 673 R. Maclaren. Automatic regulator for electric radiators, &c.
3 689 R. M. Radio, Ltd., W. H. Merriman & H. R. Rivers-Moore. Wireless call device.
3 695 Phi-Kappa Synd. & D. Watson. Electric toasting or heating apparatus.
3 697 Naamlooze Vennootschap Philips' Gloeilampenfabr. Glow discharge lamps. (9/2/21, Holland.)
3 698 Naamlooze Vennootschap Philips' Gloeilampenfabr. Gasfilled discharge tubes. (9/2/21, Holland.)
3 701 S. E. & L. C. & D. Ry. Companies & G. Ellson. Live rails in electric traction.
3 703 J. R. P. Lunn. Electric tubular annealing, &c., furnaces.
3 704 J. R. P. Lunn. Connectors for concentric cables.
3 723 & 3 724 Berry's Electric & H. H. Berry. Switches
3 725 E. Urbain & C. Seal. Magneto. (8/2/21, France.)
3 728 Metropolitan-Vickers Electrical Co. & I. N. Whitesmith. Commutators for electric machines.
3 736 Siemens & Halske A. G. Alternating current generators. (8/2/21, Germany.)
3 741 G. Verdonk & D. Lodder. Electric plug contacts. (9/2/21, Holland.)

February 9, 1922.

3 760 Fuller's United Electric Works & A. P. Welch. Fixing covers for switches, &c.
3 775 L. R. Lee, H. J. Chaytor & H. Hawkins. Means for protecting joints of underground cables.
3 805 L. M. Waterhouse. Circuit connection fittings for electric wiring systems.
3 837 G. Howson. Automatic switch stands for electric irons.
3 843 P. G. Brown. Electric circuit controlling devices.
3 849 H. Leitjer. Accumulators.
3 862 Soc. dite le Matériel. Radiating surfaces in electric heating apparatus. (12/2/21, France.)
3 868 V. Ortega. Thermo-electric apparatus for heating water, &c.
3 870 A. Zaccanti. Electric apparatus for destruction of insects, &c.

February 10, 1922.

3 914 J. J. Lepine. Switch boxes.
3 926 J. A. E. A. Ellis. Changeable electric code switch.
3 937 Soc. Anon. Le Carbone. Batteries. (19/4/21, France.)
3 969 W. Williams & Co. & J. R. Middleton. Devices for dimming incandescent lamps.
3 975 B. T.-H. Co. (G. E. Co.). Electric motor control systems.
3 980 New British Electric Supply Co. & H. C. E. Jacoby. Electromagnetic devices.
3 982 H. G. Bartholomew & M. L. G. McFarlane. Telautography.
4 009 G. Natoli. Magneto-electric machine.

February 11, 1922.

4 028 E. D. Young. Electrical transmitter microphones.
4 029 W. Wilson, C. C. Garrard & M. Solomon. Motor controlling switchgear.
4 030 W. Wilson, C. C. Garrard & A. H. Railing. Motor starting and controlling switchgear.
4 053 Associated Equipment Co. & C. K. Edwards. Control gear for electric driving mechanism.
4 058 Reyrolle & Co. & H. W. Clothier. Switches.
4 061 E. Y. Robinson. Wireless receiving systems.
4 063 A. J. Dean. Electric inspection apparatus for interiors.
4 068 T. H. Kinman. Receiving arrangements for electro-magnetic waves.
4 109 J. N. Chaviara & J. F. Gill. Electro-dynamic power transmitting mechanisms.

February 13, 1922.

4 116 C. L. Arnold & C. R. Belling. Electric terminals for wall plugs and sockets, switches, &c.
4 119 L. H. Hounsfield. Electric ignition gear.
4 132 A. Page. Magnetos.
4 139 E. L. & A. E. Ward. Means for threading telephone, &c., cables through conduits, &c.
4 157 F. H. L. Holweck. Impermeable electric apparatus. (11/2/21, France.)
4 171 K. Kaisser. Electric contact devices working with mercury, &c.
4 179 J. Robinson & J. Spenser. Electric time switches.
4 191 Metropolitan-Vickers Electrical Co., A. B. Field, & L. Miller. Alternating current machines.
4 200 Automatic Telephone Mfg. Co. & A. E. Hudd. Electro-magnetic mechanisms.
4 203 F. Creedy. Alternating current machines.
4 219 A. H. Railing, C. C. Garrard, A. E. McColl, & W. Wilson. Protective systems for alternating current circuits.

February 14, 1922.

4 270 Metropolitan-Vickers Electrical Co. Electric switches. (14/2/21, U.S.)
4 282 B. H. N. H. Hamilton. Inductance coils, &c
4 291 L. W. J. Firth. Mechanical cut-out dynamo.
4 300 P. Kemp. Electric power systems.
4 302 E. F. Joyce & C. C. R. Wray. Telephone number indicator.
4 305 J. P. Haworth. Electric clocks, &c.
4 318 Western Electric Co. Repeater circuits. (11/6/21, U.S.)
4 319 Western Electric Co. Electrical networks.
4 332 B. T.-H. Co. & C. T. Hanna. Electric current controllers, &c.
4 334 Metropolitan-Vickers Electrical Co. Electric switches. (26/2/21, U.S.)
4 337 General Electric Co., Ltd., & R. Le Rossignol. Incandescent lamps.
4 339 P. Eversheim. Metallic vapour lamp.
4 351 D. C. Crowe. Telephone systems.
4 363 O. Karz. Electric supply arrangements for electrically propelled vehicles. (7/3/21, Austria.)
4 367 Macintosh Cable Co. & D. D. Watson. Dividing box for multicore cables.
4 368 L. T. C. Russell. Electric meters for a.c.
4 378 W. F. Rowlandson. Regulating switch for starting motors, &c.

February 15, 1922.

4 384 O. Meyer-Keller & Co. Electrodes for heating liquids. (9/6/21, Germany.)
4 411 S. T. Jeffreys. Electrically illuminated signs.
4 413 A. Reyrolle & Co. & W. M. Thornton. Lightning or surge arresters of electric conductors.
4 447 H. Ackermann & P. J. Barnes. Apparatus for periodical interruption of electric current.
4 463 Metropolitan-Vickers Electrical Co. Electric speed regulator systems.
4 467 B. T.-H. Co. (G. E. Co.). Circuit controllers.
4 468 H. G. Hughes & S. R. Mullard. Thermionic valves.
4 470 Western Electric Co. Multiplex submarine cable.
4 481 T. W. S. Hutchins. Electro deposition of metals.
4 485 Hart Mfg. Co. Switches. (24/2/21, U.S.)
4 488 A. & O. Neumann. Accumulators. (5/1/22, Germany.)
4 494 A. W. Burke. Motor starters and circuit controllers. (15/2/21, U.S.)
4 495 A. W. Burke. Motor starters and circuit controllers. (13/8/21, U.S.)
4 509 Ges. für Drahtlose Telegraphie. Telegraph and telephone systems. (17/2/21, Germany.)
4 510 Ges für Drahtlose Telegraphie. Thermionic generators of electric oscillations. (16/2/21, Germany.)

February, 16, 1922.

4 527 Albion Motor Car Co. & T. B. Murray. Rheostat for controlling vehicle lights.
4 542 E. Schröder. Electric welding of high speed steel to tool shanks, &c.
4 574 S. W. Hamlyn. Electric lamp suspender.
4 587 E. L. Burne. Charging secondary batteries.
4 602 Siemens & Halske A. G. Closed circuit magnetic switches. (3/3/21, Germany.)
4 609 P. Merguin. Electric switches. (18/2/21, France.)
4 615 A. W. Mathys (Wilson-Maeulen Co.). Electrical resistance thermometers.
4 618 Siemens Schuckertwerke. Electro-magnets. (17/2/21, Germany.)
4 620 E. W. Lancaster. Electric conductors and wiring for electric circuits.
4 621 E. W. Lancaster. Electric appliances for cleaning, fanning, &c.
4 637 F. Weatherill. Single fluid primary cell.

February 17, 1922.

4 650 A. J. Trott & E. L. J. Weight. Electrically heated incubators.
4 716 F. W. Sturgess & A. O. French-Brewster. Means for automatically actuating switch.
4 718 English Electric Co. & C. F. Barnholdt. Control of electric vehicles.
4 723 C. F. Johnston. Electric clocks.
4 734 M. P. Favre-Bulle. Regulating amplitudes in electro-magnetic clocks.
4 766 H. Vogt, J. Engl, & J. Massolle. Amplifier connections for wireless telegraphy. (18/2/21, Germany.)

February 18, 1922.

4 777 S. W. Amphlet. Electric switches, adapters, &c.
4 791 G. W. Humphry. Device for short-circuiting flow of electricity to sparking plugs, &c.
4 797 C. Oliver. Electric wall plugs.
4 824 G. F. Shotter. Electric measuring instruments.
4 835 E. A. Ashcroft. Electrolysing fused salts of metals and recovering metals and acid radioles, &c.
4 862 M. Benson. Mercury power plant for electricity generating.

February, 20, 1922.

4 923 J. B. Bolitho. Apparatus for reception of signals in wireless telegraphy and telephony, &c.
4 925 A. R. Angus. Electric control of trains.
4 937 G. R. Judge. Obtaining characteristic curve of thermionic valve.
4 938 G. R. Judge. Loud sounding telephones.
4 943 B. T.-H. Co. & A. P. Young. Regulating speed and voltage of electric machines having permanent field magnets.
4 944 B. T.-H. Co. (G. E. Co.). Electro-magnets.
4 946 A. Hewer & A. A. Sharples. Means for generation of electricity.
4 959 R. S. Allen. Time lag electric switch.
4 961 F. L. Hollister. Magnetos.
4 963 R. L. Chasselon. Universal current tapping connector.
4 982 Soc. Francaise Radio-Electrique. Printing telegraphs.
4 983 Pulsometer Engineering Co. & F. C. Norton. Means for securing electric lamps in holders.

February 21, 1922.

4 992 A. Challinor. Tramway trolly head.
5 048 E. G. Budd Mfg. Co. Jigs for assembling and electrically welding parts of automobile bodies, &c. (15/3/21, U.S.)
5 051 Automatic Telephone Mfg. Co. Railway signalling systems.
5 060 A. H. Railing & R. J. Kaula. Insulators for supporting electric conductors.
5 069 B. T.-H. Co. (G. E. Co.). Synchronous dynamo-electric machine.
5 070 B. T.-H. Co. (G. E. Co.). Incandescent lamps.
5 073 Metropolitan-Vickers Electrical Co. & G. A. Cheatham. Electric automatic regulators.
5 085 F. H. Watts. Electrically controlled direction indicators for vehicles.
5 091 H. J. Round. Wireless telegraph receiving systems.
5 093 G. Ellison & J. Anderson. Magnetic blow-out devices for electric controlling apparatus.
5 096 J. H. Whittaker-Swinton. Thermionic tubes, &c.
5 115 M. W. Woods. Electric motors.

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5 157 L. F. E. Ferrette. Incandescent safety lamps for mines. (23/2/21, France.)
5 165 E. E. Fournier d'Albe. Producing visual effects by sound
5 170 C. P. Ratcliffe, W. K. Barker, & S. G. Jones. Electrical intruments, &c.
5 193 J. B. Belcher. Bonding device for metal covered wires.
5 207 B. T.-H. Co. (G. E. Co.). Electric switches.
5 208 J. F. G. P. Hartmann. Oscillographs.
5 209 C. J. Coleman. Transmission of messages through cables having high electrostatic capacity.
5 236 Metropolitan-Vickers Electrical Co. Electric switch gear. (30/6/21, U.S.)
5 237 Metropolitan-Vickers Electrical Co. (Westinghouse Electric & Mfg. Co.). Temperature regulating devices.

February 23, 1922.

5 251 K. E. Edgeworth. Device for tuning high frequency oscillating circuits.
5 253 A. M. Taylor. Electric transmission systems.
5 291 L. J. Rich. Loading submarine cables.
5 309 R. D. Archibald. Electric machines.
5 315 L. J. Steele, A. E. McCarthy, & H. Martin. Electric arc welding.
5 321 A. W. Sharman. Apparatus for production of high voltage currents applicable to thermionic valves, &c.
5 351 B. T.-H. Co. (G. E. Co.). Electrically heated tools.
5 369 W. R. James & A. L. Nickerson. Electric indicators for doors.
5 373 L. Walker. Apparatus for testing electrical spark producing appliances under pressure.
5 376 E. Schattner. Electric heating devices.
5 378 H. G. C. Fairweather (Dubilier). Selectively transferring electrical oscillatory energy.
5 379 Radio Communication Co. & J. Scott-Taggart. Generation and modulation of electrical oscillations.
5 380 Radio Communication Co. & J. Scott-Taggart. Radio frequency signalling systems.
5 392 G. N. Cadbury & A. W. Maley. Trackless trolly vehicles.
5 398 E. Santuari. Recovery of energy in electric railway systems. (12/10/20, Germany.)
5 399 & 5 400 F. C. B. Chase. Fitments, &c., for electric wiring systems.
5 409 P. Jäger. Indicators illuminated by electricity. (23/2/21, Switzerland.)
5 411 H. Frei. Alternating current machines. (23/2/21, Switzerland.)
5 415 J. H. Reeves. Coupling of inductance coils for wireless apparatus.

February 24, 1922.

5 434 J. F. Sutton. Automatic circuit breakers.
5 472 E. D. Young. Electric transmitter microphones.
5 489 M. Y. L. Dupour. Automatic commutators or switches.
5 498 J. R. Quain. Electric contacting device.
5 523 Metropolitan-Vickers Electrical Co., A. Stubbs, & J. F. Perry. Electric mining plant.
5 541 Meirowsky & Co. Akt. Ges. Tubes and leads for high electric tensions. (19/3/21, Germany.)
5 542 W. Prior & C. E. Riley. Selenium cells.
5 545 Western Electric Co. Telephone exchange systems.
5 553 H. T. Worrall. Electric meters.
5 555 W. J. Gooderidge. Electric horns.
5 563 C. Oliver. Electric switch wall plugs.

February 25, 1922.

5 590 T. L. Carbone. Arc lamps.
5 593 R. Bosch Akt. Ges. Switches. (28/2/21, Germany.)
5 619 A. E. Osborne. Electric alarm bolts.
5 620 Midland Electric Mfg. Co., W. G. H. Cox, & W. L. Barber. Adjustable time lags for circuit breakers, &c.
5 629 T. H. Kinman & H. J. Warner. Wireless telegraph and telephone systems.
5 630 W. E. Barber & H. J. Warner. Coils for wireless apparatus, &c.
5 637 General Electric Co., Ltd. (Just). Electric gasfilled lamps, &c.
5 662 Automatic Telephone Mfg. Co. Telephone systems. (16/3/21, U.S.)

February 27, 1922.

5 722 P. J. Monks. Telephone call indicator combined with sounder.
5 749 H. Booth. Electric laundry irons.
5 751 G. A. Revdle. Multiple-way connectors for electric conductors.
5 791 T. E. D. Bilde. Push-button switches. (21/3/21, Sweden.)
5 800 Western Electric Co. High-frequency signalling apparatus.
5 801 Western Electric Co. Carrier wave transmission systems.
5 802 Western Electric Co. Telephone systems.
5 815 E. Dobson. Oil trip and refused switches.

February 28, 1922.

5 833 H. Hawkins & L. R. Lee. Jointing of stranded electric conductors.
5 836 Forges et Ateliers de Constructions Electriques de Jeumont. Regulation of polyphase commutating motors. (5/4/21, France.)
5 842 R. A. Macaulay. Electric switches.
5 843 T. Clarke. Supports for incandescent lamps.
5 849 T. Cooper. Method of connecting up and driving dynamos.
5 850 C. V. Drysdale. Windings for electrical apparatus.
5 870 G. McKinnon. Junction boxes.
5 909 H. Gennings. Revolving dome electric alarm push bell.
5 924 H. Baron (Aldendorff). Automatic telephone exchange system.
5 925 B. T.-H. Co. (G. E. Co.). Thermostatic electric circuit controllers.
5 928 Watson & Sons (Electro-Medical). Diagrams for Röntgenology.
5 929 Chamberlain & Hookham & S. James. Instruments for measuring wattless component of energy in a.c. system.
5 948 English Electric Co. & J. C. Wilson. Protective arrangements for electric machines.
5 951 H. H. Berry & C. A. Painton. Decorative electric devices.

March 1, 1922.

5 980 J. Burn. Ship's telegraphs.
5 982 J. G. Stirk. Electric motor for power traverses, &c.
6 007 E. Melano. Electric bells.
6 027 Singer Manufacturing Co. Rheostat. (20/7/21, U.S.)
6 049 A. A. Sandbrook. Electric lamps for road vehicles.
6 059 K. Kando. System of pole changing for polyphase induction motors. (2/3/21, Hungary.)
6 072 B. T.-H. Co. (G. E. Co.). Thermostatic electric circuit controllers.
6 073 B. T.-H. Co. (G. E. Co.). Electric circuit controllers. ...
6 074 B. T.-H. Co. & A. P. Young. Magneto-electric machines.
6 092 G. W. Harris, L. G. Preston & C. E. Horton. Direction finding apparatus for wireless telegraphy.
6 101 H. C. Braun. Electric conductors.
6 102 H. C. Braun. Electric contacts.
6 103 H. C. Braun. Signals and alarms.
6 112 H. J. Round. Reception of wireless signals.
6 113 J. Bethenod. Electric railway signal repeating system. (2/3/21, France.)
6 120 J. B. Bower. Electrode holders for high-frequency apparatus.
6 122 J. B. Bower. Electric interrupters or make and break switches.
6 141 H. F. J. Thompson. Dynamo-electric machinery.

March 2, 1922.

6 143 H. McKinnon. Ships' telegraph systems.
6 151 T. R. Stancombe. Combined electric cooker and water heater.
6 179 R. P. Forster & J. W. Taylor. Brake blocks, electric collector shoes for railway vehicles, &c.
6 188 W. E. Bladon. Electric lamps.
6 192 H. Marcussen. Method of controlling electric battery used with instruments for assisting the deaf.
6 202 C. W. Denny. Switches.
6 205 G. V. Twiss. Means for supporting and insulating conductors of electric overhead distribution, &c., lines.
6 222 B. T.-H. Co. (Cie Francaise Thomson-Houston). Motor control systems.
6 232 Hart Manufacturing Co. Reciprocating rotary electric switches. (3/5/21, U.S.)
6 239 E. Green. Thermionic generators of high-frequency oscillations.
6 250 North & Sons & A. Massey-Allen. Magneto-electric machines.
6 255 O. Kurz. Electric driving apparatus for vehicles. (2/3/21, Austria.)
6 258 P. P. Berthet. Trolley wheels. (2/3/21, France.)

March 3, 1922.

6 262 W. M. Edwards. Electric light baths.
6 270 J. C. Lee. Cable joint boxes.
6 283 F. G. Warbrook. Reflectors for electric lamps for vehicles, &c.
6 289 J. C. White. Electric switches.
6 323 M. A. Codd. Electrical instruments in vacus.
6 329 Metropolitan-Vickers Electrical Co. Governing mechanism for multiple motor power plants. (3/3/21, U.S.)
6 330 Metropolitan-Vickers Electrical Co., A. E. L. Scanes & E. E. I. Pilcher. Cubicles for enclosed electric switchgear.
6 332 R. Bomborn. Electric hoisting device.
6 337 R. A. S. Paget & J. R. Quain. High-frequency therapeutic applicators.
6 358 T. Crackne'l. Electric light fittings, &c.
6 363 Sir C. A. Parsons & J. Rosen. Electric machines.
6 367 London Electric Railway Co. Turnstiles for registering and checking passengers' luggage.
6 372 K. Küpfmüller & K. W. Wagner. Arrangement for increasing speed of telegraphing over long lines. (4/3/21, Germany.)
6 380 B. T.-H. Co. (G. E. Co.). Electro magnets.
6 381 B. T.-H. Co. Arc welding apparatus. (27/7/21, U.S.)

March 4, 1922.

6 423 G. T. Smith-Clarke. Wireless telegraphy and telephony.
6 436 G. Comboni. Electrical hot air stove.
6 437 J. Stone & Co. (Bury). Locking devices for incandescent lamps, &c.
6 465 Ges. für Drahtlose Telegraphie. Radio antenna system. (5/3/21, Germany.)
6 467 L. Satchwell. Grid resistances.

March 6, 1922.

6 495 G. C. Lang. Apparatus for testing electrical apparatus and installations.
6 518 W. Muller. Telephone systems. (4/3/21, Germany.)
6 521 J. Watson. Electric reading lamps, &c.
6 536 H. D. Pyne. Telephone instrument apparatus, &c.
6 554 A. C. Hyde. Incandescent lamps.
6 561 J. F. Broom. Electric burglar alarm systems
6 574 Marconi's Wireless Telegraph Co., E. W. B Gill & J. H. Morrell. Generation of high frequency electrical oscillations.
6 575 R. B. Ransford (Smith). Electrical conductors.
6 582 C. H. Klyne. Automatic voltage regulators.
6 583 S. G. Brown. Cable telegraphy.
6 587 B. T.-H Co. (G. E. Co.). Oil-filled electrical devices.
6 598 K. Küpfmuller & K. W. Wagner. Shortening duration of telegraph signals on long lines. (7/3/21, Germany.)
6 608 H. Marlière. Apparatus for electrical ringing of bells. (7/3/21, Belgium.)

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CONTENTS.

EASTER HOLIDAYS.

Owing to the Easter holidays "The Electrician" next week will be published on Thursday, April 13th, instead of on Friday as usual.

Notes of the Week.

Electricity Supply Bill.

The Committee stage of the Electricity Supply Bill was commenced on Tuesday in the House of Lords. The proceedings, we fear, clearly indicate that dilatory and obstructive tactics are being resorted to in order to defeat or mutilate the measure. Though a motion to refer the Bill to a Select Committee was defeated by 42 votes to 40, there are sixteen pages of amendments, only a few of which are constructive, and it looks therefore as if few of the original clauses will remain if the opposition have their way, as seems likely, for Lord Peel is singularly complacent. From the remarks of some of the noble lords it is evident that they are ignorant of the most elementary facts concerning electricity supply.

The Opposition Analysed.

For instance, Lord Askwith wanted to exclude local authorities from being classed among the undertakers who are empowered to lend money to joint electricity authorities. He appears to be unaware of the fact that the majority of the supply authorities in this country are local authorities which have been in possession of their powers for years. Fortunately, this foolish amendment was negatived without a division. We regret, however, to see that an amendment limiting the operation of the clause to districts having a population of upwards of 50 000 was accepted by Lord Peel and agreed to. This will have the effect of excluding a number of the existing municipality electricity undertakers and so render the Bill practically unworkable, and therefore useless. We do not object to the amendment limiting the liability of Councils which are not authorised undertakers to the amount of a penny rate, because we believe there will be no general need to call upon the rates to make up any deficit.

The Institution—New Council.

As was recently announced, the election of the Council of the Institution of Electrical Engineers, which will take office on September 30th, 1922, will be held under the old dispensation, whereby the retiring Council nominates more names than there are vacancies, and the general body of members are left to make further nominations if they wish. This year, nevertheless, the Council breaks new ground in more than one way. In the first place, Mr. F. Gill, whom we are glad to welcome as President-elect, is at present only an ordinary member of Council, though he has, of course, served one term, if not two, as vice-president. Mr. Gill, as readers of The Electrician know, has had a distinguished career both as chief engineer of the National Telephone Company and, more recently, as European chief engineer of the International Western Electric Company. When the business of the National Telephone Company was taken over by the Post Office it was decreed that those in the more responsible positions should not pass into Canaan. Had a different policy been followed subsequent history might also have been different. Who knows? Mr. Gill is the first telephone engineer who has been president since the days of Sir John Gavey. That is an additional reason for welcoming him at a time when so much fierce light is being thrown on telephone organisation and when the technical problems in that branch of electric science are being both more interesting and more difficult.

A Useful Working Body.

Dr. W. H. Eccles, Mr. A. A. Campbell Swinton, and Sir James Devonshire, who are nominated for the two vice-presidencies and the honorary treasurership, are already serving in those capacities, and therefore require no introduction. Mr. J. W. Beauchamp, Mr. A. C. Cramb,

Major K. Edgcumbe, Dr. C. C. Garrard, and Mr. W. M. Selvey are nominated for the three vacancies among full members on the council; Mr. F. W. Crawter, Mr. A. B. Hart (of the Post Office), and Mr. W. R. Rawlings are nominated as associate members, and Mr. D. N. Dunlop is nominated, after a minimum period in retirement, as an associate. This, it will be agreed, is a useful working list, and Mr. Beauchamp's nomination, no less than Mr. Dunlop's, is a triumph for the new ideals that the Institution has in view. Mr. Cramb should be able to establish a useful *liaison* between the Institution and the I.M.E.A., and manufacturing and contracting interests will also be well looked after. Whatever the results of the election, we should have a good strong progressive Council drawn from those younger members who have up to now had little experience of Council work.

Cable Manufacturers' Results.

In our last issue we analysed the past year's accounts of the British Insulated and Helsby Cables, and were able to congratulate them on a record profit. But other cable and wire manufacturers also appear to have had a successful year, for W. T. Henley's Telegraph Works Company's net profit in 1921 was the largest in its long history, and the total of the London Electric Wire & Smith's was only £4 900 less than in 1920. No doubt the cable makers are the best organised branch of the electrical industry, and the good results of the past year's working are the direct result of this organisation, coupled with conservative methods of finance. The Henley ordinary dividend is maintained at 15 per cent., but the amount carried forward (£260 244) is nearly £80 000 more than the sum brought in. This company complains of the great difficulty, owing to depreciated exchanges and competition, of dealing with the demands from foreign countries. Signs of improved home and colonial trade are, however, reported, but such foreign orders as were obtained were taken at unremunerative prices. The London Electric Wire dividend (7½ per cent.) is the same as in 1920, but the amount carried forward is greater by £5 600.

T. C. & M. Progress.

The Telegraph Construction & Maintenance Company, whose speciality is the manufacture and laying of submarine cables, has also been able to maintain its dividend of 10 per cent. The past year was one of great difficulty for the company, as for all undertakings which have to maintain large stocks of raw materials. When the market for these materials is falling a great responsibility is laid on the management, but in this case the problem was dealt with so satisfactorily that the profit was £11 241 higher than in 1920. This result was obtained in spite of the turnover being less owing to the coal strike restricting the supplies of wire and other materials. The company's financial position is a strong one, and with the return of stable prices and better trade we feel sure will come increasing prosperity.

Electrical Engineering Companies.

Few reports of heavy engineering firms have been published, but most of those that have indicate satisfactory results, despite the industrial situation. Mather & Platt's experience was better than in any previous year; for the same rate of dividend as in 1920 has been maintained on a larger capital, while the carry-forward is much higher. The percentage of profit on the turnover was slightly less than in 1920, but higher machine capacity enabled the firm to increase the output and to show a larger profit. This firm has always followed a progressive, enlightened policy, and the extensions to the tools and works equipment have been amply justified by the results shown. From the report of the Metropolitan-Vickers Electrical Company we learn that the profit was £440 300, an increase of £38 100 over the previous year, and that after paying debenture interest and providing an increased amount for depreciation there is a net profit of £337 100, or £28 000 more than in 1920. The dividend is at the same rate (12½ per cent.) as in the previous year, and the amount carried forward is £92 800, or £34 000 more than the sum brought in. The Brush Electrical Engineering Company's profit is £319 000, or £33 700 more than in 1920, and again a dividend of 15 per cent. has been declared on an increased capital. There have also been heavier appropriations to reserves and depreciation, and the balance carried forward is up by £70 800. Bruce Peebles & Company are making a distribution of 15 per cent. (of which 5 per cent. is a bonus); Mirrlees Watson are paying 12½ per cent. (10 per cent. as dividend and 2½ per cent. as bonus); Browett, Lindley & Company have declared an ordinary dividend of 10 per cent.; and Stewarts & Lloyds one of 10 per cent. on the preferred ordinary and 12½ per cent. on the deferred shares. Among the better-known companies in the lighter branches of the industry may be mentioned the Pritchett & Gold & E.P.S. Company, which is paying an ordinary dividend of 10 per cent.; while Ferguson Pailin's distribution is 13 per cent.

A Few Sufferers from Depression.

On the other hand, a few firms have been badly hit by depreciation of stocks and raw materials. In this category may be mentioned Davis & Timmins, who report an actual loss on the past year's working. The Edison Swan Electric Company's experience has also been painful, for the directors' report announces that the debit balance for the year ended June 30 last was £344 000, so that after using the reserve of £55 000 the adverse balance is £289 700. The company appears to have been badly affected by strikes and by restricted trade. In addition, there has been a heavy depreciation in stocks, which have been written down by £346 000. In fact, depreciation of stocks is said to be responsible for most of the year's loss. It is, however, satisfactory to be able to record an improvement since November last, and it is claimed that with a moderate revival in trade the outlook would be much more favourable. Important changes have taken place in the directorate, and there is a prospect of litigation with the Philips Glowlamp Works.

"Listening-in."

There are legal and illegal ways of using the telephone; but the number of calls which can with justice be placed in the latter category certainly form only a negligible percentage of the total. On the other hand, the number of calls in which it is desirable that the information passing should only be heard by the two persons communicating, not because the purpose of the conversation is in any way illegal, but because it is private, is certainly much larger. The question, therefore, arises to what extent do operators habitually listen-in on subscribers' conversations, and if this undesirable practice is general what means other than disciplinary action can be taken to prevent it. It may be said that, apart from automatic systems, there are no means of preventing listening-in, though there are schemes in which the requirement of strict privacy is approximately met—more or less as a side line.

The Technical Difficulties of Prevention.

Thus, when keyless cords are employed the insertion of the answering plug puts the operator's telephone in circuit with a caller's line. But when the calling plug is inserted in the multiple jack of the calling party, and the called subscriber has answered, the operator's telephone is cut off and she cannot reconnect it in the ordinary way of business. Even so it is possible for her to listen-in by inserting the answering plug of another pair into another multiple jack of the called party or into a jack of the calling party and so satisfy her curiosity and perhaps gain useful information. Theoretically, however, even this action can be prevented by using a device to short circuit the operator's telephone when the answering plug is inserted in a multiple jack, though this would introduce considerable complications, making it practically impossible of employment on existing boards.

The Chief Safeguard.

The chief safeguard against such curiosity on local lines is that normally the operator is too busy with her own work to worry about other people's business. At other times it is a habit—if it be a habit—which should be strenuously discouraged by the authorities. For even high rates and a service that is not perfect will not more quickly give the telephone a bad name than the idea that it is not private. On trunk lines—and it is because of certain recent happenings on trunk lines that the question has arisen—the operator must " listen-in " on occasion to ask whether a subscriber will break his local call to take up a trunk, so that there has to be at least one position on which an operator can overhear. At the same time, the end of the call must be notified, and this applies equally on automatic as on manual exchanges. The maintenance staff, too, are sinners, inasmuch as from time to time they must enter circuits and can then, of course, overhear any conversation so proceeding if they wish to do so. In practice, however, the attraction is not so great as to make it worth while, and it is therefore a case where for many reasons discipline is better than electricity in effecting the cure.

Electric Welding and Ship Construction.

Electric welding is now a familiar and established process in ship construction. We therefore notice without surprise that Mr. A. T. Wall, in a Paper read recently before the Institution of Mechanical Engineers, speaks highly of its advantages in replacing rivets, always a source of latent weakness. For the assumption that plates are only weakened in proportion to the area punched out is not confirmed by facts; the weakening is so much greater that when special strength is desired flush joints with riveted straps are usual; but even with this arrangement theoretically only 81 per cent. of the strength of the intact plate is obtained. Electric welding, on the other hand, allows the use of practically 100 per cent. of the material for strength purposes, and has other economic advantages. For instance, the saving in weight by the use of electric welding methods amounts to 5 per cent. of the total weight of steel in the ship. The author also remarks that welding, while resulting in a more efficient structure, should not cost more than riveting. The saving in weight is of special value in warships and high-speed merchant vessels, because the horse-power needed for propulsion can be materially reduced. One point of great importance, however, is the human element. Welders should not only receive a specialised training, but should be men who are morally incapable of doing scamped work or covering up defects.

The L.C.C. Trolley Omnibus Proposals.

Misfortune seems to attend every attempt of the London County Council to improve its tramway system or to increase the transport facilities in the Metropolitan area. A couple of years ago a somewhat ambitious tramway extension scheme was wrecked by the borough councils insisting upon exercising their right of veto, and this year's Bill, containing powers to experiment with trolley omnibuses in the Lewisham area, has met with a similar fate. The Lewisham Borough Council refused to give its consent on the ground that overhead wires were unsightly, and, though the Ministry of Transport were favourable, the House of Commons, by 86 votes to 72, supported the Borough Council and have refused to allow the Bill to proceed. This is to be regretted, for undoubtedly the trackless trolley is much cheaper than the conduit system, and it has other advantages in areas where traffic is not heavy. The episode is a further illustration of the chaotic condition of local government in London and of the urgent need of a central traffic authority to deal with all questions relating to transport in the Metropolitan area. For the veto of the Borough Councils is used to obstruct, and should be treated as befits obstructions.

Glasgow's Tramway Undertaking—A Contrast.

To compare the fate of the London County Council Bill with that of the Provisional Order of the Glasgow Corporation is to be convinced of the difference in treatment that is vicariously meted out to legislative projects. As we have noted, the Bill has been rejected unceremoniously, but the Order of the latter has been passed, after slight modifications only, by a Joint Committee of the House of Lords and House of Commons. It is true that the omnibus clauses aroused strong opposition from railway and tramway companies and other private interests, but the County Councils supported them as they preferred to deal with the Corporation rather than a number of private companies. After a full investigation the Commission sanctioned the running of omnibuses on any route within a ten-mile radius of the city in extension of the existing tramway system, with the consent of the Minister of Transport and of the local authority. There is a right of appeal to the Ministry of Transport.

Municipal Manufacturing Scotched.

But the Corporation, we are glad to see, failed to secure the right to manufacture motor omnibuses, and a limit has also been imposed on the capital expenditure which may be incurred in the purchase of these vehicles. On the whole, this seems to be an equitable decision, and it will enable the Corporation to test the utility of omnibuses on a limited number of routes and to link up certain of the tramway termini, a right which has been more than once denied to the London County Council. Surely what is good for Glasgow cannot be bad for London, and therefore we deplore last week's decision of the House of Commons, which places the Metropolis in a less favourable position than the city on the Clyde.

Electricity Supply Regulations.

In the new edition of the Electricity Commissioners' Regulations for (*a*) securing the safety of the public, and (*b*) for ensuring a proper and sufficient supply of electrical energy, the only alterations appear to be those rendered necessary by the changes in administration made by the Electricity (Supply) Act. Hitherto four forms of these Regulations have been in use, viz., two for the provinces and two for London, in each case one being for companies

and one for local authorities; but only the provincial Regulations have been issued on this occasion, as the whole of London is already supplied by electricity undertakers, and no Special Order authorising the supply of electricity is likely to be issued for this area. In the past, when companies have desired to change the system of supply or the pressure or frequency, the consent of the local authorities, as well as the sanction of the Commissioners, has been necessary, though in the ultimate resort the consent of the local authority could be dispensed with. In view of the necessity for developing a national system of electricity supply, we cannot see that any useful purpose is served by going through the formality of obtaining the consent of the local authority, and we hope that the Commissioners, who are in the best position to judge of the merits of any proposed changes, will now abolish a useless practice. Hitherto it has, as far as we know, only been used for dilatory or obstructive purposes, and in the supply industry there is now no place for any formality which can be employed as a check upon progress.

Trade and Trade Associations.

WHAT, it may be asked, are the proper functions of a trade association? And what, it may be propounded as a corollary question, are the best methods of determining whether a particular association is efficiently fulfilling those functions or no?

Starting at the bottom of the ethical scale, it will perhaps be agreed that the first of the functions is to achieve some form of price-maintenance for the sale of products, but above that we place both as more important and on a higher ethical scale the co-operative dealing with matters that arise to affect and influence the well-being of the association in its relations with the Government, the community, the transport undertakings and other trading bodies. While giving its members full scope to carry on their business in the way that seems to them best, providing only that that way does not include actions which will react harmfully on those with whom they are combined, any association can do most useful work in watching the actions of the bodies we have named and in placing before them views of those for whom they are working, not as individuals but as corporations.

The Highest Duty of an Association.

More than that, it should be the aim, and the highest duty of such a body, to inaugurate research and to provide funds for carrying on that work, which, though not immediately remunerative, is by the strength which it gives to the foundations of the industry of the very greatest importance. Especially is this the case in the electrical industry (for while arguing generally we are, of course, thinking particularly) where the connection between pure science and commerce is closer and more visible than is usual in other cases.

Examined from these points of view, how do the operations of the British Electrical and Allied Manufacturers' Association, as disclosed in their annual report, indicate the extent to which the functions of an ideal association are being performed or neglected? We think it will be agreed that the marks scored are very high.

Research and Scholarship.

Dealing first with research, the B.E.A.M.A. is giving adequate support to the Electrical Research Association, which, as readers of THE ELECTRICIAN well know, is, after the troubles inseparable from infancy, now performing useful work. The association's own research committee has also been reorganised and enlarged so as to represent directly the interests of the sections and to facilitate communication with the E.R.A. The association is playing its part in the operations of the B.E.S.A., on whose various committees and sub-committees it is adequately represented. It is watching the situation with regard to education, and has itself endowed scholarships to assist research in certain subjects and has taken steps to facilitate the introduction of students from overseas into the works of members. In the performance of this, the highest of its functions, the evidence is all that it is doing very well.

Relations with the Government.

Nor are the results less gratifying when we descend the scale a step. A close *liaison* has been established with the Board of Trade, so that the interests of members under the Safeguarding of Industries Act, the Overseas Trade (Credits and Insurance) Act, the Trade Facilities Act, and the Local Authorities (Financial Provisions) Act are being watched. In conjunction with other similar associations much good work has also been done on the problems of railway rates, claims for damage, demurrage tariffs, and conditions of contract. Here, again, it is obvious that views will be heard and concessions obtained more easily in combination than by individual action. Last, but not least, the establishment of a Conference of Joint Industrial Councils and Other Bodies in the Electrical Industry, in which the B.E.A.M.A. is taking an active part, should be of much assistance in presenting the views of both employer and employed to Government Departments and other interested bodies with a single voice. A most important matter in these troublous days?

A Lesson that Need Not be Repeated.

While direct reference to the first function of a trade association, which we have detailed above, is not made in the report, the chairman, Mr. W. O. SMITH, in moving its adoption, remarked in no uncertain terms that, though combination was easy in times of prosperity (when it is not greatly needed), its responsibilities imposed a great strain in times of depression, when the temptation to obtain work at any price was almost too great to be resisted. He pointed out quite rightly that if that temptation is not resisted the electrical industry will find itself in the same unsatisfactory position as when the B.E.A.M.A. was started, and that surely is an experience which even the most individually minded will not wish to repeat. For while association has meant remunerative prices, it has also inspired confidence (where before there was distrust) which it would be suicidal to dispel in view of the better times which must surely come.

We are glad indeed to find that Mr. SMITH is an optimist. There are those who consider that the electrical industry has not seen the worst of the slump. But the chairman of the B.E.A.M.A., putting his faith in the Stock Exchange barometer, declares that though there may not be an immediate boom there should be a slow, solid, and durable improvement. We sincerely hope this cheerful prophecy may be justified.

One Criticism.

Speaking generally, then, there seems every reason to suppose that the British Electrical and Allied Manufacturers' Association is performing its functions to the satisfaction of its members; and therefore for the good of the

electrical industry. It is true the report is an *ex parte* statement, and that there will not be lacking critics both of the association's policy and its actions. On one small point we are numbered among that band. Why is it necessary for the B.E.A.M.A. to hold its annual general meeting in almost Masonic secrecy, not to issue its report until twelve days after it has been confirmed, and then to do so on a day which prevents most of the electrical journals from dealing with it for yet another week? There may be occasions in the history of any such association when secrecy is necessary, but this is surely not one of them.

Electro-Farming.

SEARCHING around eagerly for fresh worlds to conquer, the electrical engineer has not unnaturally turned his attention to the possibilities offered by the farm and all that term implies. We say not unnaturally, for the agricultural industry is the largest industry in this and most other countries. Like other industries, small and large, it has been adversely affected by war and post-war financial conditions, and by the claims of the worker, often well founded, to improved wages and surroundings. If then the use of electricity, by reducing labour costs and increasing output, as it has done in other industries, can widen the margin between income and expenditure its employment is worth serious consideration by the farmer. And if the farmer can be persuaded of these things the matter is equally worth consideration by those supply undertakings which operate in rural areas and whose power load is therefore small and not likely to be anything else for some time to come.

As is well known, a certain amount of progress has been made in applying electricity to farming, notably by Mr. W. T. KERR in Hereford and its neighbourhood, and in France, Norway, Germany, Canada, and the United States, where opportunity has been taken to tap transmission lines and so give a supply to farmers at a trifling cost.

A Useful Piece of Propaganda.

The paper read by Mr. R. BORLASE MATTHEWS before the Institution of Electrical Engineers on Thursday last week is therefore a useful piece of propaganda. Deserting the dusty and crowded roads of the electrical industry, Mr. MATTHEWS has taken up farming for himself, and has, moreover, introduced the electric idea into farming operations. What this connotes will be easily realised by a study of the paper. Electricity, it appears, has so many possible applications in the farm buildings, in the farm house, on the land and in treating the gathered crops that one has only to cudgel one's brains to think of some farming operation and then turn with confidence to the Paper to see how it is done electrically.

Electricity and Agricultural Production.

Leaving out of account for the moment the much discussed possibilities of electro-culture in stimulating the growth of crops, Mr. MATTHEWS is able to show that electricity can be of real use in increasing the production of a farm. To take one example, which is in some sort a reply to the criticisms to which we shall refer later, the lighting of the farm buildings electrically not only allows operations to be carried on in comfort which without it can only be carried on with difficulty or not at all, but leads to a direct increase in productiveness in such operations as egg laying, chicken farming and milking. The use of the small portable electric motor also means an increased production and a saving in labour on chaff cutting, sewage pumping, churning, threshing and such operations, while under certain conditions electric ploughing is an economy which makes its employment well worth considering.

The Electrical Engineer Turned Farmer.

It is here that some examination must be made of the devastating criticisms of Mr. MATTHEWS' arguments and results which were advanced by Mr. LLEWELYN ATKINSON and Mr. BERNARD JENKIN. The electrical engineer is often by nature a pessimist. The same description may be applied with justice to the farmer. When the two are combined in one person we mathematically obtain a mental outlook whose gloom can be better imagined than described. The actions of one with such an outlook are clouded by a cimmerian darkness which needs a vast deal of dispelling, and the result is he is fearful where others would be willing and even anxious to make a trial.

Disadvantages of Electricity.

Nevertheless, Mr. ATKINSON, being Mr. ATKINSON, we must admit that his detailed arguments that it will pay neither the electricity supply undertaking nor the farmer to use the electric device in the extensive way advocated by Mr. BORLASE MATTHEWS cannot be lightly dismissed by calling him a pessimist. He contends that the duties performed by an electric motor on the farm can be equally well, and more cheaply, performed by a petrol-paraffin engine, that though both these devices save labour they do not save one labour unit—a man—and that the chief chance for electricity on the farm lies in electro-culture, which though a poor load does not cost much to install and does do something which cannot be done in any one way. Not a very cheerful outlook, it will be admitted.

But Mr. ATKINSON'S pessimism was nothing to Mr. JENKIN'S. Indeed, we began to think Mr. JENKIN was a sort of super-electrical engineer. In his view the horse is the most efficient machine to have on a farm (and even it is very inefficient), and all machinery is not only expensive to buy but fails to earn its keep by doing things too quickly. Between them these two speakers put up a heavy barrage of anti-propaganda which must have astonished the meeting as much as it must have discouraged the speaker if he were not an inveterate optimist.

Are Things Really So Bad?

But having recovered from the first shock of the attack, it may be as well to enquire whether things are really as bad as these two speakers would have us believe.

It seems to us that both Mr. ATKINSON and Mr. JENKIN made the mistake of comparing ancient with future farming methods. In towns the lighting load is becoming to be looked on as a necessary evil. In obtaining the farming load it may be the deciding factor, both financially and as a weapon in the selling armoury. For a considerable period of the year many essential operations on the farm have to be carried on in darkness made visible by the light of a lantern. Direct savings might easily be effected by employing more modern methods. Mr. MATTHEWS has shown how. The start having thus been made, the advantages and economies of the electric motor on the farm would be magnified in the view of both the farmer, pure and simple, and the electrical engineer turned agriculturist. He could then start to reap those advantages by co-operating with his neighbours so as to reduce initial outlay on equipment and to improve its total hours of use.

Modern Telephony Technically Considered.*

Phantom Telephone Circuits—Combined Telegraph and Telephone Circuits Worked at Audio Frequencies—The Effect of Loading and Amplifiers—A Review of the Present Position.

By J. G. HILL.

In a Paper entitled "Phantom Telephone Circuits, and Combined Telegraph and Telephone Circuits, worked at Audio Frequencies," which was read at a recent meeting of the Institution of Electrical Engineers by Mr. J. G. Hill, the author deals with the effect of loading and the use of thermionic amplifiers in providing efficient long-distance telephonic communication by means of small gauge conductors in underground cables. This constitutes a revolution in modern circuit provision, and makes it an opportune time for a review of the theory of superposed circuits worked at audio frequencies.

The methods most generally employed to provide extra channels for telegraph or telephone communication may be classified under the following heads: (1) The impedance or retardation method of combined telegraphy and telephony over the same wire or wires, and (2) the equipotential method of providing simultaneous channels for telegraphic and telephonic communication over the same wires, and the application of this method to the balancing of telephonic relayed circuits.

Impedance Method.

This method was first introduced by F. Van Rysselberghe in 1882. Combined working is rendered possible by the different impedance of inductance coils and condensers respectively to high- and low-frequency currents. A condenser is placed in series with the telephone and an inductance coil in series with the telegraph branch. The condenser permits the speech frequencies to pass readily in the telephone branch, but opposes a high impedance to the lower frequencies of the telegraph currents. The inductance coil reduces the shunting effect of the telegraph branch on the telephone branch and also reduces the rate of rise of line voltage when telegraph signals are sent, thus minimising the disturbance caused by these signals in the telephone branch.

Van Rysselberghe System.

A high inductive impedance RL is placed in the path of the telegraph apparatus and a condenser C in the path of the telephone apparatus, the two sets of apparatus being joined in parallel and connected to the line as indicated in Fig. 1.

It is of interest to study more closely the effect of the inductive impedance and the condenser in order to find to what extent (if any) the retarded telegraph signals cause disturbance in the telephone set, and, further, how far the retardation affects the telegraph signals themselves. On account of the variable characteristics of the iron cored telegraph apparatus, experiment is usually preferred to calculation in determining the best values of the inductance and capacity required. The fundamental effects may however be studied with advantage from the mathematical point of view.

Let E be a constant applied voltage at A; v be the voltage at the terminals of the condenser at the time t; R be the resistance of the retardation coil; L be the inductance in henrys of the retardation coil; R be the unvarying resistance of a long line supposed to be non-inductive; C be the capacity of the condenser in farads; t be the time in seconds after the application of the voltage E to the circuit.

Then the equation connecting the voltage v with the time during the transient period when the E.M.F. is rising from zero to its steady value E, is

$$\frac{d^2v}{dt^2}+\left(\frac{R}{L}+\frac{1}{CR_1}\right)\frac{dv}{dt}+\left(\frac{R}{CLR_1}+\frac{1}{CL}\right)v=\frac{E}{CL} \quad \ldots\ldots\ldots\ldots(1)$$

The corresponding equation for the value of v at any instant t after the application of E, is

$$v=\frac{ER_1}{R+R_1}\left[\left(-\frac{1}{2}-\frac{\alpha}{2\beta}\right)e^{(-\alpha+\beta)t}+\left(\frac{\alpha}{2\beta}-\frac{1}{2}\right)e^{(-\alpha-\beta)t}+1\right] \quad \ldots(2)$$

where

$$\alpha=\frac{1}{2}\left(\frac{R}{L}+\frac{1}{CR_1}\right) \text{ and } \beta=\frac{1}{2}\sqrt{\left[\left(\frac{R}{L}-\frac{1}{CR_1}\right)^2-\frac{4}{LC}\right]} \quad \ldots\ldots(3)$$

If $R/L=1/CR_1$ and $R=R_1$ the equation for v may be written

$$v=\tfrac{1}{2}E[1-\sqrt{2}e^{-t/cR}\sin(t/CR+\tfrac{1}{4}\pi] \quad \ldots\ldots\ldots\ldots(4)$$

In any case, if β is imaginary the equation assumes a form similar to (4).

Examination of these equations shows that the rate of rise of the voltage is logarithmic, and that by arranging suitable values of R, L, C, and R_1 the rate of rise of the volts may be either advanced or retarded.

If R and L represent the reactance and inductance of a relay at the receiving end of the line and C a condenser shunted by R, at the same point we have the well-known arrangement of the shunted condenser.

*Abstract of a Paper read before The Institution of Electrical Engineers.

Fig. 2 gives an oscillogram of the normal rise of current in an unshunted Wheatstone telegraph receiver, and Fig. 3 shows the more rapid rate of rise obtained by adding the shunted condenser to the same apparatus, the adjustment being made to produce a signal as nearly square (flat-topped) as possible.

In the case of the combined telegraph and telephone circuit the values of R, L and C must be chosen to reduce the rate of rise of

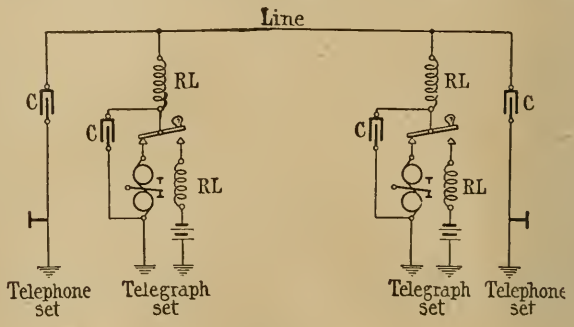


Fig. 1.

voltage at the condenser terminals. It is not practicable with this simple arrangement to eliminate entirely the disturbing effects of ordinary Morse signals in the telephone circuit.

Effect of Retarding Devices.

The rate of telegraph working is largely influenced by the electrical sensitivity of the apparatus employed, as well as its mechanical inertia, so that in practice the rate of working depends on the combined apparatus and line. From another point of view it also depends on the technical nature of the service utilised. For example, in simplex working a higher all-round speed per channel is possible than in duplex working, and, again, a higher speed is obtainable per channel in duplex working than in quadruplex working.

In order to provide a working margin of safety the Van Rysselberghe system is in fact generally worked only at hand speed. If this is assumed, electrical filters may be used to cut off the currents of higher disturbing frequencies.

Composited Circuits.

Fig. 4 shows an arrangement used in England and elsewhere for utilising the two wires of a double-wire circuit to form two duplex circuits. This arrangement is known as composited working. In

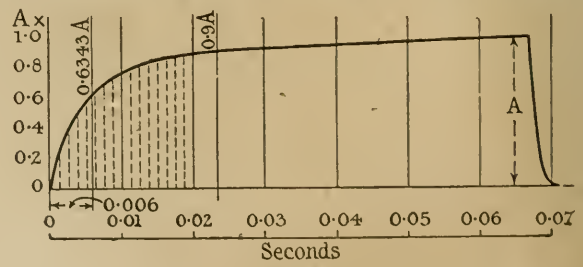


Fig. 2.

this country the arrangement is sometimes used to superpose telephone call wires worked by telegraph upon junction circuits worked on the common battery system (see Fig. 4), or, alternatively, one wire is used as a telegraph call wire, and the other for automatic signalling on the junction circuit. A transmission loss of about one mile of standard cable is usually involved for each set of apparatus.

It may be mentioned that simplexed and composited sets have been used in this country for many years. (A simplexed circuit is a telegraph circuit worked in parallel over the two wires of a telephone circuit.) And as far back as 1908, 200 circuits on the simplexed system were in use in this country. At the same time a large number of circuits were in use for local telephone circuit working on a method devised by Mr. W. J. Medlyn.

According to this method, which is described and illustrated in the Paper, use is made of a length of a main telegraph circuit to form the second wire of a local double wire telephone circuit running on the same route.

Relative Efficiency of the Side and Phantom Circuits.

The Paper next outlines the relations determining transmission efficiency and shows that in the case of open wires arranged on the pole arms at the four corners of a square the transmission efficiency

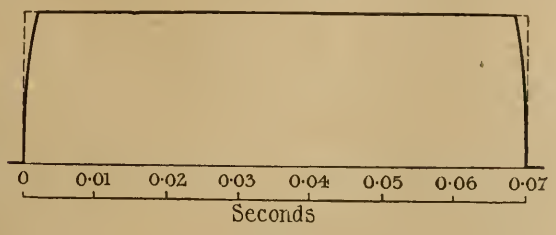


Fig. 3.

of the phantom circuits is slightly less than that of the side circuits. When the four wires are arranged horizontally on the same pole arm the reverse is the case. On unloaded underground circuits also the phantom circuit is of a higher transmission efficiency than the side circuit, so that by superposing we actually obtain an additional circuit which is more efficient than the circuits on which it is superposed.

The transmission efficiency of circuits in submarine cables is also considered. In these cables a secondary phantom circuit is possible over the four wires to earth. The metallic loaded phantom circuit has approximately the same efficiency as the side circuit. The earthed phantom circuit, however, is materially less efficient than the other two circuits, owing to the increased effective resistance, which is observed in such circuits—*e.g.* an increase of about 2·5 Ω per naut per wire at 800 periods per second—owing to the interaction between the field of the conductor and the metallic sheath of the cable, and the effect of the return path consisting of sea water.

Relative Transmission Efficiencies.

In practice, the relative efficiency of transmission of the side and phantom circuits is largely determined by commercial conditions as well as electrical possibilities, the main considerations being as follows:

It is economical to space loading coils as widely apart as possible in order to obtain a given average inductance per mile, but it can be shown that the wider the spacing the more the higher frequencies which enter into the composition of speech are cut off, and beyond a certain cut-off point telephonic speech becomes indistinct and impossible. Owing to the indeterminate nature of the frequencies entering into speech, it is necessary to make experiments to determine the widest permissible spacing. The rule hitherto obtaining as a result of experiment in Great Britain is as follows:

$$CDL=25$$

where C is the capacity of the cable circuit in microfarads per mile, D is the distance in miles separating the coils and L is the inductance

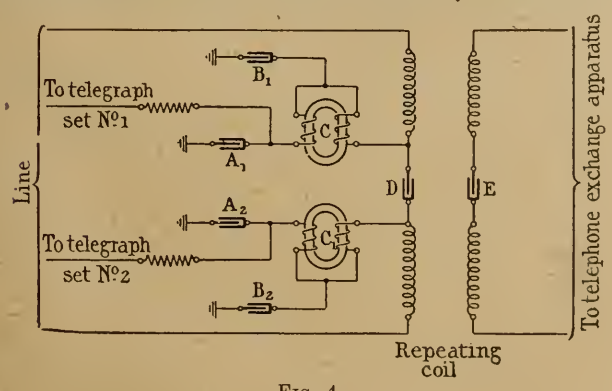


Fig. 4.

of the loading coil in millihenrys. This rule applies to circuits of length not exceeding, say, 350 miles.

Again, in practice it is economical to have only one set of manholes to accommodate both side and phantom loading coils. The most economical arrangement for the two side circuits generally leads to the greatest total economy of the four-wire combination, and the position of the manholes is therefore made to suit the side circuits; this means that there is no choice of spacing for the phantom coils. The only thing that can be done for the phantom circuit is to increase its inductance above the hypothetical value of one-half that of the side circuit up to the limit permissible by the spacing rule, and this procedure gives a phantom circuit having a lower attenuation constant, and therefore a higher transmission efficiency, than the side circuit, usually to the extent of 15 to 25 per cent. (owing to the relatively smaller capacity of the phantom circuit and its higher degree of loading).

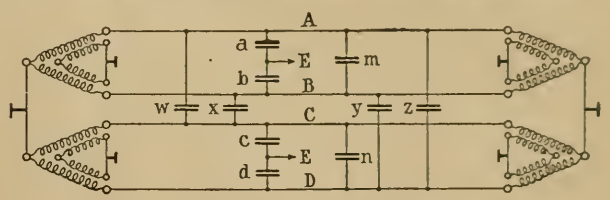
The cheapest possible combination of loading coil and cable (including side circuits and phantom circuits) which will produce the required transmission efficiency is obtained from the formula

$$P=\frac{A}{C}\left(x_2+2+\frac{1}{x_2}\right)+\frac{B\sqrt{C}}{x_2+1}$$

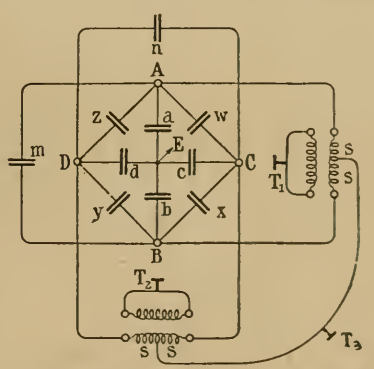
where P is the combined cost of one mile of cable pair and its loading; A is RP_1 where R is the resistance of one mile of a known and selected conductor pair and P_1 its cost; $B=\sqrt{(x/R)}P_2$ where $x=Lm/L$. Lm is the maximum loading of the conductor of resistance R and L is the loading which when combined with R gives the required attenuation constant β. P_2 is the cost per mile of providing L and includes coils and manholes. $C=R(x+2+1/x)$ $=R_2(x_2+2+1/x_2)$. Here $x_2=Lm_2/L_2$, which is the maximum loading Lm_2 for R_2 divided by an inductance L_2, which inductance when associated with R_2 in a cable pair gives the required β. R_2 and L_2 are the unknown values which may be derived from x_2.

Over-hearing and Cross-Talk.

If the circuits are long enough, the mean voltage in a loaded circuit with the same applied E.M.F. is greater than in an unloaded one,



(a) Capacity relations in a phantom circuit



(b) Symmetrical arrangement of the above

Conditions in 4-wire quad for no overhearing and no cross-talk.

$p=w-x=0$	$s=x-y=0$
$q=z-y=0$	$u=a-b=0$
$r=w-z=0$	$v=c-d=0$

Fig. 5.

and any want of equality in the constants of the A and B lines will result in a greater difference of potential between them, resulting in greater overhearing between the side and phantom circuits, and in cross-talk between the side circuits.

In order to secure a perfect balance, the resistance, capacity, inductance, and leakance of the four wires of a phantom circuit must be theoretically equal. It is possible to a large extent to control the equality of the conductor resistance of the cable in the factory. The inductance and effective resistance of the loading coils in a coil-loaded cable can also be very closely balanced.

A variation of not more than 0·25 per cent. between the inductance of the two halves of the same loading coil and not more than 0·1 Ω between the direct-current resistance of the two halves of the same coil is guaranteed. A variation of not more than 2 per cent. in the inductance of different coils is required and is possible. The leakance of the cable can also be efficiently controlled in manufacture, supplemented by care in laying the cable, and it does not cause appreciable difficulty. The electrostatic capacity of each wire in a four-wire core of the cable cannot, however, be sufficiently equalized in an economical manner in the factory. Special steps are therefore taken to equalize the capacity of the wires in each four-wire group during the process of laying.

Since the mean disturbing voltage in the circuit is much higher in the case of the relayed than the unrelayed circuit, a degree of capacity balance is now required which was not considered necessary for loaded phantom circuits without relays.

Effect of the Introduction of Telephone Relays.

The capacity system of a four-wire core may be represented by 10 capacities between different wires and between wires and earth, and it can be shown that from six capacity measurements the necessary combinations to avoid over-hearing and cross-talk can be deduced. (see Fig. 5). These measurements are made by means of a double-bridge specially designed for use on the road. Apparatus is also designed for the rapid measurement of the degree of equality of the resistance of the conductors. Special steps, however, are required in the factory to reduce the out-of-balance of resistance as far as possible, and this is considered much preferable to compensation on the road by crossing. The reduction of road balancing of resistance to a minimum is therefore aimed at. Incidentally it may be mentioned that it is highly important that the cable constants, including capacity, should be made as uniform as possible in the factory, in view of the exacting requirements of modern developments and the difficulty in replacing non-uniform cables when faulty. The amount of out-of-balance of capacity and resistance which can be permitted depends essentially on the relation between these quantities and the corresponding amount of cross-talk and overhearing resulting from them ; tests of these quantities are therefore necessary.

DISCUSSION.

Sir Andrew Ogilvie said that the Van Rysselberghe system was originally welcomed by the telegraph authorities as a chance of obtaining a share of the telephone traffic. But these hopes were not fulfilled as it could not be employed for ordinary exchange working. It was mainly useful for railway purposes, though the Post Office had employed it to extend the telephone system into rural districts by converting village telegraph offices into telephone call offices. The simplex and composited methods described by the author had not been largely used in this country, probably because the telephone and telegraph business had developed separately. But in a new country the best policy would be to provide telephone circuits and to use them for telegraph working. The super-position of phantom telephone circuits on telegraph circuits was important, and was likely to become of still greater importance in the near future, owing to the employment of thermionic relays on loaded cables.

Limitations of the Van Rysselberghe System.

Mr. S. A. Pollock said that the limitations of the Van Rysselberghe system were fundamental, for it was wrong to depreciate one circuit to gain another. One of the difficulties was that a pure inductance could not readily be obtained without capacity across it, and a very small capacity was sufficient to short circuit the inductance when the instantaneous voltage was impressed. This could be overcome by using a pure resistance associated with a condenser to earth, with the result, however, that the rate of rise of current, and therefore the speed of the telegraph circuit, was adversely affected. Resistance was an essential condition for even partial success with this system, and could not be replaced by inductance as Mr. Hill seemed to think. The winding of the coil provided a capacity between the windings which short circuited both the resistance and the inductance to a certain extent, and even a small capacity was sufficient to disturb the telephone and make the system unworkable. On the other hand, the employment of telegraph phantom circuits on telephone lines provided a field for further development, though it was probable that only a relatively small percentage of the telephone trunk lines in this country could be utilised for such super-position.

Conditions in Composited Circuits.

Mr. A. B. Hart remarked that the curve given by Mr. Hill of the rise of current in a composited circuit did not really represent what happened. The current did not increase smoothly from zero to a maximum value, but was of an oscillatory character. It was necessary in composited circuits to know the maximum frequency which had to be transmitted in order to give satisfactory telegraph working and then to cut off what was unnecessary.

Mr. A. E. Thompson said that the composited method was being used by the Danish and French administrations, while between Copenhagen and Hamburg the American composite method was being employed. A combined phantom and composited circuit was used by the American army between Tours and Chaumont with repeaters at Autun in 1918, a distance of 306 miles, and since then the system had made great progress in America, not only under the Bell companies but by the railway companies. Compared with American methods, the Post Office arrangements seemed to have the disadvantage that the telegraph signals passed through one winding of the repeating coil, which must introduce a certain amount of thump in the telephone. This might be overcome by making the condensers tapped to earth of large capacity, but if these condensers were of greater values than six microfarads the efficiency of telegraph transmission would be reduced.

A Japanese Representative.

The President said he felt sure that members would welcome Mr. S. E. Inada, of the Japanese Department of Communications, who was present at the meeting.

Mr. Inada complied with the President's invitation to speak, and though his knowledge of spoken English makes it difficult to report his remarks, it probably compares favourably with that of his hearers' knowledge of Japanese. Mr. Inada said that the Institution had been a great help to Japanese engineers, and they were making progress on the lines indicated in Mr. Hill's Paper and the Paper read by Mr. Byng earlier in the session. He was particularly interested in the subject under discussion in view of the change from the overhead to the underground system.

Nomenclature Difficulties.

Mr. W. Aitken objected to the term "side circuit." These were more often called physical circuits, which was a much more pregnant phrase. Telephone relays were now of two kinds, non-circuit-closing and circuit-closing, and there should be separate terms for each. There were speech-repeaters and impulse-repeaters. These should also be differentiated. Nowadays telephone circuits were becoming complicated, what with loading, superimposing and amplifiers. They were also to have means of calling over these circuits, and shortly they would be discussing automatically impulsing them. What the circuits would be like in the end it would be difficult to forecast, and still more difficult to understand.

Railways and the Van Rysselberghe System.

Mr. W. J. Thorrowgood did not agree that the Van Rysselberghe system was moribund. Superimposing telephones on telegraphs, and *vice versa*, was not the delicate operation some of the speakers seemed to believe. The Bath-Bournemouth circuit was 76 miles long, with a spur near Glastonbury to Highbridge, making the distance from Highbridge to Bournemouth 72 miles. On that single wire there were fourteen telegraph and sixteen telephone instruments, and it was possible to speak from one end of the line to the other. On the line from Waterloo to Southampton there was a single needle telegraph instrument at each end, and twelve telephones at various places. The separating apparatus consisted of a line from earth to the single needle instrument with two bridge coils, each with a resistance of 750 O. The circuit was connected to the telephone switchboard at Waterloo, on which there were 250 lines, and to the switchboard at Southampton, where there were 200 lines, and each of those extensions could speak over the line. Battery-ringing had been arranged so that any station could call another without interfering with the Waterloo switchboard.

Filter Design.

Mr. C. Robinson said the Post Office had worked out a system of automatic signalling for phantom circuits and side circuits which it was hoped soon to have in commercial practice. The first consideration in designing a filter was the calculation of its cut-off point, but the Paper gave no expression for that.

Mr. C. C. Marris asked how the various machine units of the telegraphs compared with the curves given for the Wheatstone, and what the maximum speed found practicable on circuits with the transformers used in phantom telephone circuits was. He wanted to know how the limit for the magnification of the single relay could be arrived at, and whether that limit was mainly one of cross-talk or of balance, or whether it arose from the possibility of deflection of the repeater. Was there any particular difficulty in balancing phantom circuits for relay purposes ?

Capt. F. Reid said the variation of the capacity in cable circuits was given by Mr. Hill as 1½ per cent., but variations of from 10 to 15 per cent. in single lengths with 5 per cent. on complete coil-loaded section were often obtained. Specifying a certain mean figure sometimes resulted in all the circuits being of low capacity, while in others cases some circuits were very much higher and some very much lower than the mean. It would therefore be as well for cable manufacturers to standardise the capacity for a specified type of cable and fix the limits of capacity variation.

The Author's Reply.

The Author, in reply, remarked that though the sine-wave system would be very valuable in certain conditions, it would be difficult to apply it to circuits when the reactance of the apparatus was considered. The use of filters was an alternative method. Although the telegraph current had a slow periodicity, its rate of rise, particularly with a square signal, was very rapid and made it equivalent to a very high frequency signal. It was the normal thing for the capacity of the phantom circuit to be double that of the side circuit, and that was the variation of the capacity that caused the effect. The filter method was the best way of dealing with the composited circuit using the wires of a double wire circuit to form two duplex circuits. This worked very satisfactorily. He agreed with Mr. Aitken regarding nomenclature, and had followed the terms given in a Paper issued by the American Institute of Electrical Engineers. American conditions did not apply over here, and it was a question how much noise the general public would stand. The price of an approximately silent circuit was the reduced speed.

Radioactivity.*

In the first three of a series of six lectures which Sir Ernest Rutherford, Cavendish Professor of Physics at Cambridge, is delivering before the Royal Institution, reasons are given why radium has been singled out from many radioactive products for practical use. The work of a committee appointed for testing radioactivity is considered, and some practical applications of this substance are detailed. The law of radioactive changes is discussed, the delicacy of radioactive analysis being demonstrated by experiments, as were the characteristics of the products of radio-emanation.

Having, in the introduction to his first lecture, dwelt on the fertile developments that physics owed to the study of radioactivity, the transformations and disintegrations of atoms, the emission of flying particles endowed with undreamt-of energy, by means of which we could probe the structure of the atoms, the discovery of thirty new elements, the shedding of new light on atmospheric electricity and on the age of the earth, Prof. Rutherford remarked that the detection of radioactivity had a history of dramatic interest. In the period of intense activity following the discovery of the Röntgen rays late in 1895, the association of the new rays with phosphorescence suggested to some experimenters that the generation of the rays was itself connected with phosphorescence. Henri Beequerel placed various substances (wrapped in paper), which had been previously rendered phosphorescent by exposure to light, on photographic plates, among them some twelve-years-old crystals of uranium-potassium sulphate. These crystals gave out

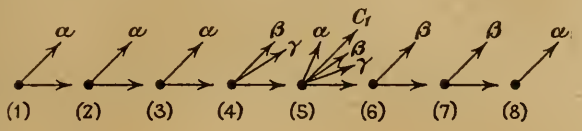


FIG. 1.

a radiation affecting the photographic plate. Fresh exposure to light made no difference, and the property was common to all uranium compounds, as he showed in the "Comptes Rendus" of Feb. 24, 1896.

The Work of Mme. Curie.

The new rays also discharged an electroscope. For his demonstrations Sir Ernest either used a Zeleny arrangement, the gold leaf of which is so suspended from the horizontal plate at the top that it hangs edgeways in front of a vertical plate kept charged from a battery and oscillates at a rate proportional to the rate of leakage from the top plate; or a simpler electroscope in which the substance was fixed underneath a base plate of lead so as to stop all but penetrating radiations. With the help of similar devices Mme. Curie found that the radioactivity was proportional to the amount of uranium in the compound, and was thus a property of the atom of uranium, U, but that Joachimsthal pitchblende (with 70 per cent. of U) was five times as active as it would be if wholly consisting of U. By precipitation with H_2S she then precipitated from the solution of the pitchblende an exceedingly active constituent which she called polonium; she further observed that the barium sulphate precipitated from the solution of the mineral was radioactive, and by fractionation she finally isolated a salt the metal of which, radium, had an atomic weight Ra=226, against U=238. The metal could be electrolytically deposited and had a melting point of

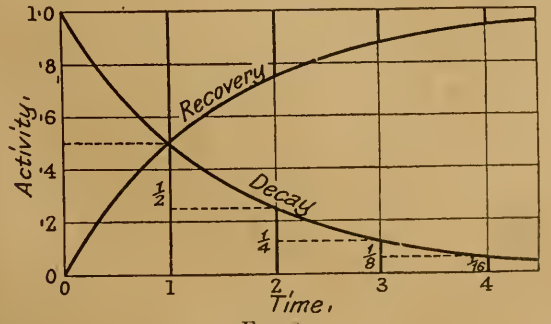


FIG. 2.

about 700°C. If a piece of pitchblende were represented by a line 380 miles long, the amount of radium in it would correspond to 4 in., the polonium to 0·001 in., and the Ra C to 0·0000001 in.

Why Radium is Used.

But why was radium itself singled out from the many products, some of which were much more radioactive? Because radium was easily obtained; it had a long life (half-period, 1 650 years), and gave rise to a large family of descendants of comparatively short life under the emission of α, β and γ rays. Fig. 1 is a diagram of the radium family; the members, the life period, and the ranges of the α particles in air, were: (1) Ra, 1 650 years, 3·5 cm.; (2) emanation, 3·5 days, 4·3 cm.; (3) Ra A, 3 min., 4·8 cm.; (4) Ra B, 26·8 min.; (5) Ra C, 19·5 min., 7·06 cm.; (6) Ra D, radium lead, 16·5 hours; (7) Ra E, 5 days; (8) Ra F polonium, 136 days. Ra A to Ra C are the active deposits of rapid change; Ra D to Ra F active deposits of slow change. As regards the minerals, Sir Ernest remarked, the pitchblende (uraninite) contained up to 80 per cent. of uranium oxides, and the primary uraninite from very ancient rocks was simpler in composition to the secondary blende (from Johanngeorgenstadt, Saxony), in which very small proportions of very many elements seemed to be lumped together. Joachimsthal now produced about 2 grams of radium per year. There was a little pitchblende in the tin mine dumps of Cornwall. Antunite was a complex uranium-calcium phosphate. Most of the uranium now came from the carnotite of Colorado, a yellow vanadate of potassium and uranium, which might contain 51 per cent. of uranium. Though 500 tons of the carnotite-sandstone would yield only 1 gram of radium, the treatment of the ore (dissolution in hydrochloric acid, and precipitation with sulphuric acid) was relatively simple, and the Standard Chemical Company of Pittsburgh had already produced 85 grams of radium (16 grams last year) from this ore. Europe had altogether produced 40 grams of radium, the world, 160 grams; and of that only 5 grams had gone to physicists for research.

Thorium and its first descendant, mesothorium, discovered by

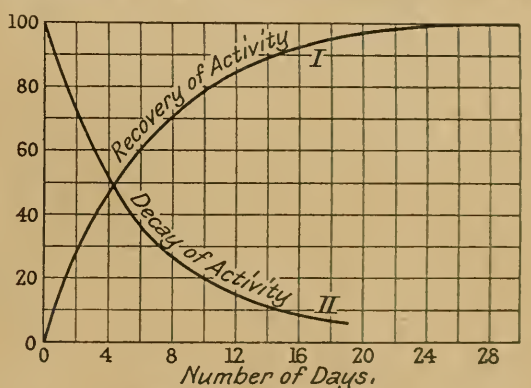


FIG. 3.—THORIUM CURVES.

Hahn (an isotope of radium, differing from it in its radioactivity), was another important radioactive element. Mesothorium cost only half as much as radium, which was now from £20 to £30 per milligram, but had only a life of 6·7 years (mesothorium I., mesothorium II., 6·2 hours). One-fourth of the activity of radium preparations might be due to mesothorium. Thorium occurred in monazite (phosphates of the rare earths, the raw material of the incandescent mantle industry), and some 300 000 kg. of thorium nitrate, equivalent to 5 grams of radium, were produced annually.

The Radioactivity Committee.

A committee for testing radioactivity had been appointed in 1912 (Prof. Rutherford was chairman). Mme. Curie had prepared (at the expense of Sir George Beilby) a standard of 22 mg. of Ra Cl; secondary standards were made in the Radium Institut, Vienna, and sub-standards issued. Tests within 0·5 per cent. of Ra were possible without opening the glass bottle, because the tests were made by the γ-ray method, and because the decay of different mixtures of Ra and Th varied with those proportions largely owing to the shorter life of mesothorium. Such measurements of mixtures took months; for rough tests the α rays afforded guidance, because those of Th had a longer range than the Ra rays. The penetrating character of the X-rays had made it possible to recover £1 000 worth of radium, it was said, from a rubbish heap on which the sweepings of a hospital had been piled. First, the respective heap was identified with the aid of electroscopes; then the portions of the heap; and, finally, buckets charged with the refuse were individually examined.

Some Practical Applications.

Radium salts, added to zinc sulphide to render compass sights, etc., visible in the dark, Sir Ernest continued in the second lecture, bombarded the sulphide with their α rays, so that the sulphide

*Abstract of the first three of a course of six lectures delivered at the Royal Institution by Sir Ernest Rutherford, F.R.S., of the Cavendish Laboratory, Cambridge.

structure was destroyed, and the phosphorescence decayed at a fairly rapid rate. The radium itself did not suffer, and nearly 1 gram Ra was said to have been recovered after the war from superfluous gun sights. Mesothorium might profitably replace the radium in such preparations. The α rays were positively charged atoms of helium moving at about 10 000 miles per sec.; the β rays were swift electrons; the γ rays were of the most penetrating X-ray type. Owing to their greater mass, the α rays carried much more energy than the others, and produced 100 X the ionisations of β particles; but they lost their speed rapidly, and their range in ordinary air did not exceed 7 cm. It was demonstrated that the α rays from polonium were stopped by a sheet of notepaper interposed between the electroscope and the copper-plate on which the polonium had been deposited.

The Nature of Radioactive Elements.

To account for the expulsion of these particles, Rutherford and Soddy had, nearly twenty years ago at Montreal, suggested that radioactive elements differed from others by not being permanently

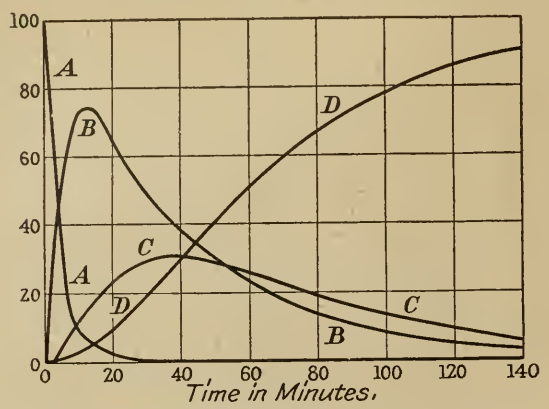


Fig. 4.—Relative Number of Atoms of *A*, *B*, *C*, *D* present at any time. (Case I.)

stable. At any moment a certain fraction became unstable, an explosion occurred, particles were shot out, and the atom left behind was entirely different from the original element. Radium mass 226, lost an α particle (see Fig. 1); the resulting emanation was a heavy gas (not a solid metal), and was itself unstable, emitting another particle, and turning into Ra A once more or a solid metal of mass 218. This broke up into Ra B, which emitted both an α and a β particle, and yielded Ra C, and so on. As regards the rate of change, observations on polonium had shown that the activity dropped to half in 136 days; in another 136 days again to half, *i.e.*, to a quarter of the initial activity, and so on; and that the exponential law had been found still to hold when the activity had diminished to one millionth, no matter what the chemical conditions and the temperature (furnace or liquid helium) were. In a series of successive changes, the equilibrium required that for each atom—*e.g.*, of Ra—an atom of emanation should be produced, while at the same time another atom of emanation was exploded. Supposing we started with pure radium, having removed all accumulated emanation. For each atom disintegrating an atom of emanations was formed, and when the Ra had died down to half, the emanation would also represent half of the activity, the sum remaining constant. Thus the decay and recovery curves were the same, as the ordinates in Fig. 2 indicated.

The Law of Radioactive Changes.

The law which they had first worked out for thorium (see Fig. 3) was the following: If N_o represented the number of initial atoms, N_t the atoms left after t seconds, then $N_t/N_o = e^{-\lambda t}$ where λ was the radioactive constant. T, the time for half-transformation, was $0{\cdot}693/\lambda$ second, and L the average life $= 1/\lambda$ seconds; further, $dN/dt = -\lambda N$, λ representing the fraction of the total number of atoms changing per second. If the decay were A→B→C, P, Q, R being the numbers of atoms of each present, and λ_1 λ_2 λ_3 the respective constants, then (1) $dP/dt = -\lambda_1 P$; (2) $dQ/dt = \lambda_1 P - \lambda_2 Q$; (3) $dR/dt = \lambda_2 Q - \lambda_3 R$, and those three equations gave the P, Q, R at any subsequent time when the initial values were known. The L might amount to a few seconds or many years; L was always $= 1/\lambda$, and Q could be found from P by (2). As regards radium, Fig. 4 represented the number of atoms of Ra A, Ra B, Ra C, Ra D present after certain numbers of minutes; each of these curves passed through a maximum. The rate of change, on which the number of atoms of A, B, C present at any instant depended after removal of the emanation, were indicated in Fig. 5. In order to elucidate these relations, Sir Ernest arranged three vertical glass tubes, partly filled with coloured water, in cascade, tube A communicating by a horizontal pipe (of small bore) near its bottom with the middle of B, and B similarly with C, which had an outlet into D. When the tap between A and B was opened, the level in A fell; in B it rose to a maximum (depending upon the respective heads of water) before A was empty; then the B level went on falling until A was empty. If A had been replenished so as to keep its level constant, the levels in B and C would also have remained steady. That illustrated the decay of a radioactive series—*e.g.*, of Ra in equilibrium with its emanation, exactly the same number of liquid molecules leaving each of the three tubes in each unit of time.

Delicacy of Radioactive Analysis.

Having demonstrated that the electroscope came to rest much more rapidly when excited by actinium emanation (life, 3·5 sec.) than with thorium emanation (54 sec.), Sir Ernest demonstrated the delicacy of radioactive analysis in some striking ways. Actinium would deposit its emanation on platinum foil held above it. In an electroscope there would be no visible film; yet 10^{-17} milligrams would suffice for electroscopic analysis as well as a kilogram. Sir Ernest had prepared such a piece of platinum foil; he cut it in three pieces with a pair of scissors, after having shown it to be strongly radioactive. The first piece was placed in warm hydrochloric acid, then dipped into alcohol and dried over a Bunsen flame; the radioactivity was practically gone. The second piece was heated in the flame; the deposit was volatilised, and the radioactivity lost. The third piece was washed in water only; the activity was retained, because the deposit was insoluble in water; but a similar specimen, exposed to chlorine before the lecture, lost its activity in water because the chloride formed was soluble in water. When the emanation was kept sealed up in thin glass tubes for long periods, only the long-period products survived and coated the glass, which they discoloured. Breaking such a polonium tube up and placing it in warm hydrochloric acid, Sir Ernest dissolved the deposit, which settled again on a piece of copper held in the solution. The solution electrolysed with two small electrodes in circuit with few cells deposited more polonium on the kathode (not on the anode). Another piece of copper exposed to radium emanation proved very highly active; yet there was nothing like a continuous film on it, perhaps 1 atom of Ra C for every 50 atoms of copper in the surface.

The Products of Radio Emanation.

Of the products of radium emanation, Prof. Rutherford stated in the third lecture, Ra A, B, C were the most important. Ra A was very short-lived (3 min.); B could be volatilised at 700 deg., so that C was left behind. This was best done by dissolving the deposit formed on the walls of a glass tube (as just mentioned), and by placing a piece of nickel foil or nickel wire in the warm solution; Ra C was then obtained almost pure, free from Ra B. Thorium emanation (life, 54 sec. only) could similarly be treated, and two-thirds

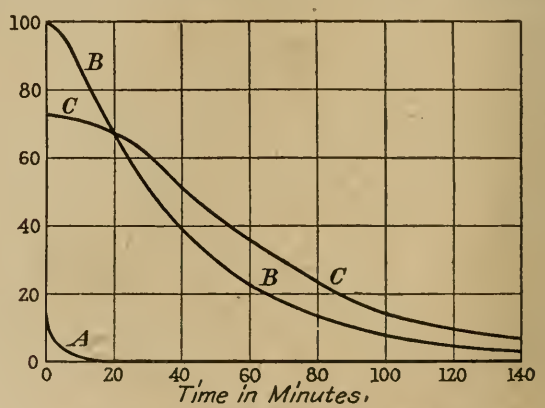


Fig. 5.—Relative Number of Atoms of Matter *A*, *B*, *C* present at any instant. (Case II.)

of the Th C in it would be deposited on nickel. In studying the properties of Ra emanation, Soddy and he had first tried to condense it by the aid of solid CO_2; they had no liquid air machine at the time, but with the first 25 cm³. of liquid air, they later produced, they condensed an emanation at −150 deg. at very low pressure. To prepare the emanation, the Ra salt was dissolved in water in a flask joined to a pump; the rays decomposed some of the water into hydrogen and oxygen (which partly recombined also under the action of the rays); these gases were removed by sparking, and the remaining emanation was condensed in a U-tube. One gram of Ra would, in about 30 days, generate a volume of 0·6 cub. mm. of emanation (in equilibrium at normal pressure and temperature), and with such quantities they had made their studies. Radium salts themselves should not be used for experiments; they were too costly and contaminated the laboratory; in hospitals, emanation confined in tiny glass tubes of common pin size was also

preferable. The very difficult purification of the emanation was effected in delicate glass apparatus as in gas analysis. In order to determine the true boiling point at atmospheric pressure the emanation had been drawn into an exceedingly fine capillary, 1 in. long; there it boiled at −65 deg., and solidified to an orange speck. The atomic weight of Ra emanation was 222; the atomic number, 86; the half-period, 3·85 days. It was the heaviest gas known, the density of the solid being about 5 or 6, and it formed the highest member of the helium-argon group of inert gases. It had a spectrum of some fifty bright lines, quite distinct from helium and other elements, and was strongly absorbed by charcoal, oils and water.

Characteristics Demonstrated.

To demonstrate the character of the gas, Sir Ernest made use of a horizontal glass tube (connected at the one end with a Gaede pump), from which branched off a charcoal tube and three smaller tubes, containing respectively willemite, a mineral giving a red phosphorescence and zinc sulphide. The emanation was introduced into the main tube through a tap and another branch tube dipping into a mercury basin. By wrapping cotton wool round different parts of the apparatus, soaking the wool in liquid air and immersing the charcoal in liquid air, the emanation was condensed first into the tube phosphorescing red; it was then driven by gentle heating into the willemite tube and finally into the zinc sulphide, where it was left, causing the sulphide to phosphoresce with a brilliant green glow in full daylight all through the rest of the lecture.

In the early days it was thought that radium was the direct offspring of uranium. But Soddy did not succeed in growing radium. Boltwood then discovered the intermediate product ionium (period, 100 000 years), which was separated like thorium. To explain the decay, Sir Ernest used, as he had done before, three glasses containing balls of different colours, representing uranium U, ionium Io, and radium Ra. When three ionium balls were transferred to the third glass to indicate that 3 Io had changed into 3 Ra, three radium balls had also to be taken out of their glass, because the radium had itself changed.

If any uranium mineral and the chain of transformations U→Io →Ra . . . is considered all the members of the chain would be present in the mineral and would be present in equilibrium amounts, such that, $N_1/T_1=N_2/T_2=N_3/T_3$ . . . where the N indicated the numbers of the respective atoms present in the order stated (N_1 referring to U, N_3 to Ra) and the T their respective half periods. How we could, by chemical analysis, determine the actual amount of Ra in the mineral; we could not control the growth of Ra by chemical analysis, but we could control it by the electroscope; thus we found the radioactive constant λ_3 for radium, and knowing λ_3 in that case we could determine it for the other transformations; for $N_1\,\lambda_1 = N_2\,\lambda_2 = N_3\,\lambda_3$. . . . Further we knew, that the proportion of radium in uranium was $N_3/N_1 = 3{\cdot}4/10^7$ as to atoms, and $3{\cdot}6/10^7$ as to parts by weight. The λ gave for radium a half period of 1 650 years, the corresponding life period for uranium would then be 5 000 million years.

The Term Life Explained.

What did that life of 1 650 years mean? It meant that of 1 gram of radium which we now possessed there would, in 10 000 (6 × 1 650) years, be left only $1/2^6=1/64$ grams=16 mg. of Ra. The life of uranium would be 5 000 million years—a long time, certainly, but there was not much doubt. If uranium had decayed much faster there might be none left in the world. On the other hand, actinium, Act, had a period of only 0·002 sec.; that was the other extreme. When we looked at the three radioactive families of Ra, Th, Act, they showed great similarities. All gave emanations and deposits and similar bodies showing the usual periodicities of elements in their properties. The nomenclature was not systematic, because workers in different parts of the world had met with new products at different stages of their work. An international congress would settle that. Yet it was extraordinary that all the C products were analagous in their peculiarities. Normally a product gave off an α particle of a definite speed, the same for all the particles of that product. But the C products broke up in two (possibly three) ways; there was, hence, not one uniform way, and it might be a chance whether the one or the other change would take place. Though these questions remained speculative, it seemed that Ra C first sent off a β particle, passing into Ra C, and then an α particle, leading Ra C_2; whilst Th C and Act C first gave the α particle and then the β. He had, however, recently obtained evidence—not unexpected—of a third body in Th C, possibly in the other cases, too, and the changes were certainly complicated. Atoms might exist in more than one state of temporary equilibrium, however. The recent researches made the existence of isotopes of the heavy elements very probable, and the different nuclei of different isotopes would break up in various ways. Actinium, in particular, could not belong to the main branch of the uranium-radium family; its radioactivity was only 4 per cent. of what it should be in that case. Where the branching actually occurred was not quite certain; the genesis seemed, however, to be of the following type, starting from uranium II.

$$(2\times10^6 \text{ years})\ U_{II} \begin{cases} \rightarrow 96\%\ Io\ (2\times10^5 \text{ years}) \rightarrow Ra\ (1\,650 \text{ years}) \\ \searrow 4\%\ Uy\ (25{\cdot}5 \text{ years}) \rightarrow \text{Protoact } (10^4 \text{ years}) \rightarrow \text{Act } (25 \text{ years}) \end{cases}$$

All these transformations of uranium into actinium were accompanied by the expulsion of α particles, except in the case Uy→Protoact, where $\alpha\,\beta$ was ejected.

The discovery of further side branches did not appear likely.

(To be concluded.)

Specifications and Estimates.

At the second informal meeting of the I. E. E. North-Western Centre this session, Mr. Julius Frith opened a discussion on "Specifications and Estimates."

Mr. Frith dealt with the whole machinery by which engineering plant is bought and sold, including the specification prepared by the purchaser or his engineer, the manufacturer's estimate and tender, and the subsequent contract between them. The purchaser and even his engineer might be unable to adjudicate correctly from tenders received owing to omission of particulars necessary to enable them to be compared on the same basis. Two methods of specifying overcame the difficulties arising from merely describing the result desired, the first comprising a precise statement of how the result was to be obtained; the second asking for information from the various manufacturers and selecting the best scheme. A combination of these methods was also used, *i.e.*, an exact description of both results and system to be adopted was specified, coupled with permission to the manufacturer to put forward an alternative scheme. To reap the advantages of standardisation, the purchaser must aid the manufacturer by leaving him free to use his standard materials and methods of manufacture. Tests should be specified in advance, particularly with regard to the quality of materials, the adequacy of the plant in size or temperature rise, and for efficiency. In addition, a penalty or bonus for an efficiency lower or higher than that guaranteed should be given, together with any delivery penalties desirable. Finally the terms of payment should be detailed. Engineering plant designed to effect a given result might differ in first cost, running costs, delivery period, convenience of working, space occupied, weight and appearance, and, Mr. Frith subsequently added, reliability.

The preparation of the tender, which normally followed on the distribution of the specification, was vital to the whole business. Its importance could scarcely be over-estimated. In a large engineering scheme there was always a great deal of purely engineering work, and subsequently a firm had to decide which parts of the tender could be covered by standard products and which parts would require to be made outside. The technical departments having estimated the amount of material, the works departments would require to estimate the amount of labour and other charges.

Reason and Rhyme.

To the subsequent discussion Messrs. S. J. Watson, G. A. Cheetham, A. B. Mallinson, W. Kidd, H. C. Lamb, A. S. Barnard, R. E. Grime, H. Midgley, and W. Eccles, contributed, while a rhymed contribution by Mr. J. H. C. Brooking was read by the Chairman. The general trend of opinion was that the manufacturer should be as free as possible to achieve the results required in any way he chose, and a number of amusing illustrations were given of the absurdity of many specifications and of the manner in which they still embalmed ancient requirements. Considerable emphasis was also laid upon the importance of purchasers conveying to manufacturers the purpose of their inquiry, and examples were cited of schemes which were unduly costly through the manufacturers not being in a position to offer the most suitable arrangement. Some speakers said that a specification should be confined to half a sheet of notepaper, others that all essential points should be covered. The meeting was generally of the opinion that the I.E.E. Model General Conditions should be as widely used as possible. Purchasers were also urged to specify when they wanted an approximate price for the purpose of estimating the cost of a scheme in its preliminary stages and when detailed competitive figures were required. Manufacturers were asked to state in advance whether they proposed to depart from the specification.

The Consulting Engineer Peptonised.

After hearing Mr. Frith's reply we came away from an extraordinarily illuminating and valuable discussion with the impression of the consulting engineer, abnormally vigilant, omniscient, sitting on the fence, holding the scales of justice evenly between the contending factions on either side. In so far as the metaphor is a little mixed, it is unfair to Mr. Frith, but his own fertile mind is responsible. Ruling out the ordinary significance of the phrase the precariousness, prominence, and judicial character of the position will perhaps reflect the consulting engineer's responsibility.

British Electrical and Allied Manufacturers' Association.

Record of a Year's Work.

The annual general meeting of the BRITISH ELECTRICAL and ALLIED MANUFACTURERS' ASSOCIATION was held on March 16, when Mr. W. O. Smith, Chairman of the Council, presided over a large attendance.

The Chairman's Address.

In proposing the adoption of the Annual Report of the Council for the year 1921, the CHAIRMAN said at that the last general meeting he was compelled to deal with the then existing situation in a pessimistic tone. In the light of subsequent events it would be agreed that his pessimism had been justified. In March, 1921, the industry was in a bad state, but it was nothing to what it had been since. For the coal strike had been followed by a business depression such as had never been experienced in the life of the electrical and allied industries.

The Stock Exchange Barometer.

At that time he had remarked that the tone of the Stock Exchange was one of the best indications of the state of the country's trade, but whereas a year ago the Stock Exchange was in the depths of depression, to-day there was buoyancy and optimism all round; and he was convinced that that feeling of optimism would gradually permeate other branches of business so that those who had been holding back would sell out gilt-edged securities and utilise the money so realised to finance new enterprises. A fair proportion of that money should find its way into the electrical and allied industries in the shape of orders, and though the start might be slow, so long as it gradually increased, the improvement was likely to be both solid and durable.

Competition and the Future.

It was easy to run an association like the B.E.A.M.A. when everybody was busy and profits were being made, but it was a different matter when work was scarce, for it was then individual firms were tempted to act for themselves. If the course were generally adopted there would be a scramble for any work and the industry would find itself in exactly the same unsatisfactory position as it had been before the B.E.A.M.A. was started, when only the consumer benefited from a cut-throat policy. If the B.E.A.M.A. had done nothing else it had done splendid work by bringing individual members together to know and trust each other. If this happy state were to be continued patience must be exercised, for better times were coming when the benefit of the bonds of union would surely be reaped.

The Council had authorised the Director to promote a World Power Conference, which by permission of the Executive Council of the British Empire Exhibition would be held at Wembley during 1924. The Association was inviting technical institutions and trade organisations in this and other countries to co-operate, and the exhibition authorites had agreed to give free use of a conference hall and to provide certain entertainments for guests from other countries.

A Personal Explanation.

Continuing, Mr. Smith referred to the fact that he had filled that position of chairman of the Association for three years. He felt that his retirement would be both for the good of the B.E.A.M.A. and of himself. Three years was quite long enough for anyone to hold the chairmanship, and after nearly fifty years of business life he was beginning to feel the need of a little more leisure and less responsibility. Those three years, during which he had not missed a single Council meeting, had been very pleasant years, and it had been a great satisfaction to assist in fostering those great principles of co-operation for which the B.E.A.M.A. stood.

Mr. Smith concluded by tendering his special thanks to the staff of the Association for the willing and prompt manner in which they had invariably carried out his wishes.

THE ANNUAL REPORT.

In the Annual Report of the Council, which was presented at the meeting, it was pointed out that the cures for the disease from which the world was suffering could only be effected by the expiration of time. The steadiness and patience of members under adverse conditions and the highest taxation of any country in the world were sufficient proof that the qualities necessary for taking the fullest advantage of the opportunities of restoring British prestige in the world's markets were present.

A significant indication of the state of world finance was the sudden move during 1921 on the part of almost all countries towards a revision of tariffs. The Association passed under review during the year the tariffs of New Zealand, India, Canada, Spain, and South Africa, and had been successful in the case of New Zealand in securing the admission, duty free, of British electrical apparatus, and in the case of India in obtaining a reduction from 11½ per cent. to 2½ per cent. *ad valorem* of the duty on high tension switchboards, oil switches, motor starters, controllers, regulators, rheostats, and transformers.

It was now the practice throughout all the Dominions that the value according to the current rate of exchange should be the value upon which import duties were chargeable, while an Imperial Conference of Dominion customs authorities which sat during the spring had recommended the general adoption of a standard form of declaration which, however, the Dominions had not yet found it practicable to adopt.

Legislative Work.

The B.E.A.M.A. technical code, which was published during February, represented one of the most comprehensive and complete technical codes in existence. By its use the cost of cabling messages connected with tenders and contracts would be very greatly reduced. Reference is made in the report to the Safeguarding of Industries Act, to the Overseas Trade (Credits and Insurance) Amendment Act, to the Trades Facilities Act, and to the Local Authorities (Financial Provisions) Act. As regards the second and third of these the relations of the Association with the Board of Trade are such as will allow any member desirous of availing himself of facilities to obtain the best confidential advice and assistance.

Co-operation and Unemployment.

During the year Mr. L. B. Atkinson happily seized the moment when the industry was most divided as to the representations which should be made to the Government on the subject of unemployment to form one of the most important of the industrial organisations established in this country, the conference of Joint Industrial Councils and Other Bodies in the Electrical Industry. Thus the industry as a whole can speak to Government Departments with a single voice, a fact appreciated by no one so much as those Government Departments especially concerned with the industrial questions arising out of the present exigencies.

The Electrical Research Association.

The year 1921 was the first complete year of work of the Electrical Research Association. It has now entirely cleared the ground and built the foundations for the superstructure. At the end of the Association's financial year eleven sections divided into thirty-nine committees had been formed, retaining the services of 150 experts in the various branches of research, and it is clear that the establishment of a central body to secure the help and win the confidence of all interested parties from the premier Departments of State to the smallest manufacturing firm is gradually making its way to success. Meantime the Association's own Research Committee has been correspondingly re-organised and enlarged, so as directly to represent the interests of the sections of the Association and so facilitate freer and more expeditious communication of members' research proposals direct to the E.R.A. The Council are of opinion that the present year should see the machinery both of the E.R.A. and the Association's Committee in perfect working co-ordination and giving the fullest satisfaction to all those who have enrolled as members of the E.R.A.

Standardisation.

The Council recall with satisfaction that the interest of members in standardisation has been well maintained during the year. This is an encouraging sign, for nothing is better calculated to consolidate the position of the British electrical industry in foreign markets than the adoption by those markets of British standards.

Reference is made to the stricter interpretations given by the Home Office of the regulations for the installation and use of electricity in mines which had as a result the publication of regulations regarding the safeguarding of surface switchboards. Committees of the Association recommended draft specifications for underground machinery and apparatus, which may result in new B.E.S.A. specifications for mining motors, switchgear, plugs for coal cutters, and other portable apparatus. Reference is also made to the revision of the B.E.S.A. specifications on electrical machinery, the commencement of the work on slow speed steam engine, gas and oil engine and Diesel engine specifications, and to the nomination of representatives to B.E.S.A. sub-committees and panels on various subjects relating to electrical and allied work.

Work of the Traffic Committee.

The Traffic Committee of the Association during the year have concentrated practically their whole attention upon the revision of the general railway classification of goods, which is being undertaken by the Ministry of Transport and the railway companies.

and lodged causes of objection, both in particular and general, to the provisional proposals made by the railway companies on this question. These proposals have also been combated by other branches of industry, and it was found necessary to set up a Co-ordinating Committee with headquarters at the F.B.I. The Rates Advisory Committee found it expedient to recognise this Committee and to suspend its sittings for the time being to permit of its conferring with a committee of the railway companies. This conference resulted in the gradual reduction in the number of objections and the breaking down in great measure of the feeling of antagonism between the traders and the railway companies. Nevertheless, notwithstanding a reduction in the wages of railway workers and a material reduction in the cost of railway plant and material, no reduction has been made in the rates for general merchandise, though a small reduction was made in the rates for fuel, limestone, and lime for iron and steel working.

Railway Rates and Trade Revival.

The Association has been represented on several deputations to the railway companies to urge the importance of a general reduction of rates in the interest of trade revival. The attitude of the railway companies is that they are entitled to make a certain profit regardless of the state of trade and that a reduction in rates would not bring about such an increase of traffic as would enable them to do it. It is satisfactory to note that the Railways Act 1921 embodies a principle of charging which the Traffic Committee of the Association have throughout strenuously advocated, namely, that all rates shall be disintegrated, showing separately the rates for conveyance, station terminals at each end and service terminals for loading, unloading, covering and uncovering. The Traffic Committee also opposed the attempt of the railway companies to obtain the right to carry goods by road, but the attempt was frustrated by the Speaker's ruling that the proposal did not come within the scope of the Bill. Companies are now seeking the same powers in a separate Bill and the Traffic Committee is still continuing its opposition in co-operation with other traders. Several claims of members for damage and non-delivery and warehouse rent charges have also been discussed and attempts have been made to get the question of demurrage dealt with on equitable lines.

Contract Conditions.

The Revising Committee carried through several important amendments to the text of the I.E.E. Model Form of General Conditions and have presented to the I.E.E. a new text based on the model text purporting to cover export work so as to provide for cases where the customer particularly specifies "I.E.E. conditions so far as they may apply." An I.E.E. special committee is now considering the text with a view to recommending their Council to sanction it.

The text of the Association's Conditions of Sale "A," covering sales without erection, suitably amended is now under discussion between the Association and the I.E.E. with a view to joint adoption, and the Association are also co-operating with the F.B.I. to obtain an amendment of the sets of conditions issued by Government Departments where they are considered inequitable.

Assisting B.E.D.A.

The British Electrical Development Association, of which the Association is a founder member, has in the past year considerably increased its membership and consolidated its position. The Council of the Association recommend members to acquaint the secretary of the B.E.D.A. with any new devices and developments in their branch of the industry so that the public may be kept alive to the best and latest practice.

Extending the I.P.S.

The financial year of the Industrial Publicity Service, Ltd., ending April, 1921, showed a substantial development, and preparations are now completed for giving a separate establishment to the propaganda side of the activities of this organisation by means of a new company registered under the name of Industrial Intelligence, Ltd. This organisation which is also supported by the F.B.I., the British Engineers' Association, the C.M.A., and the E.L.M.A. is not intended to be a trading company, but will carry out the distribution throughout the world of news matter of British industrial and commercial interest. Recent reference in the Press to the activity of competing countries and the dissemination of propaganda confirms the opinion that this scheme is very well worthy of support by British trade interests. The main source of funds for the purpose is the profit derived from the advertising agency work of the Industrial Publicity Service which affords another reason why that organisation should be used by members.

The Council have under consideration proposals for participating in the British Empire Exhibition, 1924, and the suspension of the standing rules as to exhibitions has been extended to December 1, 1922.

The number of members on the register of the Association at the end of the year was 200 compared with 224 at the end of 1920.

Recent Extensions at Stoke-on-Trent.

Before electricity districts were thought of, a start towards the co-operation they envisage had been made in that part of Staffordshire, commonly known as the Potteries, by the appointment in 1910 of Mr. C. H. Yeaman, who had previously been Borough Electrical Engineer of the Hanley undertaking, to control and develop electricity supply in the new Borough of Stoke-on-Trent, which comprised the townships of Burslem, Fenton, Hanley, Longton, Stoke and Tunstall.

It will probably be remembered that at that time a direct current supply was given from small stations at Burslem, Longton, and Stoke, and a single-phase supply from a station at Hanley. These soon were supplemented by a supply in bulk from a new power house at Stoke which originally consisted of two 1 500 kW turbo-alternator sets, together with the necessary water tube boilers, cooling towers and auxiliaries.

Result of War Conditions.

Three-phase supply from this station was first given in the summer of 1913, and when war broke out the new system was fully at work. Development continued satisfactorily throughout the war, the load reaching 4 240 kW in 1915, and it soon became evident that it would be necessary to increase the generating plant. A 3 000 kW set and two boilers were therefore started in 1919. Meanwhile Sir John Snell had recommended a further extension of the power house by lengthening the engine room to accommodate a fourth generating set, and the addition of larger boilers and double the cooling tower capacity. This advice was taken, and a further 3 000 kW set and auxiliaries purchased. This extension was put to work on Thursday, March 30. It consists of a 3 000 kW three-phase 51½ period 6 000/6 600 V Metropolitan Vickers turbo-alternator, with surface condensing plant and switch gear.

Details of the Plant.

In design the set follows the standard Metropolitan Vickers practice very closely, and operates with a steam pressure of 170 lbs. at the turbine stop valve, and a super-heat of 200 deg. F. The temperature of the circulating water is 80 deg. F. The condensing plant is of the Leblanc type, and is situated directly below the turbine, the auxiliaries being driven by squirrel cage induction motors provided with auto transformer starters and control pillars. The condenser is provided with a circulating water pump driven by a 110 H.P. motor running at 1 000 revs. per min. The main air and condensate extraction equipment consists of a Leblanc rotary valve dry air pump coupled to a centrifugal condensate extraction pump, the two being driven by a 28 H.P. motor running at 1 500 revs. per min. A duplicate air and water extraction equipment comprising a steam-operated air ejector, and a further centrifugal extraction condensate pump driven by a 8 H.P. motor running at 1 500 revs. per min. has also been installed, pipe connections being arranged so that the ejector can be used either simultaneously with the air pump to assist in starting up or independently, while the separate motor-driven extraction pump can, with the ejector, form a complete standby.

Steam Raising Plant.

The boilers are of the Stirling five drum type, working at 200 lbs. steam pressure. Those installed in connection with No. 4 turbine extension have self-contained fans and double grates, and are fitted with Underfeed "A" type stokers.

Two cooling towers supplied by the Davenport Engineering Company form part of the new extension. They are capable of dealing with 400 000 gallons per hour, and reducing the temperature from 95 deg. to 75 deg. F., with the atmosphere at 55 deg. F. and 75 per cent. humidity One of these cooling towers has a capacity of 228 000 gallons, and the other a capacity of 172 000 gallons.

Coal Supply.

Coal delivery is effected by three electric automatic end tipping vehicles. On arrival at the station it is tipped into four outside receiving hoppers, and thence passes by a series of conveyors into the overhead storage bunkers. The ashes are discharged from the hoppers under the boilers into a set of buckets, which run through to the boiler house and discharge into a receiver pit which is fitted with a crusher. The soot is discharged in a similar manner from separate hoppers into a low-level bin, and both ashes and soot are extracted from these hoppers into wagons for conveyance to a suitable dump.

The switchgear is an extension of the system first installed in 1913, the apparatus employed generally following that supplied with the original equipment. The principal exception is in the type of oil-circuit breaker used. The generators are equipped with the Merz-Price balanced potential protection and automatic field-breaking apparatus.

The Daysohms Utility Arc Welder.

Although we have already described the Daysohms low tension a.c. arc welder (see THE ELECTRICIAN, Vol. lxxxiii., p. 522), we think it will be of interest to our readers to give details of the latest pattern

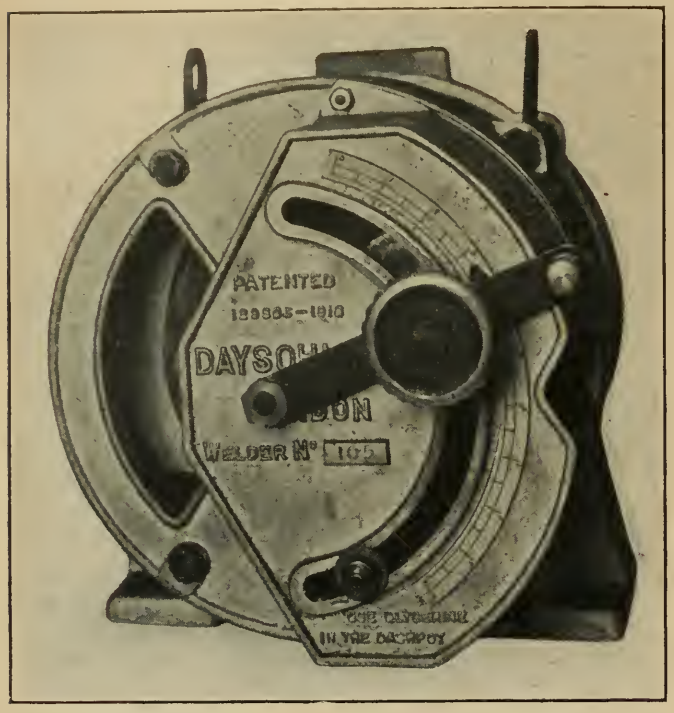


FIG. 1.—THE DAYSOHMS AUTOMATIC CHOKE.

of this machine, especially as it has been designed to supply a very large, but hitherto much neglected market. This market is among the medium and small iron-working shops, such as the motor-car

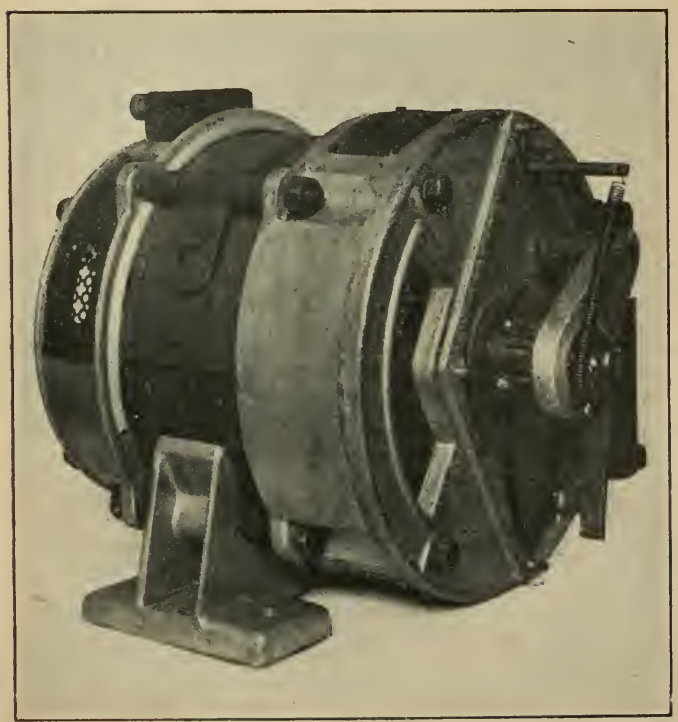


FIG. 2.—THE DAYSOHMS AUTOMATIC CHOKE. HALF-SIDE VIEW, SHOWING DASHPOT.

repairing shop where only two or three men are employed and where not more than 6 or 7 kW for light and power is required.

Most published accounts of work done by electric arc welding have usually dealt with large and impressive operations such as erecting ships' bulkheads and constructional iron work for huge buildings, with the result that the small man is not aware of the vast amount of profitable work that he can undertake by this means. In fairness it must be added that owing to the consequent lack of demand, a simple outfit which may be installed upon such a small circuit as indicated above is hard to come by.

Details of the Equipment.

The Daysohms utility welder is, however, designed to work on ordinary a.c. supply circuits, with a maximum demand of 5 kVA. It can therefore be installed on any lighting circuit; its current range being from 20 to 80 A on the secondary circuit at an open circuit pressure of 55 V. This is sufficient for any normal make of electrode on the market, and work from No. 19 gauge sheet to ¼ in. thick, can be handled as well as larger work in way that is described later.

The outfit consists of a stepdown transformer of 5 kVA capacity and a Daysohms automatic choke, the essential feature of which is that a much lower choke is in circuit when the arc is struck than

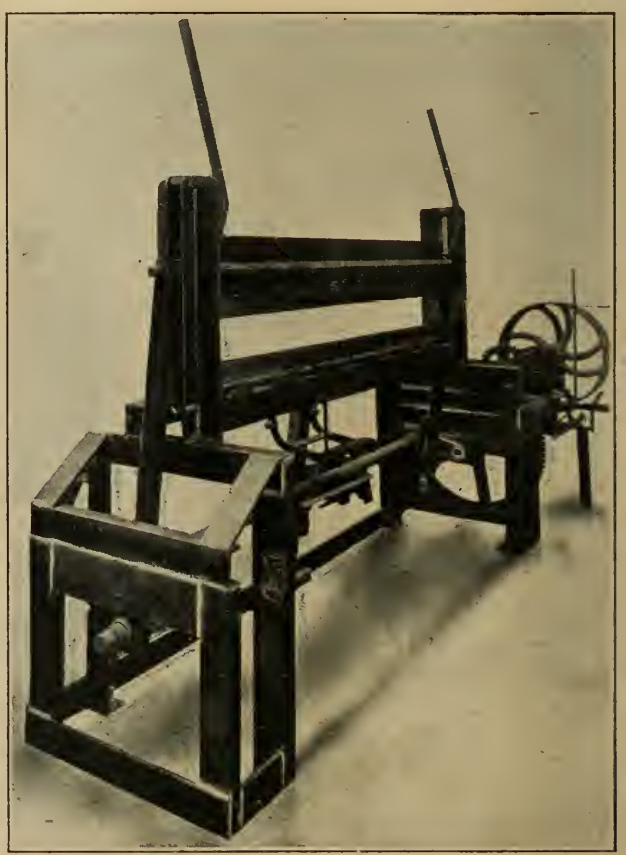


FIG. 3.—A CORRUGATOR BUILT UP OF STRIP AND ANGLE IRON BY ELECTRIC WELDING METHODS.

when it is running. The amount of choke in circuit when striking the arc may also be adjusted, quite irrespective of the amount in circuit with the arc when welding, both these adjustments being continuous and not by steps.

The Importance of Proper Regulation.

Regulation of this kind is of the highest importance when welding thin material, such as No. 19 gauge steel plate. For if a fixed choke is used to regulate the current, the rapidly-falling volt-ampere characteristic produced across the arc space makes it practically impossible to get an arc on striking, with so low a pressure as 55 V on open circuit. If on the other hand the open circuit volts are raised to the normal amount for a.c. welding, viz., 100 to 110 V, the sudden rush of current on striking, in the case of thin material, pierces a hole in the work, whereupon, however small the hole, the electrode, having an edge to work on, starts cutting, instead of welding.

The general construction of the machine is the same as we have already described, with the difference that all the Daysohms

automatic chokes are now fitted with an arm moving over a scale, and a hand screw for locking the arm in position (see Figs. 1 and 2). This arrangement, it is claimed, enables a better adjustment of the welding current to be made, while the scale enables the operator to return to any known position. The standard machine is designed to work at an open circuit pressure of 55 V and on a current range of from 50 to 150 A. The dashpot in all the machines has now been modified by giving it a conical bore, thus reducing its action as the current is reduced, an arrangement which greatly improves the capabilities of the machine for welding thin material.

Advantages of Thin Work.

In the case of No. 19 gauge sheet there is no trouble from buckling, as there would be with acetylene welding, while the current consumed is only 30 A at 55 V, or 1·65 kVA, *i.e.*, an actual consumption of appreciably less than 1 kW, a result that we believe has not been hitherto accomplished.

As the managing engineers of Daysohms Ltd., point out such a welder as we have described when installed in a small but growing iron-working shop would probably rapidly pay for itself by enabling much of the odd gear and fitments required about the shop to be expeditiously and cheaply made up on the spot. That there are grounds for this statement we may show by giving a few examples of this class of work with their cost in labour and materials, which has been executed by The Foster Engineering Company, of Wimbledon, for use in their own factory.

Examples of Work Performed.

Fig. 3 shows a machine for corrugating up to 6 ft. No. 18 gauge steel sheets for welded transformer cases. With the exception of the bearings, which are standard plummer blocks bolted on to the framework, the whole machine was welded up of strip and angle iron, the gear wheels being taken from a dismantled crab. The labour and materials on this machine came to £36, whereas

Fig. 4.—Fly Press, strengthened for Larger Work by Daysohms Methods.

to buy such a machine would have cost at the time it was made about £300, the saving on this one job being sufficient to pay for the welder more than twice over.

Fig. 4 shows a fly-press which has been strengthened, and the whole stand from which the bolts have been removed welded up and strengthened with angle iron diagonals to take the torque.

Fig. 5 illustrates a 6 ft. 6 in. iron door of a transformer house

Fig. 5.—Welded Transformer House Door.

welded in position. The frame consists of angle iron, welded up and fitted inside with angle plates fitting round the end of the bricks.

In all the illustrations the welds have been chalked to throw them up; in practice they are quite unobtrusive.

London County Council Tramways.

The District Auditor's report on the accounts of the L.C.C. Tramways Department for 1920-21 was presented to the Council on Tuesday. The total income on revenue account was £4 904 427, and the total working expenses were £4 623 654, showing a surplus of £280 773; deducting the net cost of renewals (£215 639), the credit balance was £65 134. After providing for debt charges (£590 665), income tax (£125 000), interest on overdrafts (£23 322), and other smaller charges, the deficiency to be met out of the special county rate was £590 579. There was an increase during the year in revenue receipts of £608 581, attributable, to the extent of £600 965, to larger passenger traffic receipts. On the other hand, the expenditure showed an increase of £942 755 over 1919-20. Since the inception of the undertaking in 1897, the net contribution out of the rates to meet the deficiency has been £315 802.

Commenting upon the sanction of the Treasury to the transfer of one-half the cost of renewals of trackwork from revenue to capital to be treated as repayable within twelve years, and the repayment of outstanding debt charges on the basis of a 3½ per cent. cumulative annuity system, instead of on the instalment system, the auditor states: "There is something to be said in favour of the repayment of loans on the annuity system in the case of a new trading concern by reason of its lighter charges on the earlier revenues, which facilitate the creation of a reserve; but when, as in the present case, the undertaking has reached a definite stage of maturity, it means the postponement of charges upon the revenue to future years. This arrangement, together with the transfer of half the cost of renewals to capital account, will be particularly burdensome in view of the fact that the renewals and reserve funds have now disappeared, with the result that the revenue will be saddled not only with these postponed charges, but also with the additional debt liability arising from fresh capital outlay."

Harland and Wolff, Limited, have placed orders for electrical equipment to the amount of over £32 000 with A. Chaplin & Co. in connection with the new site at North Woolwich yard. This includes two 3-motor 20 ton cranes, five 3-motor 10 ton cranes, one 4-motor overhead travelling crane, four 3-motor 3 ton slewing mono-rail cranes, and the necessary runs of longitudinal conductor. The two 20 tonners will cost £5 536 16s., the five 10 tonners £11 792, the 4-motor overhead 10 tonner £4 200, and the four 3-motor slewing cranes £7 324.

Electricity Districts.

A scheme prepared by Blackburn and Preston Corporations for the supply of electricity in a portion of the MID-LANCASHIRE ELECTRICITY DISTRICT is to be submitted to the Electricity Commissioners. The area extends from Fleetwood to the industrial area of East Lancashire. It is suggested that capital power stations be erected at Blackburn, Preston, Burnley and Rawtenstall, with "peak load" stations at Blackpool, Burnley, Accrington and Nelson, and distributing stations at Fleetwood and St. Anne's. At the outset the stations at Preston, Blackburn and Burnley would be linked up through Accrington, the cables to be laid before 1926, after which extensions in other towns will be carried out. The proposed authority will consist of representatives of the local authorities concerned. The scheme provides that during the years 1922-31 existing stations, except those at Blackburn and Rawtenstall, are to be gradually closed down, and normal supplies will be available from the large stations at Blackburn, Preston and Burnley. The capacity of the Blackburn plant is 20 000 kW, but this will be extended to 30 000 kW; Preston will have 20 000 kW, to be extended to 40 000 kW.; and Burnley 20 000 kW, to be extended to 30 000 kW. It is proposed that Preston should be in a position to supply electricity not later than 1924. An estimated saving of £95 622 per annum would be effected by the scheme.

EAST SCOTLAND ELECTRICITY DISTRICT.

Tyneside Tramway Systems.

Now that important tramway developments and extensions are to be carried out between Newcastle and Gateshead, the "Newcastle Chronicle" urges the ADVANTAGES TO BE GAINED BY AMALGAMATION of at least some of the Tyneside tramway companies.

Under existing conditions the tramway systems in the district are owned by the following authorities:—Newcastle Corporation Tramways, Tyneside Tramways & Tramroads Company, Ltd., and Tynemouth & District Electric Traction Company, Ltd., on the north side; Gateshead & District Tramways Company, Jarrow & District Electric Traction Company, Ltd., and South Shields Corporation Tramways on the south side.

On the north side the three tramway systems are adjacent, and through running exists to a certain extent between the Newcastle Corporation Tramways and the Tyneside Tramways & Tramroads Company, Ltd. Through running is not, however, possible at present with the Tynemouth & District Electric Traction Company, as that company has a narrow-gauge line.

On the south side, although the South Shields Corporation Tramways and the Jarrow & District Electric Traction Company are adjacent, there is at the moment no through running, although the Ministry of Transport has now proposed the provision of this through service. Between the Gateshead tramways terminus at Heworth and Jarrow—a distance of about four miles—no intercommunication exists.

The case for amalgamation therefore seems pretty strong.

Electricity for Domesticity.

Referring to our editorial note in THE ELECTRICIAN of March 10 on the subject of the electrical industry and exhibitions, Mr. F. M. Spry, of the Cardiff Electricity Department, suggests that a better slogan than "Electricity in the Home" would be "Electricity for Domesticity." He thinks that the latter phrase is more euphonious, if not more apt.

Edinburgh Tramway Inquiry.

The inquiry by Sir William Marwood and Colonel Pringle, of the Ministry of Transport, into the vexed question of the SYSTEM OF TRACTION TO BE ADOPTED FOR PRINCE'S-STREET, Edinburgh, was opened on Wednesday of last week and concluded on Saturday. The Corporation, by a resolution passed some weeks ago, are committed to the erection of centre poles, and evidence in favour of this system included that of Mr. R. S. Pilcher, Edinburgh tramway manager, Chief Constable Ross, Superintendent A. Bassom, Mr. Alfred Baker, general manager of Birmingham tramways; Mr. Dalrymple, general manager of Glasgow tramways. Those in favour of the conduit system included Councillor Guest, on behalf of the Scottish Commercial Motor Users' Association; Councillor Thomson, general manager of the Scottish Motor Traction Company; Mr. A. R. Hoare, civil engineer, of Westminster, London, and Lord Salveson, chairman of the Citizens' Protection Committee.

Brighton Tramways Inquiry.

The report of the Tramways Inquiry Sub-Committee, appointed to consider various points regarding BRIGHTON tramways raised at recent meetings of the Council, completely vindicates the management of the undertaking, and the few recommendations made should, if carried out, help to put the undertaking in a better financial position. The committee find that the price charged to the undertaking for electricity supplied is in excess of that charged to other power users, and recommend that the Lighting Committee be requested to consider a reduction as from the 1st inst. They also recommend that the cost of repairs of the road surface between the two sets of rails beyond the distance of 18 in. from the rails be charged to the district fund in exoneration of the tramways undertaking, and that for the future, until the financial position of the undertaking is greatly improved, all surplus income arising in any year should be applied to the reserve and renewals fund, and no part in relief of rates, and that after the accident reserve fund has reached £10 000 no further sums be transferred thereto from revenue.

Kingston-on-Thames Electrical Exhibition.

A comprehensive exhibition of ELECTRICAL LABOUR-AID APPLIANCES is being held under the ægis of Kingston Corporation at the Baths Hall, Wood-street, Kingston, this week, and will remain open until 10 p.m. to-morrow (Saturday). Although the show is dwarfed by comparison with that at Olympia, it has the advantage that visitors especially interested in electrical appliances can see everything necessary without the trouble of searching for the stands. An orchestra and an abundant supply of refreshments add to the amenities of the exhibition, which was well attended on Monday, the opening day, in spite of the weather. There was plenty of B.E.D.A. literature in evidence, and Mr. J. W. Beauchamp himself attended to give the show a good send-off, and moved a vote of thanks to the Mayor (Dr. W. E. St. Lawrence Finny), who performed the opening ceremony.

The MAYOR expressed his pleasure in officiating, and referred to the progress that had been made by the town in general and by the Electricity Department in particular. The latter, thanks to the technical skill and business acumen of Mr. T. A. Kingham (the borough electrical engineer) and his staff, had now been placed on a sound financial basis, instead of being a source of loss, as it had been in the past, and he trusted that it would become a still more valuable asset to the ratepayers.

What is to be Seen.

A detailed list of the exhibits would perhaps be superfluous, as inevitably the goods shown are largely the same as those to be seen at other electrical exhibitions. The stands include those of the General Electric Company, who show heaters, cookers, irons, alabaster bowl fittings, and the "Time Saver" washing machine; the Sun Electrical Company, suction cleaners, washers and wringers, table lamps, bowl fittings, &c.; W. H. Gaze & Sons, lustre and candle fittings, radiators, &c., and a fine collection of silk shades; Thames Electric Company, "Eureka" cleaners, table lamps, shades, &c.; and the British Thomson-Houston Company, floodlights, coloured lighting for shop windows, which eliminate glare in the customers' eyes, theatre lamps with wheels, holding various coloured films, which are easily and quickly brought before the light, and an interesting exhibit of daylight lighting, produced by a glass rectifying screen, and contrasted with the ordinary carbon and gasfilled lamps. Geo. Nobbs, Ltd., show "Genii" geysers, coil boilers, cooking ranges, and the "Rayvac" cleaner; Bentall's, of Kingston, "Universal" cookers, irons, coffee pots, hot plates, &c., and some very attractive alabaster table lamps; the Metropolitan-Vickers Electrical Company electroliers with candle fittings, artistic silk shades, an automatic cooker, which can be set to work by an alarm clock at a pre-determined time in the owner's absence. A new Metropolitan-Vickers' speciality is a 1 kW or 2 kW electric fire, which roasts or boils and also gives a good floor heat. The Foster Engineering Company exhibit the "Universal" electric washer, radiators, and table lamps with attractive silk shades; G. W. Jones & Company (Kingston), table and hanging lamps, also with silk shades, and an assortment of kettles, radiators, irons, &c.; the Hotpoint Electric Appliances Company, radiators, cookers, immersion heaters, &c.; the Ridgway Storage Battery Company, "Hart" portable cells, ignition batteries, batteries for wireless h.t. circuits, cell inspection lamp outfits; and Brame's, electro-platers, of Kingston, have interesting specimens of their goods on view, and give continual demonstrations of their work.

Demonstrations of electric cooking and of the use of electric washers and suction cleaners are also given frequently, and visitors are invited to complete their education in regard to the advantages of electricity in the home by visiting the Corporation's electricity showrooms in Downhall-road.

Industrial Films.

Through the kind permission of Mr. Catterson-Smith, chief electrical lecturer, the students and staff of the engineering faculty of FINSBURY TECHNICAL COLLEGE have again been able to enjoy the advantage of industrial films loaned by the British Thomson-Houston Company.

The first film exhibited showed the application of electricity in the iron ore mines and in the calcining operations preceding the smelting of the ore. The drilling of holes in the face of the ore for explosives was shown, the collecting of the ore and the taking of the tubs to the station by accumulator tractors, the hauling of the ore to the surface by mining locomotives, and the taking of it from the surface into hoppers by elevators, and hence by way of the charging cars into kilns to be calcined. The various operations are electrically controlled, and this reduces the manual labour to a minimum. The film also showed the electric traction work, the lighting of the mines, the power station, the chemical laboratories, and several electrically driven accessories of the kilns.

The second film, on "Electricity in Steel Works," dealt with the manufacture of steel from the raw material to the finished product, and the processes involved in making steel wire and plates. It included excellent views of the furnace, the pouring of the metal, the soaking pits, the cogging, and rod mills in operation.

The ROYAL SOCIETY OF ARTS has bought the freehold of its Society's house in John-street, Adelphi, London. The purchase has been made possible by the gift of £30 000 from an anonymous donor, which with other subscriptions has brought the total amount subscribed to £42 000, out of the £50 000 appealed for. It is hoped that the entire sum will be secured at an early date.

Parliamentary Intelligence.

Electricity (Supply) Bill.

The House of Lords commenced the consideration of the committee stage of this Bill on Tuesday. After a motion to refer the Bill to a Select Committee had been defeated,

Lord ASKWITH moved an amendment to prevent local authorities from entering into the various monetary transactions set forth in Clause 5. If those electricity schemes were so good as was represented, let private companies take them up and if private companies did not consider them good, why should the risk be put upon the already overburdened rates?

Lord MONK BRETTON said the Bill would break down if the amendment were accepted. The Bill had been considered and agreed to by all parties in the London County Council, but it was absolutely essential that an amendment of this kind should be put on one side if the County Council were to be free to transfer to a joint electricity authority the powers it had in regard to the purchase of electricity undertakings. Lord Bessborough had an amendment on the paper limiting the charge on the rates to 1d. in the pound. He was authorised, on behalf of the London County Council, to say that they were willing to accept that limitation, though it ought to be made clear that the County Council had no idea of spending anything like that amount from the rates in connection with this Bill.

The amendment, which was opposed by Viscounts Haldane and Peel, was negatived.

An amendment by the EARL OF BESSBOROUGH, providing that the council of a county district to which the clause was to apply should have a population of not less than 50 000, was agreed to, as was another amendment limiting the annual liability to the proceeds of a rate of 1d. in the pound in the case of a local authority which is not an authorised undertaker. In the case of an authorised undertaker the liability will be limited to the estimated annual amount of capital charges of which it would be relieved by reason of taking a supply in bulk from the joint electricity authority, such estimated amount to be determined by the Electricity Commissioners.

A new clause, moved by the Earl of Bessborough, defining the power of joint electricity authorities to lease undertakings to authorised undertakers and *vice versa*, was accepted, and Clause 9 was added to the Bill.

The debate was adjourned.

Glasgow Tramways Provisional Order.

During the week Lord Oranmore and Browne, K.P. (chairman), Lord Meston, Sir Henry Craik, M.P., and Mr. J. A. M. Macdonald, M.P., sat as Commissioners for considering a series of Provisional Orders, including those of Glasgow Corporation and Ayr Burgh, for tramway and omnibus powers.

Mr. MACMILLAN, K.C. (for Glasgow Corporation), explained that Part II. of the Order related to tramways, tramroads, street works and omnibuses. The tramway system of Glasgow was a singularly successful undertaking. It had 200 miles of single track, of which 150 miles were in the city and 50 were in the three counties surrounding Glasgow or passed through burghs in these counties. The revenue last year was £2 408 094, and the number of passengers carried was over 447 million. The capital expenditure upon the system up to May, 1921, had been £4 054 892, and the remarkable achievement was attained in 1917 of paying off the entire debt on the system by sinking fund. At present the indebtedness of the Tramways Department was £126 000, a remarkably small sum for so very large an undertaking. The department now asked for authority to construct certain additional tramways, and in regard to these there was no opposition. The matter which would perhaps provoke controversy was contained in Clause 12 and the following clauses, which asked power to provide and run omnibuses. It was originally proposed to run omnibuses on thirteen routes, but five of these had been dropped. The sanctioning of omnibus services had become a matter of common form in England, but in Scotland hitherto, beyond certain limited powers to run omnibuses within municipal boundaries, authority had not yet been conferred on any municipality to run omnibuses outside their boundaries. In a tramway undertaking such as that of Glasgow, which had its radii extending in all directions and concentrating in the centre of the city, there was necessarily territory which was really in a sense suburban, largely peopled by families the heads of which carried on business in Glasgow, and who at the close of their day's work went out to the surrounding districts. Many of these districts were places to which in the course of time the Corporation would extend their tramways. At present tramway construction was almost prohibitive in cost, and the proposal was that instead of tramway construction various routes should be authorised on which by the cheaper method of omnibuses a service would be run to link up the different portions of the tramway system and to act as feeders to the tramways.

After hearing evidence (including that of Mr. JAMES DALRYMPLE, tramways general manager), for the Order and for the opponents, the Commissioners gave their decision. Of the eight routes for which powers were sought, the Corporation abandoned that of Dalmuir to Balloch Park, while the Commissioners found the preamble not proved in the case of the following routes:—Burnside to Eastwood Toll, Eastwood Toll to Newton Mearns, Millerston to Mollinsburn, Clarkston to Eaglesham, and Kilbowie to Canniesburn. They found the preamble proved as regards the general powers, and, in connection with the manufacture of omnibuses, they favoured the insertion of the model clause, which prohibits the manufacture of omnibuses by corporations. The general powers to run 'buses within a ten miles' limit of the city boundary are made conditional upon the

consent of the local authorities and the Ministry of Transport, with the right of appeal to the latter against the refusal of the local authorities. The amount for the purchase of omnibuses is not to exceed £50 000. The preamble as regards routes Burnside to Mount Florida and Pollokshaws (West) to Paisley were found proved.

Worthing Corporation Bill.

Part IV. of this Bill, which enables Worthing Corporation to extend its electricity supply area to Durrington, was considered by a Select Committee of the House of Commons last week.

Mr. Jeeves, K.C., for the promoters, stated that the Corporation had been approached by people living in Durrington to give them a supply of electricity. Their electricity undertaking was established in 1903, and the capital amounted to £120 000, of which sum only £69 000 was now outstanding. In 1903 they had 189 consumers, and in 1922 twelve times that number. The units supplied had grown to 818 000, and the gross revenue from £5 000 to £20 000. Since the end of December last they had increased the number of consumers by 235, and to-day the undertaking had 2 191 consumers. Of thirteen towns in the South of England, there were only three that had a less charge than 8d. a unit, and not one of them had a lower maximum than Worthing, and all but two had a higher maximum. The Ministry of Transport made no observations on the extension of the area, but they thought that the Corporation should have some obligations with regard to streets and the laying of mains. There was one petition against the Bill, viz., that of the Worthing Gas Company. It was somewhat pitiful to find a gas company objecting to a supply of electricity. They had heard a lot about it in the earlier days, but he submitted that they had not been interfered with, and that they had had an era of prosperity which had gone on until the war, when it was interfered with, as was everyone else. He contended that if the Corporation had been able to carry on during the war without increasing the charges they would be able to do so in the future.

Mr. Geo. Porter, borough electrical engineer, gave technical and financial particulars of the electricity undertaking. He was of opinion that it was desirable that the Corporation should have power to supply electricity in Durrington, a district in which there was considerable development. During the last two or three years the Corporation had had a number of applications for electricity from the parish, and one gentleman, who was anxious to form a company, wanted to take a supply in bulk for an estate, and it was estimated that the amount required would be 10 000 units. There had also been an application for supply for the Offington Garden City, where it was anticipated there would be about 500 good-class residences.

Mr. Wm. Cash, chairman of the local gas company, gave evidence in opposition and asked for protective clauses, as the company were large ratepayers.

Ultimately the Committee decided that the clauses in the Bill should stand, and the clauses suggested by the company were rejected. The other clauses were then dealt with, and one, conferring power to supply electricity in bulk outside the area of supply, was withdrawn.

Doncaster Corporation Bill.

The consideration of this Bill has been concluded by a Select Committee of the House of Lords. The provisions include light railway extensions, the running of omnibuses by the Corporation within and outside the borough, and further powers with reference to the electricity undertaking.

Mr. W. J. Jeeves, K.C. (for the Corporation), said that in the tramway undertaking the Corporation had something in which their responsibility to outside districts was recognised. The Corporation commenced to establish the tramway undertaking by obtaining an Order in 1899 for ten miles, half of which were in the borough and half outside it. From the outset the Corporation were given power to provide not merely for themselves but for the outside districts. Since 1911 various powers for the construction of tramways had been obtained and a large proportion of the cost had been incurred for outside districts. The Corporation felt that if they were to continue to operate their tramways successfully those powers to run motor omnibuses were essential. The motor 'buses were needed for workmen going to and from work beyond the present tramway termini.

After evidence in support of the Bill had been given, witnesses were heard on behalf of the opponents, Underwood, Ltd., and Automobiles Services, Ltd., which provide omnibus services in the district.

The Bill has now been reported for third reading.

The Post Office Tube Railway.

In reply to Mr. Perring (House of Commons, March 29), Mr Pease stated that the sum provided under the Post Office (London) Railway Act, 1913, for constructing the Post Office tube from Spring-street, Paddington, to Aldgate was £1 100 000. The account up to the end of March, 1921, had just been issued (Command Paper 13). The sum expended to date was approximately £1 127 000. He could not estimate the cost of the work remaining to be done; it would, of course, be very largely in excess of the original estimate. It was not anticipated that the construction of the railway would effect any appreciable saving. The intention was to expedite the transmission of the mails and relieve the congestion of street traffic.

Wireless Telephony.

In reply to Sir D. Newton, who asked the Postmaster-General (House of Commons, April 3) if he would sanction and promote the daily broadcasting, by established and suitably equipped radio stations, of wireless telephone messages likely to prove of value to trade and industry in this country or being of general public interest, Mr. Kellaway said he was entirely sympathetic towards this proposal. The whole question was being referred to the Imperial Communications Committee in order that the views of the other departments concerned might be obtained as early as possible.

Imperial Cable Rates.

Replying to a question by Mr. Hurd, the Postmaster-General (Mr. F. G. Kellaway) stated in the House of Commons on Tuesday that specially low rates are already given on the "Imperial" cable service for non-urgent traffic. The "Imperial" is the only cable route providing a deferred Press service to Canada at 2½d. a word, and to Australia and New Zealand at 4½d.; a deferred service for general traffic to Canada at 4½d. a word; and a week-end service to Australia and New Zealand at quarter rates. A large amount of traffic is sent by these cheap rate services, but it is held over whenever necessary in favour of full-rate traffic.

Orkney Islands Cable.

In the House of Commons on March 28, in reply to Sir Malcolm Smith, Mr. Kellaway stated that the two submarine cables between Kirkwall and the North Isles of the Orkneys became faulty on Jan. 31 and Feb. 6 respectively. The Post Office cable ships were at present employed on repairs to important cross-Channel cables. Every effort would be made to restore communication with the North Isles at the earliest possible date. He could not at present name a date when the Orkney cables could be repaired.

East of Scotland Electricity District.

In reply to Mr. W. Graham in the House of Commons on March 28, Mr. Neal said that the Electricity Commissioners had provisionally determined an electricity district for the East of Scotland. The Musselburgh and District Electric Light and Traction Company had applied to the Commissioners for a Special Order extending their area of supply. The Corporation of Edinburgh were opposing the grant of this Order, and would have an opportunity of stating their case before the Commissioners.

Wireless Service Between India and England.

In reply to Mr. Hurd (House of Commons, March 28), Earl Winterton said he understood that an Indian application had been made to the Indian Government for a licence to work a direct wireless service between India and England, but that the Government of India did not consider it desirable at this early stage to disclose the name of the applicant. No licence to private persons or companies for wireless communications between India and England was being granted at present.

Railway Electrification at Midland Coalfields.

In reply to Major Kelley (House of Commons, March 29), who asked whether any preliminary survey had been made for the electrification of railways in the coalfields of South Yorkshire, Nottinghamshire and Derbyshire, and whether any railway route in these areas was to be electrified, Mr. Neal stated that he was informed that the railway companies concerned were not at present considering any project for the electrification of any of their lines in the area referred to.

Yorkshire Electric Power Bill.

The Standing Orders Committee of the House of Lords have granted the application of the Yorkshire Electric Power Company for leave to introduce into this Bill an additional provision to authorise an increase of the capital and borrowing powers, and to authorise them to raise additional moneys by the creation and issue of ordinary and preference shares, and by borrowing, or by the creation and issue of debenture stock, &c.

Minister of Transport.

In reply to Major Kelly (House of Commons, March 27), Mr Chamberlain said it would be necessary to appoint another Minister of Transport, though the post would carry no salary.

Metallurgical Aspect of Electric Welding.

A general meeting of members of the Sheffield Society of Engineers and Metallurgists was held in Sheffield last Friday, when Mr. J. H. Paterson, of Newcastle-on-Tyne, lectured on "The Metallurgical Aspect of Electric Welding."

To a large extent the lecture was devoted to a consideration of nitrogen and oxygen in steel. Mr. Paterson referred to the various processes of welding, and laid down the assertion that the correct current-strength at which to weld was the highest possible —certainly the higher the current-strength the more perfect would be the weld. The percentage of oxygen varied according to the strength existing in globules in the metal, and, though generally nitrogen had a bad effect on the steel, it had at the same time a tendency to strengthen. His own experiments at Newcastle had been conducted with the help of a specially prepared iron box, with glass front and four openings for experiments, and he had found that by this means he could obtain any strength he wished, often without the least trace of foreign or objectionable matter. It was possible even then to find occasionally that nitrogen could not be wholly excluded, but at the most it was no more than 0·025 per cent., so that it was practically negligible.

The Right Hon. F. Huth Jackson, a director of the London & South-Western Railway, has left unsettled property of the gross value of £169 907, with net personalty £101 677.

Legal Intelligence.

Dumfries Burgh v. Dumfries Electricity Supply Company.

Lord MORISON has closed the pleas in this action, brought by the Provost, Magistrates and Councillors of the Royal Burgh of Dumfries against the Dumfries Electricity Supply Company for a declaration that the company is not entitled to charge any private consumer for energy supplied to him more than 7d. per unit for lighting and 3d. per unit for power and heating; that the company is not entitled to apply to the Ministry of Transport for an Order under the Statutory Undertakings (Temporary Increase of Charges) Act, 1918, for a modification of the statutory provisions regulating the charges to be made by them for electricity supplied by them under the Dumfries Electric Lighting Order, 1899, and in particular that the company is not entitled to apply to the Ministry of Transport for an Order authorising them to charge any consumer 1s. per unit of energy supplied. The Council obtained a Provisional Order in 1899 to supply electrical energy within the burgh, and the following rates per quarter are permissible under the Order—for any amount up to 20 units 13s. 4d., and for each unit over 20 units 8d. The Order was first transferred to the India Rubber, Gutta Percha and Telegraph Works Company by an agreement approved by the Board of Trade on Jan. 16, 1906, but the India Rubber Company were entitled to sell, assign, or otherwise dispose of the undertaking, or any part thereof, and to transfer their powers, duties and liabilities. By a collateral agreement between the Council and the India Rubber Company, dated Dec. 5, 1905, the maximum price to be charged by the company to private consumers was fixed at 7d. per unit for lighting and 3d. for power and heating. Subsequently the India Rubber Company transferred the undertaking to defendant company, the capital of which was almost entirely held by the India Rubber Company. Notwithstanding the terms of the collateral agreement, the company has applied to the Ministry of Transport for an Order authorising them to charge any consumer 1s. per unit of energy supplied, and it is asked that the company should be interdicted from charging any consumer rates per unit in excess of those stipulated in the agreement and from applying to the Ministry of Transport to impose any increased charges in excess of those stipulated in the collateral agreement, and in any event from increasing the maximum charges fixed by the Provisional Order.

Defendant company admits the transfer of the Order, and that it has made representations to the Ministry of Transport on the subject of charges; it pleads that Sec. 71 of the Order of 1899 entitles it to the benefits of any general Act relating to electricity or to the supply of or price to be charged for energy which might be passed after the commencement of the Order. The company is the undertaker under the Order, and is, therefore, entitled to the benefits conferred by the Statutory Undertakings (Temporary Increase of Charges) Act, 1918.

Serious Fraud Charges at Leeds.

At the West Riding Assizes (Leeds) on Saturday, WILLIAM ARTHUR DAVIS, a tinsmith, of Wortley, was found guilty of obtaining investments for the Leeds Battery Company, of which he said he was proprietor, when he had not actually purchased the company. The police statement was to the effect that Davis first obtained £400 to start a business at Ilford, but never gave any of the money back. He got a staff of fifty-five, from most of whom he obtained money. When the business closed down he became a manager at Chadwick Heath, but he did not pay in the money he received from clients, and the firm went into liquidation. He came to Leeds in February, 1919, and started in the name of W. A. Davis. As a result of advertising he obtained £500 from three persons. In April of the same year he obtained other premises and traded as W. A. Davis & Company. He advertised for capital, and obtained £1 550 from six persons. In November, 1919, the company at Coronation-street was registered as the Leeds Alliance Electric Manufacturing Company, and he then obtained £2 650 from ten other people. During the early part of May, 1920, he sold the firm of W. A. Davis (Coronation-street) to the Leeds Alliance Company (although it had been previously registered as part of the company) for £2 000 in shares and £1 000 in cash, and shortly after he made a return that he and his wife were the only shareholders, except a Mr. Morris, who held 200. This Mr. Morris had previously invested £600, and had issued a writ against Davis. Prisoner gave back £400, and promised £200 in shares to Morris. Continuing to advertise, Davis obtained £2 415 from six other investors, and in December, 1920, he went to Basinghall-street, Leeds, and obtained goods from London firms to the value of £2 126. Before that he had made a false return, and secured an overdraft from the National and Provincial Bank for £515. The total amount involved since prisoner came to Leeds, and which had not been returned, was £10 150.

The judge, in sentencing the prisoner to four years' penal servitude, said Davis was a thorough scoundrel.

Wiring Contract Dispute.

At Marylebone County Court on Tuesday Henry Edward Childs, electrician, sued Philip Greenberg, for £49 10s., the cost of goods sold and work done.

PLAINTIFF'S case was that defendant asked him to do certain wiring at his house, this including wiring for lighting and heating purposes. The work was completed on Nov. 4 last, and defendant paid £10 on account. There were several items for extra work, such as erecting pendents, &c. For the wiring steel tubes were used. Plaintiff said he agreed to put the steel tubing down the walls, but not to chase it to the walls. He had heard nothing of not having done the work in accordance with the requirements of the local electrical supply company.

DEFENDANT gave evidence, and said his complaint was that the work had not been carried out according to contract, adding that plaintiff promised to put the tubing in the walls and ceilings so that it would not show. Otherwise it was to be chased, so as to be invisible.

JUDGE SCULLY held that defendant was right as to the method of erecting the steel tubing. It seemed to him that it was the usual way of carrying out such work. He would not say that the manner in which plaintiff put in the tubing was unsafe, but in his opinion it was not according to contract. He gave judgment for plaintiff for £35 5s., the amount paid into court, with costs up to the time of payment in.

Black Smoke Nuisance.

At West Ham Police Court on the 29th ult., the Charing Cross, West End and City Electricity Supply Company were summoned at the instance of Poplar Borough Council for permitting black smoke to issue from their electricity works at Marshgate-lane, Stratford, in such quantity as to be a nuisance. For the Poplar Council, it was said that when the wind was in a particular direction the company's smoke drifted into Poplar.

Mr. F. A. S. STERN (for the company) urged that they used 80 000 tons of coal a year. Latterly they had been receiving all sorts and conditions of coal, and at times it had been difficult to avoid a nuisance.

Mr. RATCLIFFE COUSINS made a formal order to abate the nuisance forthwith, and ordered the company to pay £5 5s. costs.

The Engineering Lock-Out.

Though at the moment of going to press the lock-out of the members of the Amalgamated Engineering Union does not seem to be any nearer settlement, there are features which make for optimism. As a result of the Prime Minister's intervention, the delegates of the forty-seven unions, which were expected to support the A.E.U., have accepted the proposals for the resumption of negotiations as arranged between the National Joint Labour Council and Sir Allen Smith, and discussions have been resumed.

The leaders of the A.E.U., however, are stated to have said that they would fight on to the bitter end, though it is to be hoped that more sober counsels will prevail.

Cobalt Steels.

Mr. F. W. Kayser, lecturing on COBALT STEELS before the members of the Sheffield Association of Metallurgists and Metallurgical Chemists last week, gave some interesting particulars with respect to one of the most recent developments of research work in Sheffield in steel. The addition of cobalt to magnet steel, he explained, enabled magnets to be made which were less than half the weight of the magnets made of ordinary tungsten magnet steel. The credit for the discovery should not go to Japan. It was quite true that the Japanese had brought out a magnet steel containing from 20 per cent. to 35 per cent. of cobalt, but a short time before this was patented a Sheffield steel was patented containing a much less percentage of cobalt, with a high percentage of chromium, which was practically the equal of the Japanese material and less than half the price. This new steel was practically revolutionising the magneto industry and also the telephone industry. People had not previously realised to what a tremendous extent the whole shape of a magneto or a telephone depended upon the magnet steels they were using. The soul of the instrument was the permanent magnet.

Institution of Engineers, India.

In the course of his presidential address at the second annual meeting of the INSTITUTION OF ENGINEERS (INDIA), Major G. H. Willis said that the Government of India, in addition to entrusting the work on Engineering Standards for India to their Institution, was preparing to hand over that of the Electro-Technical Commission also, when the Institution had completed its third year of existence as a corporate body. In the meantime they had nominated a committee of three of the Council of the Institution—Messrs. Coubrough, Cochran and Hindley—to deal with the subject.

Continuing, Major Willis stated that one great corporation—he was not at liberty to give names—employing many engineers, had decided to insist on all its junior engineers qualifying for Associate membership of the Institution either by passing the Institution examinations for Associate membership or such other examinations as the Institution might accept. These were only beginnings in the vast sphere of usefulness to India and to their profession, which they, as an Institution, hoped to fill.

The first volume of the Proceedings of the Institution, recently to hand, opens with an account of the inaugural ceremony performed by Lord Chelmsford on February 23, 1921. The opening address by Sir Rajendra Nath Mookerjee, the first president, is then given, and is followed by the first annual report. The succeeding pages are devoted to the papers read during the session. The subjects dealt with included "Light Railways," by Mr. F. G. Royal-Dawson; "Electro-chemical Industries," by Mr. L. L. Fermor; "Driving Belts," by Mr. A. T. Weston; and "The Patent System," by Mr. V. Lough.

Electricity Supply.

A proposal that the dual administration of the Blackpool electricity and tramways undertakings shall cease, and that two departments be set up, is to be placed before the General Purposes Committee at a special meeting.

The Electricity Committee recommend Dundee Town Council to consider favourably a proposal to combine the Grampian hydro-electric scheme with the municipal electricity undertaking, provided financial terms favourable to the city can be obtained and the municipal interests are otherwise safeguarded.

Belfast Electricity Committee has made several recommendations with regard to the supply of current for lighting and power, and these will be considered this week by the Corporation. The recommendations include a reduction of 1d. per unit for lighting and power purposes, and a larger reduction for big consumers, picture houses, &c.

A special meeting of East Grinstead Urban Council was held last week to consider the estimates for the first three years of the proposed electrical undertaking. For the first year a deficit of £643 was estimated, for the second year £215, and for the third year a profit of £138. An amendment to take a canvass of the ratepayers before proceeding further with the scheme was rejected, and the Council accepted tenders totalling £17 186.

Ogmore and Garw Urban Council are applying to the Electricity Commissioners for a Special Order authorising the Council to provide and supply electricity in their urban district, to purchase electricity from the South Wales Electrical Power Distribution Company, Cory Brothers & Company, the Ogmore Valley Electric Light & Power Supply Company, or other body or person. Any objections must be sent to the Electricity Commission by May 1.

The Ministry of Health have sanctioned a loan of £517 for ten years, and another of £2 593 for twenty-five years, in respect of electric lighting on the Promenade at Morecambe. The Ministry have authorised the removal of portions of the Lancaster and District Tramways Company's rails within the borough of Morecambe, thus completing the legal formula in connection with this transaction. The motor firms who were granted powers to run services subject to certain conditions, have appealed to the Ministry of Transport against these conditions.

The Visiting Committee of the Dundee Town Council are making inquiries into the working of the various municipal departments. A report issued on the Electricity Department deals exhaustively with the various branches, and concludes: "The Committee was much impressed by the whole organisation, evidently giving the Engineer an oversight and grip throughout, and yet without the useless redundancies of organisation that are in some modern systems. They were also very pleased to observe the good spirit and the conspicuous interest in their work shown by the staff throughout. They spoke as if they and the undertaking were one. The custom observed of having a monthly meeting of the staff for discussion of methods and suggestions for improvement is typical."

New Schemes and Mains Extensions.

Ashford Urban Council has decided to obtain a Special Order to supply electricity in the area.

Sidmouth Urban Council has decided to apply for a loan of £12 000 for carrying out an electric light scheme.

Plymouth Electricity and Street Lighting Authority have decided to carry out cable extensions in the district amounting to nearly £3 000.

Reigate Town Council has applied to the Electricity Commissioners for a loan of £48 100 for the installation of three new 350 kW Diesel sets, &c., at the electricity works.

Leyton Urban District Council has received sanction to borrow £27 500 in respect of the application for a loan of £34 454 for the erection of the electricity sub-station at Waterloo-road.

Ilford Urban Council has applied for a loan of £6 609 for excess expenses in respect of the Grove-road sub-station and plant, £2 918 for sub-station extension, coal elevator, oil fuel plant, &c., and £10 000 for mains and house services.

Truro Town Council has received from the Electricity Commissioners approval of a scheme for obtaining a supply of electricity in bulk from the Cornwall Electric Power Company. The Council will now continue negotiations with the company for a supply of current.

Hawarden Rural Council has applied for a Special Order to supply electricity in the parishes of East Saltney, Higher Kinnerton, Hope, Llanfynydd, Sealand and Tryddyn, and part of the parish of Hawarden, and to authorise the Council to purchase electricity in bulk from the North Wales Power & Traction Company, Ltd.

Without prejudice to any future action they may take, Chesterfield Electricity Committee have approved the revised representation of Sheffield Corporation's scheme for the formation of a North-East Midlands electricity district. Under this revised scheme Sheffield and Rotherham (jointly) have twelve members, Chesterfield two, Doncaster two, and Worksop one.

A scheme of electricity extensions, estimated at £105 000, has been drawn up by Mr. Christie, the Brighton borough electrical engineer and manager, and is at present under the consideration of the Lighting Committee. In the meantime application is to be made to the Electricity Commissioners for sanction to a loan of £42 000 to cover the cost of a new 600 kW turbo-alternator and a 400 kW d.c. turbo-generator, for which tenders are being invited.

At a public meeting on March 28 of Bideford ratepayers a resolution was carried in favour of the electric lighting scheme prepared by the newly-formed Electric Light Company. The engineer, Mr. J. N. A. Houblon, emphasised the importance, if possible, of the town providing sufficient capital to enable the complete scheme, involving £25 000, to be carried out, as they would then be in a position to supply not only Northam, but also to give a supply to Torrington. The system of overhead wiring is being adopted.

Alteration of Charges.

Maidstone Town Council has decided to lower the charge for electricity by ½d. per unit as from April 1.

Blackpool Electricity Committee have decided to reduce the price of electricity from 50 to 40 per cent. over pre-war rates.

The price of electricity at Bury is to be reduced by 20 per cent. for lighting and tramway purposes, and 30 per cent. for power.

Barking Urban Council has reduced the charge for electricity for lighting by 25 per cent. to 8d. per unit, and by 27½ per cent. for power, cooking, and other purposes.

Electricity charges at Horsham have been reduced from 8d. to 7½d. per unit for lighting purposes, and a reduction of ¼d. per unit has been made on all power accounts, including contracts which exceed 100 units per quarter.

The Electricity Commissioners have made an order that the maximum price to be charged by Ammanford Urban Council shall be 15s. per unit up to 15 units, and 1s. per unit over 15 units, for the quarters ending March 31 and Dec. 31, and 10s. per unit up to 10 units, and 1s. per unit afterwards, for the quarters ending June 30 and Sept. 30.

Electric Traction.

The Minister of Transport has extended for one year from Aug. 7 next the time allowed for the completion of tramway No. 2 authorised by the Leeds Corporation Act, 1914.

One of the reasons why Southport Council has been recommended to discountenance the running of motor-'buses is that the electricity department would lose revenue by a drop in the traction load.

Burnley Tramways Committee recommend that the relaying of the track be carried out at a cost of nearly £13 000. The lines to be relaid include sections on the Rosegrove, Manchester-road, and Townley routes, whilst a double line is to be placed on the Rosehill-road section.

Owing to the recent heavy snowstorms the tramway services in many districts have been interrupted. The service between Merthyr and Dowlais was stopped on Friday night and was unable to resume until mid-day on Saturday. At Bournemouth also the service was disorganised owing to the deep drifts.

Leicester City Council have approved of a recommendation by the Tramways Committee that the Welford route be completed, and that the section be opened as early as possible. The work was authorised in 1913, and after the completion of the track and certain overhead equipment the work had to be suspended on account of the war.

Belfast tramway system shows a falling off of no fewer than 278 152 passengers in the last two weeks ending the 24th ult., as compared with the corresponding period of last year, and a decrease of £1 947 in revenue. This was largely owing to the repeated attacks by bomb and revolver on the trams, particularly those carrying workmen from the Queen's Island shipyards.

The sum of £301 000 has already been expended on the reconstruction of Cardiff tramways track, and as the fund of over a quarter of a million sterling, set apart by the department for the purpose, has been expended, it is necessary to obtain a loan of £160 000 to finish the work. The additional sum is required owing to the enhanced cost of labour and material. Although many of the men engaged in the work are of the unemployed, only £7 000 has been received from the Government, and the Department has decided to put in claims for a larger contribution.

Mr. R. L. Horsfield, the tramways manager, has been instructed to prepare a report as to the reintroduction of 1d. fares and on the introduction of special fares for children.

The Ministry of Transport held an inquiry last week into the application by Newcastle Corporation to amend the Newcastle-on-Tyne Light Railway Order by including an additional tramway. The Town Clerk stated that the proposed line is situate near the western boundary of the city, and when constructed would, in conjunction with Tramroad No. 2, now in course of construction, form a means of communication to the centre of the city for passengers from the west and south-west of the city. The length was six furlongs, and the total estimated cost of construction and of acquisition of land and buildings was £13 564. It was felt that the present necessities of the public could adequately be served by the proposed light railway, in conjunction with Tramroad No. 2, and that it might well serve to assist in the development of the Fenham district of the city. Details of the proposed construction were given by Mr. Ernest Hatton, engineer and general manager of the tramways, and Major Steele, city engineer. At the close of the inquiry the chairman, Mr. Alan D. Erskine, stated that he would report upon it to the Minister of Transport, and he hoped there would be no delay in making the Order.

Personal and Appointments.

Major-General Sir FREDERICK SYKES has joined the board of the Anglo-Argentine Tramways Company.

Mr. E. R. DUNN, electrical engineer, has been elected chairman of the committee of Ramsgate Chamber of Commerce.

Lieut. L. S. KING, from the London Electrical Engineers, has been posted to the Reserve of Officers of the Territorial Army.

Commissioned Telegraphist W. S. BLOODSWORTH has been appointed to the battle cruiser "Queen Elizabeth" from the 16th inst.

Mr. G. W. SPENCER HAWES, secretary of the Reading Electric Supply Company, Ltd., has been elected to the committee of the Reading Athenæum Club.

Councillor E. C. RANSOME has been elected president, and Mr. LLEWELYN B. ATKINSON chairman, of the British Development Association for the ensuing year.

Mr. FRANK MARSH, formerly of Curran's Cardiff Foundry & Engineering Company, has been appointed public lighting inspector by the Cardiff Electricity Committee.

Mr. W. J. WEBB, one of the representatives for Rotherhithe on the London County Council, has been appointed a member of the Electricity Committee of the County Council.

Consequent on a naval officer being put in charge of the Bermuda Wireless Station, Lieut. E. C. L. BEARCROFT has been ordered to return home to join the Chatham Division, R.M.L.I.

Mr. A. C. GORTON has retired from the firm of Gorton and Smith, electrical engineers, St. Swithen-street, Winchester, and the business will be continued by Mr. ROWLAND HERBERT SMITH.

Major G. H. WILLIS has been elected president of the Institution of Engineers (India) for the ensuing year in succession to Sir R. N. Mookerjee, who has held the post from 1920-22.

Colonel H. MACCALLUM, of the Marconi Company, has, at the request of Mr. Wm. Le Queux, president of the Reading Radio Research Society, consented to serve on the committee of the society.

Mr. B. F. KERRIDGE, formerly under-surveyor of Baldwin's collieries, and later H.M. Inspector of Mines at Newport, sailed for India last week to take up an appointment as the first Electrical Inspector under the Mines Department of the Indian Government.

Mr. JOHN BERNARD, manager of the Bolton Tramways Department, has been elected one of the employers' representatives on the National Joint Industrial Council for the Tramways Industry in succession to Mr. J. M. McElroy, the retiring manager of Manchester Tramways.

We are glad to be able to announce that Mr. ERNEST HATTON will continue in his position as engineer and general manager of Newcastle-on-Tyne Corporation tramways. Since we announced, in our issue of Feb. 24, his intention to retire in three months' time, Mr. Hatton has had further medical advice, and has received a more favourable report. The Transport and Electricity Committee have agreed to the withdrawal of his notice.

Mr. C. E. SKINNER, manager of the research department of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., has been appointed assistant director of engineering in that company. Mr. Skinner is known throughout the electrical world for his extensive research work, especially on insulation, and his efforts in this direction have had a marked effect on the development of electrical machine design. Mr. Skinner has contributed frequently to the literature of the electrical industry, and is well known for his researches. In 1915 he was a special representative of the American Institute of Electrical Engineers, of which he is a Fellow, at the International Conference on Electrical Standards held in London, and he is now a member of the committee representing the Institute of the International Electrotechnical Commission. He was chairman of the American delegates to the Brussels meeting in 1920.

Mr. S. M. KINTNER, who is well known for his research and engineering work in the development of radio apparatus, has been appointed manager of the research department in succession to Mr. Skinner.

Business Items, &c.

The telephone number of Sir CHARLES BRIGHT & PARTNERS is now Bishopsgate 1120 (two lines).

The ALFO ELECTRICAL ENGINEERING COMPANY announce that they are closing down their branch business at Telegraph-road, Heswall.

A reduction in the price of ROYAL "EDISWAN" KINGOLITE LAMPS is announced in our advertisement columns. This reduction amounts to as much as 1s. 9d. per lamp in some cases.

Mr. H. B. TURNER has taken over the complete control of Hall & Turner, wholesale factors of electrical goods, and will be glad to receive manufacturers' and agents' price-lists for cables, switches, lamp-holders, &c., at 79, Playford-road, London, N. 4.

The A. & A. ELECTRICAL COMPANY announce that as from April 1 they have taken over the business of Spicer & Company, Ltd., 41, Red Lion-street, Clerkenwell, E.C. 1, with all cash assets and liabilities, and that they will collect all outstanding cash assets of that company and satisfy all liabilities. They have also been successful in securing the services of Mr. S. J. Levi as manager, who is joining the board of directors of their company.

GRAFTON (N.S.W.) Council have decided to equip electricity works which will be capable of subsequent working in co-operation with the Nymboida hydro-electric scheme.

Institution Notes.

Among the Papers to be read at the annual meeting of the IRON AND STEEL INSTITUTE, which is to be held on May 4 and 5 at the Institution of Civil Engineers, Great George-street, London, is one entitled "Recent Developments in Power Production," by Mr. D. Selby-Bigge.

Mr. J. A. Kuyser's Paper on "Protective Apparatus for Turbo-Alternators" will be read and discussed before the INSTITUTION OF ELECTRICAL ENGINEERS on April 27, instead of April 6, as already announced. The joint meeting with the Röntgen Society and the Electro-Therapeutic Section of the Royal Society of Medicine, previously announced for April 27, has been postponed.

A ballot for the election of members and student members of the INSTITUTE OF METALS will be held at noon on Wednesday, April 19, in connection with the twelfth annual May Lecture. This lecture is to be delivered on Wednesday, May 3, by Prof. Sir Ernest Rutherford, of Cambridge University, on "The Relation of the Elements." Membership application forms and cards of invitation to the lecture may be obtained on application to Mr. G. Shaw Scott, M.Sc., the secretary of the Institute of Metals, 36, Victoria-street, London, S.W. 1.

The opening meeting of the 1922-23 session of the British Section of the SOCIÉTÉ DES INGÉNIEURS-CIVILS DE FRANCE will be held at 5.30 p.m. on Tuesday, April 11, at the Institution of Mechanical Engineers, Storey's Gate, S.W. 1, when Mr. W. Noble Twelvetrees will deliver the presidential address, opening a discussion on "Co-operation between Engineering Institutions in France and Great Britain." Ladies will be cordially welcomed. Several well-known engineers have already announced their intention to take part in the discussion, and we are informed that members of all British engineering institutions and societies are invited to attend the meeting.

The Council of the OPTICAL SOCIETY is arranging a programme of papers dealing with motor headlights, having reference more particularly to the optical problems involved. The question of "glare" or "dazzle," and the methods proposed for overcoming it, will be considered, both from the point of view of the optician, the lamp manufacturer, and the road user. The meeting will be held at the Imperial College of Science and Technology, South Kensington, on May 11, and anyone desiring to contribute to the discussion or to exhibit models or give experimental demonstrations is requested to communicate with the honorary secretary of the Society, Mr. F. F. S. Bryson, Glass Research Association, 50, Bedford-square, W.C. 1.

Telegraph and Wireless Notes.

Direct telegraphic connection from GOTHENBURG TO PEKING *viâ* Petrograd and Irkutsk has been re-established by the Great Northern Telegraph Company.

A loud-speaking wireless telephone installation has just been completed at LAUSANNE, which will be in communication with the Eiffel Tower telephone each evening, and will be able to record communications from London, Berlin, and even America.

Sir THOMAS WATT, the South African Minister of Public Works and Posts and Telegraphs, states that the Government intends to acquire a wireless station for the purpose of establishing an adequate service with other countries of the world, and is at present considering several propositions in this connection.

Arrangements have been made by the Postmaster-General to enable telephone subscribers to BOOK TRUNK CALLS IN ADVANCE. The calls, which are effected at or about a specified hour, as desired by the subscriber, are known as "fixed time" calls, and the booking may be either for a single call or for a daily call for a minimum period of a week, including or excluding Saturdays and Sundays. The calls are number to number, not person to person calls. A single "fixed time" call should, if possible, be booked at least three hours before the time at which it is required, such as stock exchanges, corn exchanges, etc.

MARYLAND TELEPHONE EXCHANGE, which replaces the Stratford and Broadway Exchanges, was opened on Saturday. The equipment at Stratford Exchange was of an obsolete type, and there was no spare capacity, while Broadway Exchange was only of a temporary character. Accommodation is provided for approximately 2 000 subscribers and 460 junctions to other exchanges in London. Ample external cable plant exists in the neighbourhood, and the new exchange will be capable of extension to meet the needs of the district for a number of years ahead. Maryland Exchange is the twelfth new exchange to be opened in London since the Armistice.

Exhibition Notes.

The thirteenth INTERNATIONAL BUILDING TRADES EXHIBITION will be held at Olympia from the 11th to 27th inst.

A Mining and Industrial Exhibition is to be held by the Chemical, Metallurgical, and Mining Society of SOUTH AFRICA in October. Firms interested are advised to communicate with their local agents, or the secretary of the society, 100, Fox-street, Johannesburg, South Africa.

At a meeting of members of the Council of the Birmingham section of the BRITISH INDUSTRIES FAIR and the leading exhibitors on Thursday last, it was proposed that the Fair at Castle Bromwich next year be held in May instead of early March; also that there be no standardising of stands, and that the public be admitted on two days (Saturday and the second Wednesday) at a small charge, which will probably be fixed at 1s. These matters will now be dealt with officially.

Obituary.

The death has occurred of Mr. Philippe Guye, Professor of Physical Chemistry at Geneva University.

We regret to record the death, which took place on Monday, of Mr. E. A. Claremont, chairman and managing director of W. T. Glover & Company.

The death has taken place at Bournemouth of Mr. James N. Paxman, in his ninety-first year. Mr. Paxman was born at Colchester, and at the age of fifteen entered his father's engineering business. Four years later he became joint manager with Mr. C. Marriage of Catchpool & Sons' engineering and ironfounding business, and two years later he was appointed to the entire charge. In 1865 he resigned this position to commence business with C. M. and H. M. Davey at Colchester. In 1869 he patented the "Paxman" vertical boiler, and in 1878 his automatic cut-off gear, combined with a governor for effectually regulating and controlling the speed of a steam engine. The same year the Messrs. Davey retired from the business, their interest being taken over by Mr. Paxman and his partner. At the International Electric Exhibition at the Crystal Palace in 1882, Mr. Paxman's engine was retained by the jury for carrying out their experiments; they commended it for its efficient and regular performances, and awarded him a gold medal. The firm's business continued to develop, and in 1898 it was converted into a private limited company, and to-day ranks as one of the leading firms in the kingdom. Mr. Paxman was elected Mayor of Colchester for 1887-1888, and for 1897-1898. He had served as High Sheriff for the County of Essex, and was a Justice of the Peace for Colchester as well as for the county of Essex.

Social Notes.

The eleventh annual dinner of the Batti-Wallahs' Society was held at the Holborn Restaurant last Friday, with the president, Mr. Edgar S. Barralet, in the chair. After dinner an excellent musical programme was rendered, during the intervals in which the toast of "The Society" was proposed by Mr. Elmhirst, one of the half-dozen men who met together and formed the Society in 1906, and that of "The Ladies and Visitors" by Mr. W. Riggs. These toasts were replied to respectively by the President and Mr. L. C. Gamage, secretary of the G.E.C.

Past and present members of the Board of Control of the National Association of Supervising Electricians and their friends, to the number of about seventy, met at a whist drive and dinner at the Mecca Café, Ludgate Hill, London, on Saturday, March 25. During dinner Mr. R. W. Whitley, in a humorous speech, proposed the toast of "The Ladies," to which Mr. W. J. Revell responded. A musical programme, followed by an enjoyable whist drive, with Mr. A. J. Stiling acting as M.C., added to the success of the evening. Mr. T. H. Windibank, as chairman, caused much merriment with his humorous remarks when distributing the prizes, and delighted his guests with the manner in which he carried out his duties.

Trade Inquiries.

A manufacturers' agent in Vancouver desires to obtain the representation of United Kingdom manufacturers of electrically galvanised metal strip, on a commission basis, for the province of British Columbia. Particulars from the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1. (Reference No. 360.)

A manufacturers' agent in Montreal wishes to represent, on commission, United Kingdom manufacturers of electrical specialities for sale in Eastern Canada. Particulars from the Department of Overseas Trade. (Reference No. 362.)

Electrical Activities in China.

C. C. Nieh, Lu Er-kia, and other Shanghai merchants propose to organise the Yeh Chung Machine Manufacturing and Engineering Company in Shanghai, for manufacturing electric fans, electric lamps, dynamo, motors, and all other electrical goods. Its capital will be $300 000 in 3 000 shares of $1 000 each.

The Ta Tung Company, Ltd., has recently been organised by Chang Chien, Jr., and others, with a capital of $1 000 000, at Garden-road, Tungchow. The company will specialise in engineering and electricity contracts and work.

The Siemens-Schuckert Company, of Berlin, is establishing works at Shanghai, in co-operation with Chinese interests, for the manufacture of electrical fittings and supplies for domestic purposes. It is proposed to form a joint stock company which will embrace the pre-war China organisation of the Siemens companies and represent the Rhein-Elbe-Union (Stinnes) interests.

The Yau Hua Electric Company, of Hsuchow, was established in 1905. Three new plants have been installed and a new building erected, which was completed on Dec. 27. It is estimated that the three plants supply 30 000 lights.

Chung Hsin Electrical Company, Soochow, Kiangsu, has been amalgamated with the Soochow Electric Company. The latter was established in 1920 to compete with the Chin Shing Electrical Company, a part of which is owned by Japan.

A company to be known as the Ming Yuan Electric Light Company is being established at Chuchow, Anwhei.

The merchants of Hokow, Yunnan, have raised $20 000 for the establishment of the Hokow Electricity Company, Ltd.

Companies' Meetings, Reports, &c.

Edison Swan Electric.

The accounts of the Edison Swan Electric Company for the year ended June 30, 1921, show, after providing for various adjustments, a balance to the debit of profit and loss of £344 720. The board recommend that the sum of £55 000 now standing to reserve be transferred to profit and loss account, thus reducing the debit balance to the sum of £289 720. The directors regret that the operations of the company should have resulted in the loss shown, but the effect of the coal strike resulted in the company's business being practically brought to a standstill in many parts of the country. Under these circumstances the works could only be operated on a scale considerably below their full capacity, and various workshops were not able to carry their due proportion of overhead charges, but every effort has been made to reduce them to the lowest figure. A searching valuation of stocks of raw materials and manufactured and partly-manufactured goods has been made, and it has been found necessary to write £346 445 off as depreciation, this accounting for the greater portion of the loss. Since November last the position of the company has slowly improved, and with a moderate revival of trade the outlook for the company should become much more favourable. Since the date of the balance-sheet, loans from the bankers have been increased by £90 150, making the total loan advanced by them to date £313 950. A meeting of shareholders in November authorised an increase in the borrowing powers, and to provide the necessary security for the advances made the board have issued to the bank £100 000 Second Debenture stock, together with a further specific charge of £66 000 upon certain of the properties of the company. Mr. A. F. Philips and Mr. G. L. F. Philips, of Philips Glowlampworks, have retired from the board as technical directors. Subsequent to such retirement the board, under legal advice, commenced proceedings against Philips Glowlampworks with the view of determining the agreement existing between that company and the Edison Swan Electric Company, and also in relation to other matters. Mr. C. E. Hunter resigned his position as managing director in January, 1921, and Mr. C. J. Ford has been appointed in his stead.

British Aluminium.

The annual meeting of the British Aluminium Company, was held last week, Mr. A. W. Tait (Chairman), presiding.

The Chairman said that the net profit for the year was £221 506, compared with £428 157 in 1920, and the trading profit was £183 041, against £373 779. This substantial decrease, while very disappointing, was not unexpected. The trading for 1920 was a record, but at the last annual meeting he said that a sudden falling off in demand had become evident in August of that year. This depression assumed serious proportions about the end of the year and continued with increasing severity throughout 1921. The result was an over-production of metal. They closed two aluminium plants and one alumina plant, and reduced production at the works in the early part of the year. So far there had been no great improvement in the position, and the aluminium works in Norway were still closed down, although output at the works in Scotland had been somewhat increased. He could not see how they could expect business to show definite improvement until there was a more or less general return to normal trading conditions.

Having alluded to taxation as a great source of weakness in industry and to the need for drastic and immediate reduction of the burden, the Chairman said that the Lochaber Water Power Scheme was approved by both Houses of Parliament, and received the Royal Assent on July 28, 1921. The Act granted to a statutory company (which would be controlled by the British Aluminium Company) one of the largest water powers in the United Kingdom, and when this was developed it would give power for the further expansion of their industry in a district contiguous to the Kinlochleven works, and which would also provide power for the development of local industries. The scheme would not be proceeded with until the general conditions of trade and the expansion of their own industry warranted it. The total reserves were approximately £967 000, or very little short of the issued ordinary share capital. After meeting debenture interest, placing £20 000 to reserve for depreciation and £10 000 to reserve account, and paying the preference dividend and 5 per cent. on the ordinary shares a sum of £14 791 was carried forward.

Torquay Tramways.

In moving the adoption of the report and accounts at the annual meeting of the Torquay Tramways Company, Ltd., last week, Mr. H. T. Barnett (chairman of the company), who presided, said that although the coal strike seriously affected the receipts at one time, the year ended with an increase in revenue of £710, creating another record, and the number of passengers carried was the highest in the history of the company. The progress of the motor-'bus undertaking had been up to expectations, and the directors had every confidence in the future. Referring to the heavy taxation, the chairman stated that he thought the company was the only tramway company in this country that had been liable for excess profits duty, and that tax being now gone, the burden would be considerably eased in the future. It was important to bear in mind that the increased revenue was not due to increased fares, as the fares at Torquay were still on practically a pre-war basis. The accounts of the company disclosed a strong financial position. Although by Dec. 31 last an expenditure of £45 828 had been incurred on the motor-'bus undertaking, they finished the year with investments, cash at bank, &c., amounting to £43 089. The reserve and renewals

account had been increased from £48 000 to £59 000, and reserve for equalisation of dividends from £4 000 to £5 000. The motor-'buses capital account now stood at £45 828, as compared with £16 485, the increased expenditure being represented by additional rolling stock and the new garage. On the revenue side there should be a considerable decrease in the cost of current during 1922, in view of the substantial fall in coal. The balance carried to net revenue account was £26 397, compared with £24 968, and the additional profit in operating motor-'buses had been £8 188, compared with £2 582. The profit was £36 178, and after providing for debenture service and for the above reserves there was a balance of £11 370, out of which a dividend of 8 per cent., free of income tax, was recommended, carrying forward £2 206. The directors had under consideration the advisability of forming a subsidiary company to operate the motor-'bus undertaking, in view of the considerable expansion in the services which must take place, and shareholders' claims in that event would be taken into consideration.

Hadfields, Ltd.

Sir Robert Hadfield, Bart. (chairman of Hadfields, Ltd.), was unable to preside on Monday at the annual meeting of shareholders, but sent a message to the meeting from the Riviera, where he is recovering from an illness.

Sir Robert pointed out that the iron and steel industries throughout the world had felt the depression most acutely. The British output of pig-iron dropped from 8 000 000 tons in 1920 to 2 500 000 tons in 1921, the steel output from 9 000 000 tons to 3 500 000 tons, compared with 10 250 000 tons of pig-iron and 8 000 000 tons of steel produced by Great Britain in 1913. The strange fact was that, notwithstanding this acute depression, the world wanted and must have iron and steel on a large scale. A well-known American authority computed that the world to-day is short of no less than 200 000 000 tons of iron and steel. There must, therefore, be a large demand before long, or modern civilisation would receive a check, for the world's progress depended on ample supplies of the metal iron and on a much greater scale than the present production.

Mr. Peter B. Brown (managing director), in moving the adoption of the report and balance-sheet from the chair, said their post-war programme of reconstruction and extension was almost completed, and they were now eagerly awaiting an opportunity to put the new departments into operation. That could only be accomplished when the demand for their products matured. At the beginning of last year they had on their books a large volume of orders which had accumulated, some of them since before the war. The world slump in trade did not therefore affect them seriously until the latter part of the year. Its continuance, however, was naturally a source of anxiety to the directors.

The report and accounts were adopted, and a final dividend declared, making 5 per cent. for the year, free of tax.

Newmarket Electric Light.

The annual meeting of the Newmarket Electric Light Company was held last week, Mr. F. E. Gripper (chairman) presiding. During the past year the equivalent of 1 633 33-W lamps was connected to the mains, making the total connected at the end of 1921 40 566 lamps. The gross profit on the year's working was £3 435, compared with £2 953 in 1920. After providing for debenture interest (£710) and adding £249 brought in, a balance of £2 974 remained. The directors recommend that a dividend of 3 per cent. be declared, that £1 750 be carried to general reserve, and that the balance of £427 be carried forward. The Chairman, in moving the adoption of the report and accounts, said the company could have comfortably paid a 5 per cent. dividend this year if it were not for the restriction which existed owing to the Increase of Charges Act. The Government had introduced a Bill which would give the Electricity Commissioners power to deal with this point, and in the next few months they hoped to have an Order made by the Commissioners which would relieve them of this limitation. He thought they could look forward to a very much more satisfactory report next year; first, because the restriction as to dividend would have been removed; and, secondly, because there was a very substantial reduction in the cost of coal.

The Metropolitan Railway Company are making an issue of £600 000 5 per cent. preference stock at 87 in order to provide for additional power, plant and rolling stock.

Whitehall Electric Investments, Ltd., on Monday offered for public subscription £2 500 000 6 per cent. first mortgage debenture stock (1925-49) at £87½ per cent., and 1 500 000 7½ per cent. cumulative preference shares of £1 each at par.

The accounts of W. Canning & Company for 1921 show a loss of £23 671, after charging all expenses, including maintenance and full depreciation of properties, plant and fixtures, less surplus of £1 452 brought in, leaving deficiency of £22 218 carried forward.

Torpoint Electric Supply Company, Ltd., announce that they are issuing 950 7½ per cent. first debentures of £5 each at par. Further particulars can be obtained from the Secretary, 3, Fore-street, Torpoint, or from Mr. J. A. Pearce, 5, St. Aubyn-street, Devonport.

The profits of A. Reyrolle and Company for the past year, including balance brought in, amounted to £64 662, and a dividend of 12½ per cent. is recommended on the ordinary shares. £15 000 has been placed to reserve, leaving £12 190 to be carried forward.

The accounts of the London Electric Wire Company & Smiths for 1921 show profit, after placing £50 000 to reserve, of £83 924, making available, with £38 267 brought in, £122 851. General reserve is now £150 000; special reserve remains at £20 000. The directors recommend a final dividend on the ordinary shares, making 7½ per cent., less tax, carrying forward £44 545.

The South London Electric Supply Company has paid a dividend of 4½ per cent. on the ordinary shares, making 7 per cent., placing £12 500 to reserve for depreciation, &c., £17 500 to general reserve, £5 000 to reserve for contingencies, leaving £5 661 to be carried forward.

The receipts for 1921 of the Taunton Electric Traction Company, including £611 brought in, totalled £2 749. After deducting all expenses and debenture interest, there was a debit balance of £225 to be carried forward. During the year £2 000 5 per cent. debentures were redeemed. Further negotiations with the Corporation for the purchase of the undertaking having failed, steps have been taken to remove the tramways and realise assets.

At a special meeting of the shareholders of the Northampton Electric Light and Power Company last week it was decided to increase the capital of the Company to £350 000 by the creation of 100 000 additional "B" shares of £1 each, to be issued by the directors either as ordinary or preference shares as the directors may determine. This capital is required in connection with the extension of the works at Hardingstone Junction.

The revenue of the Bristol Tramways & Carriage Company for 1921 was £1 022 203 and working and general expenses and renewals £951 589, leaving with the balance brought forward, together with an amount recovered on an adjustment of income tax, net revenue of £104 100. It is proposed to pay a final dividend on the ordinary shares of 4 per cent., free of tax, making 7 per cent. for the year, carrying forward £3 668. After charging expenses of the issue of new ordinary shares and adjusting the value of investments at Dec. 31 last, the reserve fund amounts to £339 557. Receipts of the tramways department show an increase of £112 188.

The annual meeting of the Mirrlees Watson Company was held last week in the company's offices, Glasgow. The profit and loss account showed a profit for 1921 of £46 698, and, after providing for depreciation and directors' fees, a balance of £41 443 remains, to which is added the balance brought forward—namely, £14 409—leaving a sum of £55 853 at the credit of profit and loss. The meeting resolved that £15 942 be applied in payment of a dividend at the rate of 10 per cent. per annum, and a bonus at the rate of 2½ per cent. per annum, both less income-tax, and that £25 000 be transferred to general reserve account, leaving £14 911 to be carried forward.

The report of the Brush Electrical Engineering Company for 1921 shows, after providing for general charges, maintenance of plant and buildings and interest on debenture stocks and loans, a balance of £232 602, plus £141 983 brought forward, subject to excess profits duty for 1920 and previous years, income and corporation profits taxes, and directors' additional remuneration. The directors have allocated to depreciation of buildings and plant £14 400, and to patents and goodwill £600, further 4 per cent. interest on the prior lien participating second debenture stock £2 044, general reserve £73 191, and recommend a dividend at 15 per cent. on the ordinary shares for the year, directors' additional remuneration £2 267, carrying forward £214 074. The general reserve account has been increased during the year by £1 809, the profit on purchase of debenture stocks for sinking fund purposes. The £73 191 now appropriated to this account raises the general reserve fund to £150 000. The sum of £92 809 has been expended on capital account during year.

The annual report of Metropolitan-Vickers Electrical Company for the year ended Dec. 31 last shows that the profit available for the year, including the balance of £58 824 brought in, amounts (after providing for taxation) to £395 926, which has been appropriated as follows:—To special depreciation on plant, machinery, &c., £35 000; to general reserve account, £100 000; to dividend on preference and ordinary shares to Dec. 31, 1921, at 8 per cent. and 12½ per cent. respectively, less income tax, £168 111; leaving a balance of £92 815 to be carried forward. Orders received during the year, owing to the prevailing trade conditions, show a falling off as compared with the previous year. The works have, nevertheless, partly due to orders carried forward from 1920, been kept well employed. During the year 25 523 preference shares have been converted into 51 046 ordinary shares, making a total of 68 475 preference shares so converted. An application for a quotation of the ordinary shares resulting from the conversions in 1921 is now before the Stock Exchange.

The accounts of the Bromley (Kent) Electric Light & Power Company, Ltd., for the year to Dec. 31 last show a gross profit of £17 575, compared with £12 611 in 1920, and after payment of debenture interest, trustees' fees, &c., amounting to £3 002, writing off £3 000 of the cost of investments, and adding £1 314 10s. brought forward from last year, there is a balance of £12 887. The directors recommend the payment of a dividend of 10 per cent. for the year, which will absorb £7 500, that £4 500 be placed to depreciation and renewal reserve account, and that the balance of £887 be carried forward. During the year the connections have increased from 5 479 to 5 726 kW. To meet the increasing demand for electricity a supply in bulk has been arranged for from the works of the West Kent Electric Company. Additional machinery and mains are being laid down to utilise this supply, at a cost of about £15 000, which sum is being provided from the general reserve fund, and it is proposed to capitalise this amount by the issue of bonus shares to the value of £15 000 to the existing shareholders in proportion to their present holdings.

COMMERCIAL INTELLIGENCE.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

ALLIES ELECTRIC LAMP REPAIRING COMPANY, LTD., Montgomery-street, West Kensington, manufacturers. £61 12s. 11d. Jan. 31.

BARRINGTON, W. Mead, 37-8, Strand, W.C., electrical engineer. £21 13s. 2d. Feb. 2.

BEADLE BROTHERS, 5, Coleridge-street, Burmantofts, electricians. £17 13s. 7d. Feb. 2.

DOWELLS ACCUMULATORS (1920), 79 Uxbridge-road, Hanwell, electrical engineers. £11 17s. 7d. Feb. 1.

VENN BROTHERS, 39, Turnham Green-terrace, W. 4., electrical engineers. £18 0s. 3d. Feb. 2.

WHITE, Mr. Francis G., 68, High-street, St. John's Wood, electrical contractor. £13 11s. 11d. Jan. 31.

Bill of Sale.

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1822 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

EVERSON, James Albert, 5, Carisbrooke-road, Walton, Liverpool, importer of electric globes, &c. March 21. £55.

Receivership.

CHASE BROTHERS, LTD. W. Peet, of 39, Mark-lane, E.C., was appointed receiver and manager on March 18, 1922, under powers contained in debenture dated Oct. 25, 1920.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

COUNTY OF DORSET ELECTRIC SUPPLY COMPANY, LTD., Dorchester. Registered March 23, £500 debentures, balance of £2 500; general charge. *——. Dec. 31, 1920.

MODERN ELECTRICAL SUPPLY COMPANY, LTD., London, E.C. Registered March 23, £5 000 debentures; general charge.

WITTING (W.). LTD., Hull, electro-platers, &c. Registered March 23, £1 700 debentures and mortgage. *£1 800. Dec. 31, 1920.

Private Meetings.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

BEDESCO, LTD. (in voluntary liquidation), manufacturers of electric lighting sets, London. The creditors of the above were called together on April 3 at the offices of Messrs. Quaife & Tuke, accountants, 155, Fenchurch-street, London, E.C. Mr. A. E. Quaife occupied the chair, stating that the company had passed the usual resolution in favour of voluntary liquidation, and had appointed him to act as liquidator. He added that he had ascertained that the liabilities amounted to £1 169, while the net assets were expected to produce £139. The creditors passed a resolution confirming the voluntary liquidation of the company, with Mr. Quaife as the liquidator.

COATON, T. G. (trading as T. G. COATON & COMPANY), electrical engineer, 16, Humberstone-road, Leicester. The creditors of the above were called together recently, when a statement of affairs was presented which showed liabilities of £2 479. Of that amount £2 227 was due to unsecured creditors, and there were partly secured creditors for £396, who held securities valued at £144. After allowing £27 for preferential claims, the assets were estimated to realise £798, or a deficiency of £1 681. It was reported that the debtor commenced business in 1912 in partnership with his brother, the capital being about £300. Subsequently they were joined by another partner, who brought in £100. In 1919 the partnership was dissolved. At the date of the dissolution a balance-sheet prepared showed a capital of £1 700. After discussing the position, a resolution was passed to the effect that the debtor should execute a deed of composition to Mr. E. H. Hawkins, of Poppleton, Appleby & Hawkins, 4, Charterhouse-square, London, E.C., to secure the payment of a composition of 10s. in the £, payable as to 5s. in three months, 2s. 6d. in six months, and 2s. 6d. in nine months. A committee was also appointed, consisting of the representatives of Messrs. Drake & Gorham, British Thomson-Houston Company, and the General Electric Company.

HERBERT D. CARTER, LTD., electrical contractors and ironmongers, Edison House, Colwyn Bay. In response to a circular issued by the company, a meeting of the creditors of the above was held recently at Colwyn Bay. No statement of affairs was submitted, but it was stated that the company was a private limited liability concern, which was formed in March, 1915, with a capital of £5 000, divided into 4 000 ordinary and 1 000 preference shares of the face value of £1 each. The whole of the preference shares had been issued, while 3 000 ordinary shares has been issued. Of the issued capital of £4 000, the greater amount was for a consideration other than cash. In September, 1917, Mr. Carter advanced £1 100 to the business and was given a first debenture. In September, 1921, a second debenture for £1 500 was created. Until 1920 the company carried on business as electrical engineers, and the three largest creditors were for goods supplied in connection with such contracts. Since the date mentioned the company had also carried on business as ironmongers. A receiver had been appointed on behalf of the debenture holders. The meeting had been called for the purpose of a report being submitted as to the position, but no definite resolution was passed.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Bankruptcy Information.

COOKSON, Eugene (trading as W. TURNBULL & COMPANY), carrying on business at the Express Magneto Repair Works, Elizabeth-street and Charles-street, Blackpool, electrical, &c., engineer. Receiving order, March 28. Debtor's petition.

DICKEN, William John (trading as W. DICKEN & SON), 2, Upper High-street, Bargoed, co. Glamorgan, electrical engineer. First meeting, April 13, 12 noon, 34, Park-place, Cardiff. Public examination, April 27, 11 a.m., Town Hall, Merthyr Tydfil.

LUDLOW, Jesse Frederick, and LUDLOW, Robert Redvers, in co-partnership as LUDLOW BROTHERS, at 196, Church-road, Redfield, Bristol, electrical contractors. Receiving order, March 29. Debtor's petition. First meeting, April 12, 12.45 p.m., 26, Baldwin-street, Bristol. Public examination, April 21, 12 noon, Guildhall, Bristol.

NASON, Charles Frederick, 93, Butt-road, Colchester, electrician. Receiving order, March 27. Debtor's petition. First meeting, April 13, 12.15 p.m., 5, Butter-market, Ipswich. Public examination, April 26, 11.45 a.m., Law Courts, Town Hall, Colchester.

RAWCLIFFE, Frank (carrying on business under the style of FRANK RAWCLIFFE & COMPANY), 8, Nun-street, Newcastle-upon-Tyne, electrical engineer. First meeting, April 11, 12 noon, Official Receiver's Office, Pearl-buildings, 4, Northumberland-street, Newcastle-upon-Tyne. Public examination, May 4, 11 a.m., County Court, Westgate-road, Newcastle-upon-Tyne.

Partnership Dissolved.

PYNE, Harry Davies, and CLARK, Percival Francis, electrical engineers and manufacturers, at Latimer-road, Teddington, co. Middlesex, under the style of the PYNE MANUFACTURING COMPANY, by mutual consent as from March 18, 1922. Debts received and paid by H. D. Pyne.

Edinburgh Gazette.

M'COSH, Townley Johnson, and DEVINE, John M'Kinney, electrical, &c., engineers, 57, Peel-street, Mile End, Glasgow, under the style of M'COSH & DEVINE. Firm dissolved by mutual consent as at March 29, 1922.

Bankruptcy Proceedings.

PRINS, Nathan, merchant and agent, late 74, Forest-road, Dalston, N.E. Described in the receiving order made on March 16 upon the petition of Export Traders, Ltd., as above, the debtor had traded in electrical accessories. A Dutch subject, debtor came to this country in 1912. He was afterwards employed by a firm dealing in electric lighting appliances until the middle of 1919, when he began buying and selling electrical accessories on his own account at 74, Forest-road, Dalston. He possessed no capital, and managed to make £3 or £4 a week profit from the business. The claim of the petitioning and only creditor amounts to £143, and is in respect of goods supplied to the debtor in October, 1920. They obtained judgment against him in November last. The debtor is now employed by a firm of exporters and importers, and attributes his failure to slackness of trade and drop in the price of goods. He values his assets at £10. There was no proposal before the meeting, which was closed, and the case remained in the Official Receiver's hands.

Tenders Invited and Accepted.

UNITED KINGDOM.

Gravesend Town Council. April 12.—Wiring fifty-eight houses. Particulars from the Borough Electrical Engineer.

Bury (Lancs) Electricity Committee. April 15.—Supply and laying of about 1 000 yds. c.i. 3 ft. 6 in. pipes, construction of intake chamber, &c. Specifications from Borough Engineer.

Warrington Electricity & Tramways Committee. April 18.—Supply of h.t. and l.t. paper and lead covered cable. Specifications from Engineer.

Hornsey Town Council. April 20.—Cooling tower, &c. Specification from Borough Electrical Engineer.

Stepney (London) Electricity Committee. April 20.—Three 1 000 kW converting plants, 50-ton electric gantry crane, &c. Specifications from Borough Electrical Engineer.

Edinburgh Corporation. April 24.—Supply of 70 trucks and electrical equipment of cars; also wheels and axles. Specification from the Tramways Manager, 2, St. James-square, Edinburgh.

Metropolitan Asylums Board. April 26.—Two electric automatic passenger lifts and two electric automatic service lifts at Tooting Bec Mental Hospital. Specifications, &c., can be obtained at the Board's Offices, Embankment, E.C. 4.

Glasgow Electricity Department. May 1.—Supply of (1) cables (including small IR cables and flexibles); (2) meters; (3) carbons, for a period of twelve months. Particulars from R. B. Mitchell, Engineer, 75, Waterloo-street, Glasgow.

H.M. Commissioners of Works. May 4.—Supply of engineering labour for three years in the following districts:—Leeds (mechanical) Newcastle (electrical and mechanical), Southampton (electrical and mechanical). Particulars from Contracts Branch, H.M. Office of Works, King Charles-street, London, S.W. 1.

Brighton Corporation. May 8.—Supply, delivery and erection of (1) one 6 000 kW normal rating turbo-alternator and exciter, with condenser, complete with all necessary accessories; (2) one house service turbo-driven d.c. generating plant, comprising two 200 kW 230-280 V shunt wound generators in tandem, complete with all accessories. Particulars from the engineer and manager, Mr. John Christie, Electricity Department, North-road, Brighton.

Salford Corporation.—Electrically-driven detritus dredgers and/or reciprocating pumps for sewage works. Specifications from James Diggle & Son, 14, Brown-street, Manchester.

Wesley Church, Falmouth.—Electric light installation. Particulars from Rev. T. B. Hindsley, Wesley Manse, Falmouth.

AUSTRALIA.

Postmaster-General's Department at Melbourne.—* Sulphate of copper (Schedule No. 16), dry cells (Schedule No. 18). Tenders by April 11; ammonium chloride (Schedule No. 15), porous cells (Schedule No. 17). Tenders by April 23.

Postmaster-General's Department, Perth (W.A.). May 24.—* Supply and delivery of various accessories for telegraph instruments, including condensers, induction coils, receiver cords, fuses, &c. (Schedule No. 731.) (Ref., D.O.T. 8 273/ED/PN.)

Victorian Government Railway Commissioners. May 31.—* Two double-wheel lathes, including motors and control gear. (Contract 35 010.)

SOUTH AFRICA.

Municipal Council of Krugersdorp. April 24.—*Carrying out of the necessary work and the supplying of material for the conversion of the d.c. electric light system at Krugersdorp to a.c., viz., a.c. transformers, voltage regulators, cables, overhead transmission lines, switchgear, low-tension feeders and distributors, motors and meters. Alternate tenders are invited for the completion of the whole scheme and for taking over the electrical plant at present in Pretoria-street Power Station.

SOUTH AMERICA.

Local Authorities in Buenos Aires. June 28.—*Supply of complete machinery for hydro-electric generating station and transforming sub-station.

Skipton Urban Council has accepted the tender of the Western Electric Company for the supply and laying of electricity at £7 864.

St. Pancras (London) Council have accepted the tender of the Underfeed Stoker Company for ash conveying plant for King's-road station, £2 555.

Liverpool Corporation have accepted the tender of Tilling-Stevens Motors, Ltd., for a petrol-electric chassis for the turntable fire escape, £1 080 10s.

Hull Corporation Telephones Committee have accepted the tender of the Western Electric Company, £2 237 10s., for an automatic exchange in East Hull.

Chester Corporation have accepted the tender of the Metropolitan-Vickers Electrical Company for switchgear in connection with electricity supply to Hoole, at £915.

Bermondsey (London) Council have accepted the tender of Gillett and Johnson (lowest tender) for synchronising clocks in the Council's buildings at £236 4s. 6d. Two other tenders (£262 and £290) were received.

Dundee Town Council has accepted the tender of a Berlin firm for the supply of cables for the electricity undertaking, the same quality cable being 10 per cent. cheaper than the lowest British offer at £851.

London County Council have accepted the tender of Medway's Safety Lift Company for electric passenger lift at Geoffrey House, Tabard Garden Estate, at £775. Eleven tenders were received, ranging from £715 to £1 550.

Dundee Corporation have accepted the tenders of the British Thomson-Houston Company for converting machinery at £16 927, and supply of switchgear, £1 413 11s., and the Yorkshire Hennebique Company for circulating water-pipes, &c., £11 011 18s. 6d.

Eston Urban Council has accepted the tender of Clough, Smith & Company for the supply and erection of the overhead equipment, comprising 700 poles, &c., and the supply and laying of about 4¼ miles of underground mains in connection with the town lighting of South Bank, Grangetown, Normanby and Teesville.

Glasgow Corporation have accepted the tenders of Hackbridge Cable Company for e.h.p. cable for Pinkston station, and English Electric and Siemens' Supplies for switches for Parkhead Depot. The tender of R. J. Sinclair for electrical installation work in 750 houses at Mosspark, at £8 933, has also been accepted.

Hammersmith Borough Council have accepted the following tenders for the year commencing April 1: Enfield Edison Cable Works, Ltd., insulated wires, £140 18s. 8d., less 2½ per cent.; Albion Clay Company, stoneware conduit, £140 18s. 8d., less 2½ per cent.; W. Lucy & Co., draw boxes, frames and covers, &c., £319 14s.

Edinburgh Tramway Committee, by a majority, recommend the acceptance of the quotation of a German manufacturer in Cologne for 130 tons of tramway rails and 5 tons of fishplates. The German firm quoted, through their British agent, £1 365, and the nearest British offer was £1 495. Bailie Sleigh and Councillor Couston opposed acceptance of the foreign quotation. The Committee also unanimously agreed to accept the tender of another German firm for steel poles. The British quotation was £7 977, as against £5 436 by a Düsseldorf firm.

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* *Particulars from the Department of Overseas Trade.*

Openings for Trade in the Netherlands.

According to the Dutch Press, the N.V. Electriciteitsfabriek IJsselcentrale at Zwolle are drawing up plans for the extension of their power station. A large new boiler house will be built. Work will commence in the course of this summer. The Limburgsche Tramweg Mij. (technical manager, A. P. Zuurendonk, Grasbroekenweg 4, Heerlen; engineer, J. M. Meijer, of Kruisstraat 26, Heerlen) have plans in hand for laying a large tramway system in South Limburg, of which several lines will be put into execution this year. It has been decided to build a current-redressing installation with a capacity of 1 850 kW. The firm of Aaldijk "De Groene Molen," of Zuidwal, Delft, intend converting their windmill into a mill driven by electric power. Work will probably commence this summer. The "Provincial Electriciteitsbedrijf van Groningen" (Provincial Electric Supply Company, of Groningen) intend extending their electric power station by building a big new boiler house. Work will probably commence next autumn. A proposal has been put forward in Rotterdam Town Council to grant a credit of Gld. 65 000 for the transport by means of mechanical device of the ash at the refuse destructor works.

Imperial Trade Correspondents.

With reference to the suspension of certain Imperial Trade Correspondent posts in the Dominions announced in our columns recently, the Department of Overseas Trade state that the following, who previously served as Imperial Trade Correspondents, have volunteered to continue their services in an honorary capacity:—

Canada.—Mr. J. B. Sutherland, Lougheed Building, Calgary, Alberta; Mr. R. N. Frith, 200, Moser-Ryder Building, Edmonton, Alberta; Mr. W. E. Anderson, 162, Prince William-street, St. John, New Brunswick; Mr. E. A. Saunders, Board of Trade, Halifax, Nova Scotia; Mr. G. B. Ramsey, 53, Dalhousie-street, Quebec.

New Zealand.—Mr. W. T. Monkman, Bond-street, Dunedin.

Arrangements have been made for Mr. G. R. Stevens, the Canadian Trade Commissioner stationed in Jamaica, to act as honorary Trade Correspondent to the Department of Overseas Trade in that colony, instead of the Colonial Secretary, who has hitherto acted in that capacity. Trade inquiries for Jamaica should accordingly be addressed in future to Mr. G. R. Stevens, Canadian Trade Commissioner, 17, Port Royal-street, Kingston, Jamaica. Cable address: "Cantracom" (Bentley's five-letter code).

Mr. Hugh Horne, Commercial Secretary to H.M. Embassy at Tokio, who is at present in this country, will shortly be returning to Japan. He will be in attendance at the Department of Overseas Trade until April 13, and will be pleased to interview any firms in the London area who desire information or assistance in connection with export trade with Japan.

A petition to the King in Council for a charter of incorporation for the Federation of British Industries has been referred to a committee. Petitions for or against the grant must be delivered by May 5

New Companies.

Henry Summers & Sons.

Henry Summers & Sons, Ltd. (180 666). Private company. Registered March 28. Capital, £3 000 in £1 shares (1 300 8 per cent. cumulative preference and 1 700 ordinary). To take over the business of electrical and general engineers, &c., carried on at 1A, Essian-street, and 13A, Anchor-street, Stepney, E., by H. Summers, W. D. Summers and L. Summers who are the first directors of the company. Secretary : L. Summers. Registered office : 1A, Essian-street, Stepney, E 1.

Jowitt Engineering Company.

Jowitt Engineering Company, Ltd. (180 713). Private company. Registered March 29. Capital, £750 in 1s. shares. To take over the business carried on by the Jowitt Engineering Company, to adopt an agreement with J. E. Hackford and R. F. Power, and to carry on the business of manufacturers of gas producers and rotary and reciprocating engines of all kinds, whether for oil, gas, steam, water, electricity or other motive power, &c. Permanent directors : J. E. Hackford (chairman) and R. F. Power. Solicitors : Warren, Murton & Company, 45, Bloomsbury-square, W.C. 1.

Light & Power Company.

Light & Power Company, Ltd. (180 591). Private company. Registered March 24. Capital, £2 000 in £1 shares. Electricians, mechanical engineers, manufacturers, workers of and dealers in electricity, motive power and light, &c. First directors : W. Cussens and H. R. Brown. Secretary : W. Cussens. Registered office : 39, Norfolk-street, Sheffield.

Milliken Brothers.

Milliken Brothers, Ltd. (180 722). Private company. Registered March 29. Capital, £10 000 in £1 shares. To adopt an agreement with the Milliken Brothers' Manufacturing Company, Incorporated, of New York, and to carry on the business of wireless, electrical, mechanical and mining engineers, electricians, suppliers of electricity, manufacturers of and dealers in and letters on hire of the unit system of structural steel as described in Patent No. 17 136 of 1915, &c. First directors : C. T. Wilkinson, W. H. P. Gibson and C. T. Clack. Registered office : Amberley House, Norfolk-street, Strand, W.C.

Spensers, Ltd.

Spensers, Ltd. (180 818). Private company. Reg. March 31. Capital, £12 000 in £1 shares. Manufacturers of and dealers in electrical plant, machinery, meters, apparatus and appliances, producers and suppliers of electricity, electrical, mechanical, hydraulic, and general engineers, &c. First directors : H. E. Smith, K. Smith, and C. K. Black. Secretary : C. Kennedy Black. Registered office : 6, London-street, Paddington.

Whitehall Electric Investments, Ltd.

Whitehall Electric Investments, Ltd. Registered March 30. Nominal capital, £6 500 000 in 1 500 000 7½ per cent. cumulative preference and 5 000 000 ordinary shares of £1 each. To acquire certain bonds, debentures and debenture stock comprised in an agreement (not filed) with the Whitehall Securities Corporation, Ltd., to subscribe for, underwrite, acquire, hold and deal in the shares, stocks and securities of any electrical undertakings, and transport and public utility services, to acquire any licences or concessions for or in connection with the generation, utilisation, distribution and supply of light, heat, sound and power, by electricity or otherwise, or with the construction, equipment and control of railways, tramways and electric lighting and power supply works, and the carriage of passengers and goods; to supply electricity for all purposes, to carry on business as electrical engineers and contractors, &c. First directors : Hon. Clive Pearson, Sir Clarendon G. Hyde, Vincent W. Yorke, J. H. Macdonald and A. E. Worswick. Secretary : J. Lister Walsh. The registered office is at 47, Parliament-street, S.W. 1. File number, 180 780.

Forty Years Ago.

"The Electrician," April 8, 1882.

...RM.—The Western Counties were on Monday last Thunderstorm, ...ere thunderstorm, accompanied by hailstones of visited by a se... unusual size.

...—With reference to the correspondence in Privacy of Telegrams. ... the contents of a telegram addressed the public Press relating to ... T. Wright having been divulged, by Colonel Fred Burnaby to Mr. ... Office has no powers in respect Mr. Fawcett states that the Post... ough the Submarine and other to the secrecy of telegrams sent th... recent meeting of the Court foreign telegraph companies.

Electric Light in the City.—At the ... the electric lighting in of Common Council Mr. Felton said that ... c) at about the same No. 1 district (the Brush light) had been sup... at about 3¾ the cost price as gas, in No. 2 (the Lontin light, s... Brush Company had cost of gas, and in No. 3 (the Siemens light) ...han the cost of gas. of gas. On the last occasion he stated that the ...ce then the company supplied the electric lighting for less money t... price to about £120 About £40, he believed, was the differ...ence. Sin... templated increas- had sent in a contract which would bring up the ... in the same area. more than gas. The Siemens Company also co... the use of gas on ing their estimate to five times the cost of gas here, he might say With regard to a better light being obtained by four times the cost an improved system, as in Fleet-street and elsewhere inserted the *sic* that the cost of the gas in Fleet-street was over ... light." of the Brush system of electric lighting. We ha... above, as we believe it should read "the Weston

Arrangements for the Week.

FRIDAY, April 7th (to-day).

Institute of Cost and Works Accountants.

7.30 p.m. At the Chamber of Commerce, New-street, Birmingham. Public Lecture on "The Functions of Works Accountancy," by Mr. J. A. Lacey.

Junior Institution of Engineers.

8 p.m. At Caxton Hall, London, S.W. Lecturette on "Engineering in Southern Persia," by Mr. J. W. Maple.

Edinburgh Electrical Society.

8 p.m. At Philosophical Institute, 4, Queen-street, Edinburgh. Lecture entitled "Notes on A.C. and D.C. Plant," by Mr. J. Walker.

Royal Institution.

9 p.m. At Albemarle-street, London, W. Discourse on "The Evolution of the Elements," by Sir Ernest Rutherford, F.R.S.

SATURDAY, April 8th.

Royal Institution.

3 p.m. At Albemarle-street, Piccadilly, London, W. Lecture on "Radio-Activity," by Sir Ernest Rutherford, F.R.S. (Lecture VI.).

Birmingham and District Electric Club.

7 p.m. At the Grand Hotel, Colmore-row, Birmingham. Paper entitled "Notes on Marine Salvage," by Mr. V. H. Pearson.

MONDAY, April 10th.

Institution of Electrical Engineers.
North-Eastern Centre.

7.15 p.m. At Armstrong College, Newcastle. Annual General Meeting.

TUESDAY, April 11th.

National Association of Supervising Electricians.

6.45 p.m. At St. Bride's Institute, Bride-lane, London, E.C. Lecture on "Temporary Expedients," by Mr. W. E. Highfield.

Institution of Electrical Engineers.
North-Western Centre.

7 p.m. At the Engineers' Club, Albert-square, Manchester. Discussion on "High-Power Mercury Arc Rectifiers," introduced by Mr. R. L. Morrison.

Institution of Electrical Engineers.
Scottish Centre.

7.30 p.m. At 207, Bath-street, Glasgow. Annual General Meeting. Paper on "Rotary Converters, with Special Reference to Railway Electrification," by Mr. F. P. Whitaker.

WEDNESDAY, April 12th.

Association of Engineers-in-Charge.

7.30 p.m. At St. Bride's Institute, Bride-lane, Fleet-street, London, E.C. Paper entitled "The Artesian Wells and Geological Strata of London," by Mr. R. Langton Cole, F.R.I.B.A.

Prices of Metals, Chemicals, &c.

Tuesday, April 4.

		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£61 10 0	—	£1 0 0
Electro Wirebars ..	,,	£64 10 0	—	£1 5 0
H.C wire, basis	per lb.	0s. 9 1/16 d.	—	1/16 d.
Sheet	,,	0s. 9 1/16 d.	—	¼d.
Phosphor Bronze Wire (Telephone)				
Phosphor-bronze wire, basis	,,	1s. 1 5/16 d.	—	⅛d.
Brass 60/40—				
Rod, basis	,,	0s. 7½d.	—	—
Sheet, basis	,,	0s. 9½d.	—	¼d.
Wire, basis.....	,,	0s. 9¾d.	—	¼d.
Pig Iron—				
Cleveland Warrants .	per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 SWG	,,	£18 0 0	—	£1 0 0
Lead Pig—				
English	,,	£23 0 0	—	—
Foreign or Colonial ..	,,	£21 15 0	2s. 6d.	—
Tin—				
Ingot	,,	£143 10 0	—	5s.
Wire, basis	per lb.	1s. 11¾d.	—	⅛d.
Aluminium Ingots	per ton	£120 0 0	—	—
Spelter	per ton	£25 12 6	7s. 6d.	—
Mercury	per bottle	£11 0 0	—	—

Salammoniac.—Per cwt. 65s.-60s.
Sulphur (Flowers).—Ton £10 15s.
,, (Roll-Brimstone).—Per ton £10 15s.
Sodium Bichromate.—Per lb. 5½d.
Sodium Chlorate.—Per lb. 3½d.
Sulphuric Acid (Pyrites, 168°).—Per ton £9 17s. 6d.
Copper Sulphate.—Per ton £26 10s.
Boric Acid (Crystals).—Per ton £60
Rubber.—Para fine, 10½d. ; plantation 1st latex, 8½d

The metal prices are supplied by British Insulated & Helsby Cables, Ltd, and the rubber prices by W. T. Henley's Telegraph Works Company.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MEWBURN, ELLIS & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

COMPLETE SPECIFICATIONS.

144 319 HUBERS, G. X-ray plant. (8/4/16.) (Addition to 144 318.)
145 073 SIEMENS-SCHUCKERTWERKE GES. Sparkless disconnection of conductors traversed by electric currents. (9/11/15.) (Addition to 145 072.)
145 084 LILIENFELD, J. E. Process and apparatus for the production of Rontgen rays. (9/4/18.)
145 589 OESTERREICHISCHE SIEMENS-SCHUCKERTWERKE. Method of starting continuous current motors. (29/1/16.)
145 629 GES. FÜR DRÄHTLOSE TELEGRAPHIE. Electro-magnetic wave receiving arrangements. (6/5/18.)
145 676 SIEMENS-SCHUCKERTWERKE GES. Vacuum electric discharge apparatus. (13/8/15.)
145 677 SIEMENS-SCHUCKERTWERKE GES. Anodes for vacuum electric discharge apparatus. (29/10/15.) (Addition to 145 676.)
146 136 DUPLEX ENGINE GOVERNOR CO., INC. Electrically-operated speed-regulators. (23/6/19.)
146 155 FESSENDEN, R. A. Methods and apparatus for use in locating submerged vessels and other submerged and subterranean magnetic bodies. (12/12/18.)
147 147 BRITISH THOMSON-HOUSTON CO., LTD. Wireless signalling systems. (29/10/13.)
147 177 VAPOR CAR HEATING CO., INC. Electric contact thermostats. (19/1/18.)
147 592 KRUPP AKT.-GES., F. Overload electric switches. (15/5/19.)
147 783 APPLE, V. G. Contact members for vibrating current controlling regulators. (14/2/18.)
147 788 APPLE, V. G. Armature construction. (27/4/18.)
147 818 BRITISH THOMSON-HOUSTON CO., LTD. Dynamo-electric machines. (13/10/15.)
148 418 SIGNAL GES. Arrangement for avoiding disturbing noises in listening devices caused by changing circuits associated therewith. (30/3/17.) (Addition to 147 948.)
148 424 SIGNAL GES. Sound-receivers. (29/11/15.)
148 426 SIGNAL GES. Sound apparatus. (15/3/16.)
148 427 SIGNAL GES. Sound-signalling device for dense propagating mediums. (3/3/17.)
148 458 KRUPP AKT.-GES., F. Electric resistance connections. (21/11/18.)
148 951 LATOUR, M. C. A. Receiving-arrangement for the reception of electro-magnetic waves. (21/10/16.)
148 952 LATOUR, M. C. A. Inductances. (12/12/18.)
148 969 NEUFELDT & KUHNKE (Firm of). Electric connecting devices for floating and submarine vessels, and for diving armour. (21/7/16.)
148 982 SIGNAL GES. Sound-signalling device with two plates for dense mediums. (27/4/17.) (Addition to 148 427.)
148 987 SIGNAL GES. Submarine sound transmitter. (3/5/18.)
148 988 SIGNAL GES. Receiving device for submarine sound signals. (19/5/17.) (Addition to 1 995/13.)
149 325 SIGNAL GES. Reception of submarine sound signals. (25/1/17.)
149 331 WESTERN ELECTRIC CO., LTD. Telephone repeating circuit. (31/7/19.)
149 348 ADAMCZAK, L. Alternating current meter. (22/7/19.)
150 673 GYURIS, J. Manufacture of electric heaters. (22/8/19.)
150 730 METROPOLITAN-VICKERS ELECTRICAL CO., LTD. Time-limit relays for use in electrical supply systems. (3/9/19.)
151 615 CUMMISKEY, W. M. Timing or distributing mechanism for the electric ignition of internal combustion engines. (24/9/19.)
152 970 LAÜT, P. J. Sending devices for radio-telegraphic stations using a continuous sequence of waves generated by an arc. (23/10/19.)
154 545 SOC. ANON. BROWN, BOVERI, ET CIE. Electric transformer for feeding metal vapour rectifiers. (27/11/19.)
154 877 SIEMENS-SCHUCKERTWERKE GES. Electric suspension insulators. (29/11/19.)
155 796 REMY ELECTRIC CO. Magnetos. (17/12/19.)
156 492 EUSTACE, A. L. Electric cartridge fuse. (23/7/14.)
157 567 SIEMENS SCHUCKERTWERKE GES. Electric suspension insulators. (6/1/20.) (Addition to 154 877.)
159 130 SIEMENS-SCHUCKERTWERKE. Arrangement of the high tension insulators of electric precipitating installations. (11/2/20.)
159 902 SIGNAL GES. Method and device for the electrical navigation of ships. (12/3/20.)
165 037 SOC. FRANÇAISE RADIO-ELECTRIQUE. Electric-magnetic wave transmissions systems. (16/10/19.) (Divided application on 147 465.) (Addition to 147 465.)
167 145 METROPOLITAN-VICKERS ELECTRICAL CO., LTD. Control of alternating current electric motors. (30/7/20.)
169 060 SIEURIN, S. E. Burning of carbon electrodes in electric furnaces. (19/7/20.)
169 063 CHERRY, L. B. Electrical apparatus for the electro-chemical treatment of hydrocarbon vapours. (20/7/20.)
169 071 RUNKEL, A. C. Electric lamp supports. (28/7/20.)
169 078 RENZI, W. DE. Electrical current plugs. (30/7/20.)
169 082 OLDHAM, O., OLDHAM, G., & OLDHAM, J. Gas exits for galvanic batteries. (9/8/20.)
169 085 PAYNE, V. J. C. Alternating current electro-magnetic engine. (13/8/20.)
169 093 BROOKS, H. B. Electric transforming systems or devices. (6/9/20.)
169 105 LOIJA, M. R. Electrically-propelled boat. (27/9/20.)
169 482 WHITEHORN, H. K. Dynamo-electric machinery. (26/5/20.)
169 489 TURNER, F. Attachment for telephones. (8/11/20.)
169 494 SULLIVAN, H. W. Telegraph cables. (22/6/20.)
169 503 TURQUAND, F. J. Electric battery lamps. (23/6/20.)
169 510 SCHATTNER, E. Electric circuit making and breaking device. (25/6/20.)
169 535 RAILING, M. J., SAUNDERS, C. W., & COLLINGS, J. H. Electric bell and the like indicators. (2/7/20.)
169 538 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Electric welding electrodes. (2/7/20.)
169 541 SAUNDERS ELECTRICAL CO., LTD., & SAUNDERS, C. Electrical accumulators. (5/7/20.)
169 546 GENERAL ELECTRIC CO., LTD., & THOMPSON, M. Electron discharge devices. (6/7/20.)
169 548 RICKETS, W. J. Electrical systems and apparatus for inducing chemical action. (8/7/20.)
169 553 BRITISH ELECTRIC TRANSFORMER CO., LTD., & ROOTHAAN, J. Manufacture of coils suitable for use in the construction of static transformers. (12/7/20.)
169 563 SCHATTNER, E. Apparatus for the distance control of electric switches by means of light radiations (19/7/20.)
169 564 PILLON, L. Secondary electric clocks. (19/7/20.)
169 575 RENZI, W. DE. Electrical switch gear for controlling the supply of electricity to operate machinery and the like. (27/7/20.)
169 582 NERBONNE (NÉE ARMAGNAT), VEUVE, C. M. A. DE, ARMAGNAT, S. M. T., & ARMAGNAT, P. J. Method of measuring the lengths of electric waves. (30/7/20.)
169 604 ELLISTON, E. R. Electric service lifts. (21/8/20.)
169 609 METROPOLITAN-VICKERS ELECTRICAL CO., LTD. (Westinghouse Electric & Manufacturing Co.). Automatic electric sub-station systems. (26/8/20.)
169 610 IGRANIC ELECTRIC CO., LTD. (Cutler-Hammer Manufacturing Co.). Means for regulating alternating currents. (26/8/20.)
169 627 SHANGHAI ELECRTIC CONSTRUCTION CO., LTD. (McColl, D.) Trolley heads for electric traction vehicles. (29/9/20.)
169 649 ANTINORO, E. Safety fuses for electric circuits. (14/12/20.) (Addition to 151 523.)
169 735 HITCHCOCK, S. I. Permanent magnets and permanent magnet motors. (6/4/20.)
169 744 SCOTT, W. H. Electrically-driven winches. (5/5/20.)
169 756 MORGAN CRUCIBLE CO., LTD., & PAYNE, G. I. Electrically-heated tubes, muffles, and the like. (2/6/20.)
169 761 OLDHAM, G., & OLDHAM, J. Electric lamps particularly adapted to be carried or supported on the person. (4/6/20.) (Cognate Application, 29436/20.)
169 767 LATOUR, M. C. A. Two-phase high-frequency electric alternating current generators. (23/6/20.) (Patent of Addition not granted.)

APPLICATIONS FOR PATENTS

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6 622 FULLER'S UNITED ELECTRIC WORKS & L. FULLER. Galvanic batteries.
6 633 A. FORTESCUE. Anti-vibration fitting for electric light.
6 637 T. F. WALL. Induction motors.
6 651 A. L. DAVIS. Electric switches.
6 685 R. L. WOOD. Driving means for car-lighting dynamos.
6 709 D. TINLOT. Electric switches.
6 713 EURAL PATENTS, LTD., & H. J. WALLER. Electric contact makers for steering wheels of motor vehicles.
6 715 J. T. M. MORRIS & F. R. F. RAMSAY. Obtaining polar diagrams of alternating electro-motive force or current.
6 717 T. N. WHITEHEAD. Electro-magnetic compasses
6 723 W. F. HIGGS. Induction motors.
6 732 AUTOMATIC TELEPHONE MFG. CO. Tag blocks, terminal strips, &c.
6 734 METROPOLITAN-VICKERS ELECTRICAL CO. & N. G. LANGRISH. Controllers for electric cranes, &c.
6 736 C. H. VIDAL. Electric drilling machines
6 740 H. P. R. REES. Wireless telegraph and telephone receivers.
6 741 A. PÜSCHEL. Incandescent lamp holders.
6 747 D. FORREST. Apparatus for remagnetizing magneto magnets and recharging batteries.
6 755 ETAB. DE DION-BOUTON, SOC. ANON. Regulating devices for electric installations. (14/4/21, France.)

March 8, 1922.

6 793 R. F. WOODBURN. Electric resistance welding.
6 821 METROPOLITAN ELECTRIC TRAMWAYS, LTD., & L. B. HEWITT. Electric vehicles.
6 822 HUMBER, LTD., J. A. COLE & L. J. SHORTER. Electrical starting mechanism for fluid pressure engines.
6 827 A. L. OLIVER. Waterproof electric blasting cap.
6 833 A. E. BEATTIE. Magneto detectors and actatic and directional magnetic compasses.
6 849 R. ARRAYA. Producing electro-anæsthetic current for treatment of nervous diseases.
6 854 A. S. CACHEMILLE (Westinghouse Electric and Mfg. Co.). Control of electric machines.
6 857 R. AMBERTON. Electricity meters.
6 858 R. AMBERTON & R. H. BARBOUR. Electrical testing apparatus.
6 862 P. D'AIGNEAUX. Converting d.c. into high frequency a.c.
6 867 J. HIGGINSON. Electric ignition systems.
6 898 RELAY AUTOMATIC TELEPHONE CO. & E. J. C. ROUSSEAU. Automatic telephone systems.
6 905 AUTOMATIC TELEPHONE MFG. CO. Telephone systems. 20/2/21, U.S.)
6 909 W. J. READETT. Electric machines for heating rivets, &c.

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6 919 H. S. ROGERS & W. PRESTON & W. WALKER. Electric switches.
6 955 R. M. BEARD. Electric lighting fixtures.
6 962 J. & A. MORGAN. Lead connectors for electric terminals.
6 994 B. T.-H. CO. (G. E. Co.). Electric switches.
6 998 J. H. NICHOLSON. Electric talking machines, &c.
7 001 C. J. ASTON & A. G. T. CUSINS. Wireless masts.
7 008 R. MIEHL. Synchronous motor for electric drive of clockworks.

March 10, 1922.

7 041 H. L. MOISELLE. Electrical shop sign.
7 047 S. O. COWPER-COLES. Leading in wires for incandescent lamps.
7 048 A. M. TAYLOR. Joints of h.t. cables.
7 105 A. A. BULL. Current collecting apparatus for electric railways and tramways.
7 106 & 7 107 C. W. KAY. Current collecting apparatus for railways and tramways.
7 121 METROPOLITAN-VICKERS ELECTRICAL CO. & K. BALMANN. Ventilating or cooling electrical machines.
7 125 A. REYROLLE & CO. & R. W. BILES. Protective arrangements for a.c. circuits.
7 126 ELECTRICAL IMPROVEMENTS, LTD., & R. W. GREGORY. Electric switch fuses.
7 142 E. VARÉ. Elements for storage battery cells. (10/3/21, Belgium.)
7 152 NAAMLOOZE VENNOOTSCHAP PHILIPS' GLOEILAMPENFABR. Carbon bodies. (12/3/21, Holland.)
7 174 SOC. ANON DES ATELIERS DE SÉCHERON & C. J. BELLI Couplings for machines of high voltage d.c. series system. (15/4/21, Germany.)
7 176 GES. FÜR DRAHTLOSE TELEGRAPHIE. Antenna systems for wireless signalling. (12/3/21, Germany.)

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7 197 F. W. PELLANT. Contact legs for thermionic valves.
7 210 I. H. PARSONS. Electric horns.
7 229 F. T. ASHTON. Projection arc lamp.
7 240 ELECTRICAL IMPROVEMENTS, LTD., R. W. GREGORY & L. C. GRANT. Protective devices for d.c. circuits.
7 252 METROPOLITAN-VICKERS ELECTRICAL CO. & G. A. CHEETHAM. Electric fuses.
7 258 GENERAL ELECTRIC CO., LTD., & J. J. GRACIE. Incandescent lamps, &c.
7 260 P. C. RUSHEN (Siemens-Schuckertwerke). Electrical separation of suspended particles from gases.
7 265 E. SOMMERFIELD. Locking devices for electric safety lamps. (12/3/21, Germany.)

March 13, 1922.

7 270 CABLE ACCESSORIES CO. & P. W. DAVIS. Wall plugs.
7 278 FORGES ET ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE JEUMONT. Cascade rotary converters. (5/4/21, France.)

7 295 W. J. Gooderidge. Electric horns, &c.
7 297 British Insulated & Helsby Cables, Ltd. & F. J. Brisler. Electric cables.
7 309 P. T. Hayes. Telegraph typewriting machines.
7 317 A. Howes. Electric switches.
7 320 A. J. D. Krause & A. H. Railing. Electric cut-outs.
7 321 J. B. Belcher. Connector for insulated wires and cables.
7 326 M. F. Fisher & B. E. Thompson. Apparatus for electrical treatment of baldness, &c.
7 332 H. Baran (Aldendorff). Automatic, &c., telephone switching systems.
7 336 Radio Communication Co. & N. Lea. Method for determining direction of electro-magnetic or electro-static fields.
7 345 Western Electric Co. Printing telegraph receiver.
7 346 Buckley, Saunders & Co. Uniting metal bodies electrically.
7 358 A. Negromanti. Thermo-electric fabric.
7 366 E. P. Barfield & L. W. Wild. Electric furnaces.
7 369 Watliff Co., A. O. Hinchliff & S. J. Watson. Producing commutator bars.
7 371 V. Parvopassu, G. Gallo & R. Lenner. Unfusible electro-thermic safety devices.
7 378 A. Watts. Registration of telephone calls.

March 14, 1922.

7 411 C. E. P. Gabriel. Portable electric lamps.
7 416 W. C. Mitchell. Identification labels for cables.
7 437 Plantation Rubber Manufacturing Co. & M. M. Dessau. Devices for attachment to mouthpieces of transmitters.
7 446 A. T. Scorey. Apparatus for testing strength of permanent magnets.
7 471 Metropolitan-Vickers Electrical Co. Electric circuit interrupters. (14/3/21, U.S.)
7 472 Metropolitan-Vickers Electrical Co., B. S. & W. Whiteley & A. P. M. Fleming. Electrical insulating cylinders.
7 476 L. A. Cordenot. Manufacture of electric insulators from ceramic paste. (21/3/21, France.)
7 483 Ever Ready Co. (Great Britain) & C. S. Mummery. Inert cells.
7 484 F. Schuster. Electrically heated mould for finishing stockings, gloves, &c.
7 494 J. M. Miller. Amplifiers. (15/3/21, U.S.)
7 509 E. C. R. Marks (Bennett). Telephone mouthpiece disinfectant.
7 510 E. C. R. Marks (Colonial Lamp and Fixture Works). Portable lighting fixtures.
7 513 G. A. Bartholomew. Electric power accumulator.

March 15, 1922.

7 532 T. F. Wall. Induction motors, &c.
7 536 E. R. Bickley. Call recorders for telephones.
7 541 B. J. Baker. Electric control of a number of telephones.
7 548 R. H. Playfoot. Accumulator and accessory cases for motor cycles, &c.
7 621 Soc. Le Carbone. Electric cells. (3/6/21, France.)
7 622 Soc. Le Carbone. Wet electric cells. (9/12/21, France.)
7 632 W. H. Gwynn. Glass electrodes for high-frequency currents.

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7 651 E. Temple. Attaching wires to sparking plugs.
7 674 E. W. Reed. Electric lighting systems of motor vehicles, &c.
7 684 Implitico, Ltd. & H. S. & W. R. Lambert. Electric advertising signs.
7 708 Metropolitan-Vickers Electrical Co. & A. Stubbs. Control of turbine-driven electrically operated winding plant, &c.
7 735 D. C. Crowe. Electro-magnetic relay.
7 738 Magnet Motoren Akt.-Ges. Air-cooled cylinders. (22/3/21, Germany.)
7 739 B. T.-H. Co. & H. W. Taylor. Electric machines.
7 753 A. P. Welch. Transformers for wireless circuits.
7 770 Park Royal Engineering Works & W. J. Davis. Switch gear of the truck type, &c.
7 771 British Power Railway Signal Co. & J. Ashton. Electric switch point detecting apparatus.
7 774, 7 778 and 7 776 A. Baderna. Electric cut-outs. (17/3/21, Italy.)

March 17, 1922.

7 785 A. E. Honey & L. Snellgrove. Electro-magnetically operated switch mechanism.
7 814 C. J. Gordon. Electric vehicles.
7 830 F. J. Holtom, T. Taylor & M. J. Railing. Electric switch and fuse boxes.
7 842 Automatic Telephone Manufacturing Co. Switching mechanism for telephone systems. (28/3/21, U.S.)
7 846 A. J. H. Elverson. Electric contact breakers.
7 847 W. Clark. Electric switches.
7 852 Automatic Telephone Manufacturing Co Telephone systems. (26/4/20, U.S.)
7 855 J. Stone & Co. Electro-magnetically operated switch mechanism.
7 859 Radio Communication Co. & J. Scott-Taggart. Electric signalling systems.
7 860 Radio Communication Co. & J. Scott-Taggart. Oscillating valve systems, &c.
7 870 Akt. Ges. Brown, Boveri et Cie. Multiple control apparatus for electric railways. (17/3/21, Switzerland.)
7 881 T. J. T. Hodgkinson. Electric massage apparatus.
7 890 V. G. Murray. Electro-magnetic locks. (19/3/21, British India.)
7 893 J. C. N. Graafland. Radio-electric relay and electric signalling. (23/9/21, Holland.)

March 18, 1922.

7 902 R. MacGregor & F. W. Raisin. Self-propelled floating electric power station.
7 933 S. J. Levi & H. Rottenburg. Portable electric standard lamps.
7 939 S. O. Cowper-Coles. Zinc cylinders for primary batteries.
7 947 Metropolitan-Vickers Electrical Co. & T. Ferguson. Control of electric motors for traction.
7 969 B. T.-H. Co., H. W. Taylor & K. R. Hopkirk. Electric machines.
7 970 B. T.-H. Co. (G. E. Co.). Alternating current machines.
7 987 R. Dell. Controlling railway signals of the electric light type.

March 20, 1922.

8 007 R. Bosch Akt. Ges. Electric hooter. (17/10/21, Germany.)
8 011 F. Addie & A. G. Hartley. Electric control gear.
8 026 T. J. Hedley. Materials for use as electric conductors.
8 036 W. H. Slaughter, E. R. Beckwith & H. T. Hall. Electric couplings.
8 056 N. A. Block & J. W. Coward. Coil ignition systems for internal combustion engines.
8 064 I. Calvete. Remote control switches.
8 066 A. F. R. Cotton & E. W. Russell. Conversion of musical sounds into electricity, or vice-versa.
8 078 Wireless Speciality Apparatus Co. Electric condensers. (30/3/21, U.S.)
8 081 J. Stone & Co. & A. H. Darker. Train lighting dynamos.
8 082 W. B. Sayers. Electric machines, &c.

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8 115 C. J. R. Alsford & E. F. Turner. Oscillating circuits.
8 143 W. R. Burne. Intervalve high-frequency transformers.
8 148 S. D. Bennett. Sound producing horns for telephone receivers, &c.
8 182 J. Raper. Brush holder for electric machines.
8 187 Metropolitan-Vickers Electrical Co. & C. S. Best. Electric soldering irons, &c.
8 188 Metropolitan-Vickers Electrical Co. & C. S. Best. Electric heating apparatus.
8 191 P. G. A. H. Voigt. Electric accumulators.
8 210 Metropolitan-Vickers Electrical Co. Electric circuit interrupters. (23/3/21, U.S.)
8 211 Metropolitan-Vickers Electrical Co. (Railway & Industrial Engineering Co.). Electric insulators.
8 215 J. H. van Viersen. Joints of electric cables, &c. (1/11/21, Holland.).
8 237 A. J. Jullin. Regulating device for dynamos. (26/3/21, France.)
8 244 Akt. Ges. Brown, Boveri et Cie. Apparatus for feeding polyphase mercury-vapour rectifiers. (24/3/21, Switzerland.)
8 245 Scintilla. Magneto-electric ignition apparatus. (29/4/21, Switzerland.)
8 247 B. T.-H. Co. & H. C. Hastings. Control of electric vehicles.
8 248 M. F. H. Gouverneur. Insulators. (7/4/21, U.S.)
8 249 M. F. H. Gouverneur (G. E. Co.). Electric switches.
8 262 A. Verner. Transformer of three-phase into monophase current.
8 343 Felten & Guilleaume Carlswerk Akt. Ges. Measuring intensity of cross-talk between lines of multiple wire telephone system. (26/5/21, Germany.)

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8 271 W. J. Cole. Telegraph systems.
8 303 E. Schröder. Electric welding and heating devices.
8 304 H. W. Clothier. Electric switches.
8 305 A. Reyrolle & Co. Electric switches.
8 306 A. A. Sandbrook. Electric lamps.
8 333 H. M. Macnaughton-Jones. Telephones.
8 341 F. McClarence. Deals for telephone services.
8 348 A. Reyrolle & Co. & R. W. Biles. Protective systems for electric conductors.
8 352 W. C. Karasek. Synchronising electric safety lift lock.
8 354 B. T.-H. Co. (G. E. Co.). Automatic electric motor starters.
8 368 H. Vogt, J. Engl & J. Massolle. Glow discharge tubes. (24/3/21, Germany.)
8 369 Newton Bros. (Derby). Electric driving of compressors.
8 371 G. Newbury & H. F. Thomas. Lock for electric lifts.
8 372 H. Andre. Alternate current rectifying apparatus. (26/3/21, France.)
8 381 Dubilier Condenser Co. (1921) & W. H. Goodman. Electric condensers.

March 23, 1922.

8 421 L. R. Lee. Connectors and couplings for electric cables.
8 426 A. Fletcher. Continuity clip for electrical slip conduit pipe and fittings.
8 455 H. W. Underhill. Electric automatic weighing machines.
8 457 W. Langdon-Davies & A. Soames. Electric welding on a.c. circuits.
8 462 A. Onwood. Inductances.
8 463 A. Drummond. Electric ignition systems.
8 465 B. T.-H. Co. (G. E. Co.). Electric drives for sound-producing machines.
8 469 H. Vogt, J. Engl & J. Massolle. Cathode delivery tube for recording electric frequencies free from inertia. (24/3/21, Germany.)
8 471 B. T.-H. Co. (G. E. Co.). Arc welding.
8 494 F. Portal. Change-speed device for electric drive of underwear looms.
8 502 L. J. Hooper & C. L. Pratt. Electric switches.
8 504 C. S. Franklin & B. J. Witt. Wireless telegraph receiving systems.
8 507 L. H. M. Huydts. Electric clocks. (30/9/21, Holland.)

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8 512 & 8 513 O. Morgan. Collector for electric cranes for collecting current from trolly wires.
8 523 H. J. S. Thomas. Electric contacts.
8 526 E. K. Bedlington. Electric contacts.
8 534 A. B. Brothwell. Automatic electric illuminating device for alarm clocks.
8 535 A. F. Marsh. Telephone transmitter mouthpieces.
8 540 A. H. Culley & L. Mott. Electric accumulator.
8 554 M. T. Williams. Terminal electric connections.
8 555 G. H. Mottershead. Commutators or distributors for electric ignition circuits.
8 573 London Electric Railway Co. & J. P. Thomas. Turnstiles for registering passengers, &c.
8 578 C. J. Rixen. Protecting device for electric motors, &c.
8 583 Metropolitan-Vickers Electrical Co. Electric circuit interrupters. (24/3/21, U.S.)
8 585 L. F. R. Fell. Power generating and transmission systems.
8 590 T. R. & L. J. Hancock. Electric resistance furnaces.
8 591 T. R. & L. J. Hancock. Preventing oxidation of electric conductors, &c.
8 597 Western Electric Co. Loaded transmission lines. (4/6/21, U.S.)
8 598 Western Electric Co. & L. Polinkowsky. Telephone systems.
8 600 H. H. Berry & W. J. Markham. Fuse carriers.
8 608 E. Haefely et Cie. Akt. Ges. High-tension transformers. (26/7/21, Switzerland.)
8 619 J. Bethenod. Maintaining constant speed of d.c. machines. (25/3/21, France.)
8 620 P. Lavender. Registering telephone calls.
8 624 E. H. Newton. High-frequency electric generators.
8 633 H. St. G. Anson. Method of magnifying intermittent electric impulses.
8 639 Electricars, Ltd. & J. P. Kemp. Electrically propelled coke trucks.

March 25, 1922.

8 646 W. H. Eccles. Electric insulators.
8 670 F. D. Denner & L. J. Lepines. Electric switches, &c.
8 671 H. B. Prentice. Electric distribution for fuse boards, &c.
8 673 T. A. W. Robinson. Winding coils for inductances for radio telegraphy, &c.
8 687 C. G. Hayward. Electric time transmitters.
8 710 Westinghouse Brake & Saxby Signal Co. (Union Switch and Signal Co.). Electric signalling systems for railways, &c.
8 718 E. B. Moullin. Measurement of alternating potential differences.

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CONTENTS.

Notes of the Week.

Sir John Benn.

It is with the greatest regret that we have to record the death of Sir John Benn, Bart., chairman of Benn Brothers, Ltd., the proprietors of The Electrician. Sir John, who was in his seventy-second year, died early on Monday morning after a short illness. Though the close touch which he has maintained with electrical matters through the medium of The Electrician has only been of a few years' duration, his connection with the industry which we serve is of a much more ancient character. He will be remembered as an ardent supporter of municipally owned electric trams for London, and it is largely owing to his energy and enterprise that a wide network of communication is now spread over so much of the metropolis. Had Sir John fulfilled his desires the network would have been wider, but for many years his party in the County Council was not in power, and those who have controlled these matters, both in that body and in Parliament, have been averse to the extensions which he would himself have pushed forward. In non-electrical matters, such as housing, welfare measures, and sanitation, Sir John's influence was wholly towards the goal of better municipal government in London. His long experience (at the time of his death he was Father of the County Council) was of the greatest use both to his colleagues and to the officials, and it is not too much to say that the London of to-day is largely his creation. London, therefore, will miss him, but those of us who knew him as a chief and a leader will miss him much more.

Automatic Signalling Progress.

The part that electricity can play in handling an increasing railway traffic in a more efficient and more expeditious manner than by steam working is emphasised by implication in a Paper read by Mr. W. Willox before a recent meeting of the Institution of Civil Engineers. An abstract of this Paper will be found on another page of this issue. As is well known, the high acceleration of the electric motor makes it possible to run trains on a shorter headway than is possible with the steam locomotive. On the other hand, a shorter headway necessitates an increased number of signal movements in a given time, and therefore practically imposes the use of automatic methods of control in place of the older manual system. The order of these increases is well illustrated by the figures given by Mr. Willox for the Metropolitan Railway. In 1905, when electric traction was first used, the number of trains between Praed-street Junction and Aldgate (the busiest section) was 621 per day on both roads, with 49 signal sections, while in 1913 the number of trains was 863 between these two points and no less than 983 between Baker-street and Aldgate (owing to trains coming in from the Aylesbury extension), with 91 signal sections.

A Record of Success.

The design and installation of equipment for successfully controlling this enormous traffic naturally required a great deal of thought and careful workmanship, which are reflected in the details given by Mr. Willox. No less is it reflected in the small number of failures incurred, almost all of which were due to the operation of the train stops and so caused but a short delay. Only once has a signal failed to return to the danger position, and if such a thing should happen again the signal in rear would go to danger in its turn and remain there, so that safety is practically assured. But there is more than this to be said. For, as Mr. Willox points out, automatic signalling, besides having the traffic advantages detailed above, also means a direct saving in wages, about £325 per annum being the order of the economies on the Metropolitan. It is interesting to note, moreover, that both a.c. and d.c. are used for operating the

signals, a.c. track circuiting being, naturally, used throughout. It would be useful to have comparative figures of the operation of the two sets of equipment, and we hope these may be made available so as to render the history of an interesting piece of work complete.

Standardisation—Pros and Cons.

It might be argued that on the balance standardisation, whether we consider its broad, underlying principles or its practical results, has as many disadvantages as advantages. In the electrical industry we have recently had a striking example which falls within the former class, and doubtless others could be found without much trouble. In general engineering, on the other hand, where design and manufacture are more stabilised, the advantages probably outweigh the disadvantages, as was convincingly shown by Mr. C. Le Maistre in a Paper read recently before the North Coast Institution of Engineers and Shipbuilders. Mr. Le Maistre quoted Mr. H. J. Skelton to the effect that the savings effected in the production of rolled sections had reduced the costs of production by £100 000 per annum. Even in 1914 95 per cent. of the sections rolled at the five largest steel works in the kingdom were British Standard Sections, while the tramway rail sections had been reduced in number from 75 to 5. These examples indicate two of the many directions in which, from the consulting engineer's, the buyer's, the designer's, and the manufacturer's points of view, standardisation is a real economic advantage.

Excellent Voluntary Effort.

Mr. Le Maistre righly congratulated the industry on the organisation of the Standards Association. It is, as he pointed out, practically a voluntary body, both as regards financial support and expert assistance. Without wishing to be ungracious, however, it may be emphasised that expenditure of this kind is really an investment and not a charity, and must be returned many fold. For the work of examination and recommendation which the Association undertakes after due external pressure enables the ground to be cleared in a way that makes cheaper production possible. It must be emphasised, too, that this spade work is carried on with the assistance of every section of the industry, and how widespread that assistance is may be gathered from the statement that there are now no less than 385 committees, sub-committees, and panels engaged in the work of initiating or amending standards. The main committee itself does not initiate standardisation, but waits for pressure from outside, and then calls a representative conference to ascertain whether there is general agreement as to the need for fixing an official standard. In this way the industry regulates the advance and false steps are avoided. This good work is likely not only to continue, but to expand for the general benefit.

Temporary Expedients.

There is a right appliance or an appropriate tool for every job in engineering. And if new apparatus is developed new tools are devised for its manufacture. But every engineer encounters jobs that have to be performed when appropriate tools or appliances are lacking. A consideration of the expedients that then have to be adopted formed the subject of comment in a useful Paper read recently by Mr. W. E. Highfield before the National Association of Supervising Electricians. The case of a new generating station was taken as an example. Here the constant arrival of goods, not always in perfect condition, on a site which may be in a state of chaos, calls for method and ingenuity on the part of the engineer-in-charge. If he has heavy machinery to install, it pays him to lay a good road from the railway-siding to the site, and this can be conveniently constructed from sleepers or lengths of heavy timber. Hints were also given on the use of jacks and cranes and the levelling of bedplates. Lining up by the aid of spirit-level and a stretched steel wire as a test of alignment is important, and care should be taken that middle bearings take their share of the weight. Hydraulic gear is preferable for pressing on shafts as the pressure can be measured. On no account should the hub be heated to get the shaft on, this expedient being left for future withdrawal.

Drying Out Insulation.

Mr. Highfield also gave some useful advice on drying out insulation. Foundry core ovens, he said, were unsafe, as the heat may greatly exceed a safe value. Transformer oils were best dried in the tank by the aid of a few standard tramway resistance grids. Balancing engines was at once a highly necessary and difficult problem. Finally, some hints were given on emergency repairs. Problems of this kind form a good test of the resource and practical efficiency of an engineer, and one of the first lessons a man on installation work has to learn is the art of doing without useful and customary tools and apparatus. The practical advice given in this Paper is well worth attention not only by engineers-in-charge, but by engineers generally.

The Lighting of Public Buildings.

At a recent meeting of the Illuminating Engineering Society a detailed account of the installations in a number of public buildings was read by Messrs. E. H. Rayner, J. W. T. Walsh and H. Buckley, of the National Physical Laboratory. Sixteen installations in all were dealt with. Semi-indirect lighting seems to have been generally used, and the illumination recorded varied from 2·9 to 4·7 foot-candles, the general standard being thus considerably in advance of that customary a few years ago. To obtain 3 foot-candles, the minimum aimed at, consumption of energy varying from 0·38 to 0·63 W per sq. ft. were recorded. One good feature of the installations is the care devoted to the screening of filaments, glassware being used to diminish the brightness to quite a moderate figure (0·6 to 2·5 c.p. per sq. in.). While the discussion revealed some differences of opinion on certain points—for instance, the wisdom of the general adoption of semi-indirect methods—the measures taken in these installations appear to have been such as to ensure adequate lighting, and the data therefore form a valuable record. We wish that the illumination of public offices was always planned in such a thorough manner, and it is interesting to observe that a new building, especially designed for experiments in illumination, is being erected at the Laboratory.

Lighting Decorative Interiors.

Following the account of this work in public offices, another aspect of the subject, the lighting of more or less decorative interiors, was dealt with by Capt. J. W. Liberty, Public Lighting Inspector to the City of London. A number of photographs, taken by Mr. J. S. Dow entirely by the artificial light provided in each installation, were shown. In many cases pleasing effects were illustrated, one striking view being a passage leading to the Council Chamber at the Marylebone Town Hall, where the lighting is effected by concealed lamps placed in a dome, situated between pillars. It would appear from the ornate character of the decoration in many of these rooms that expense has

not proved a deterrent factor, and we should, therefore, expect lighting of an imposing kind. On the other hand, decorative aspirations are not always favourable to illumination. For instance, when walls are panelled in very dark walnut the contrast between the brightness of the lighting, the fittings, and the surroundings imposes great difficulties on photography, and is probably not desirable for eye comfort. A complete contrast to these methods is afforded by the main office at the Port of London Building, now in course of completion. Here lamps totalling 20000 c.p. are assembled in a vast white dome. This gives an excellent diffusion of light, and the installation, when completed, should be worth a visit. In decorative interiors it is natural that the architect should have a considerable voice in the lighting arrangements, and we do not wish to restrict his methods unduly by insisting on purely technical consideration. Nevertheless, in rooms that are used as offices, for meetings of committees, councils, &c., utilitarian aspects must be considered, and there is occasionally a tendency for undue weight to be attached to the decorative side of the problem. The Illuminating Engineering Society, in promoting this joint discussion with the R.I.B.A., has, we hope, exercised a useful influence in favour of a balance being struck between these considerations.

Tramway Change-Over Arrangements.

If we are to judge by the letter which we publish in our Correspondence columns to-day, Mr. M. J. E. Tilney is of the school that believes there are some things which "they order better in France." Paris, he points out, is not only in the throes of tramway reconstruction, but it endures, as we do in London, more than one system of tramway operation. Some means of easily and quickly changing over from one system to another are therefore necessary, if through running is to be possible, and, from the details that Mr. Tilney gives, it seems that the London tramway undertakings have something to learn from the Paris tramways authorities in this respect. We are inclined to agree with this view; as there seems no reason why the pre-historic, man-handled apparatus, which may be seen in use where the conduit is replaced by the overhead system—*e.g.*, at Highgate—should not be replaced by some simple, mechanical or electrical device which could be easily operated and save both time and labour. The probable answer to the question propounded by Mr. Tilney in the last paragraph of his letter is that capital expenditure stands in the way. At the same time, in these labour-saving days the advantages and disadvantages of the apparatus which Mr. Tilney describes might well be examined to see whether its adoption is not possible.

The Circle of Delimitation.

The draft of the Brentwood Electric Lighting Special Order recently issued by the Commissioners exhibits a new method of determining an area over which statutory powers are sought. Generally, the area in such Orders is coterminus with some existing boundary, and this is a ready and practical means of delimitation. But the promoters of the Brentwood Order have invented another method. They have disregarded every existing boundary and have specified simply that the area shall consist of the plot which lies within a circle whose radius is two miles from a particular spot in Brentwood. A circular area like this certainly has the advantage that anyone can mark it out for himself on a map. On the other hand, when it comes to practice this simplicity disappears and many difficulties simultaneously arise. To determine such an area *in situ* is by no means easy. It cannot be done direct as when parish boundaries, which are known to all and sundry, are picked out. To find just where this hypothetical circle actually runs is only possible by the use of a large scale ordnance map and from calculations made on the spot. In a rural area like Brentwood it is, perhaps, more tedious than difficult, but would be a very awkward matter in a district entirely built over. We hope this example of ingenuity will be the last.

The Plaint of the Passenger.

We have the highest authority for the statement that to every action is an equal and opposite reaction, and this is equally true in many other spheres than the purely physical. The latest example is to be found on the London Underground Railway, where the laudable efforts, from the management's point of view, to prove by poster and assertion what a wonderful service is being provided is being counteracted by suggestions that improved facilities would be really more welcomed by the public than this wealth of illustration based largely on supposition. We hear, nay, we all experience too often, the doubtful joys of using lifts which will miss trains, of travelling in connecting trains that do not connect, of hanging suspended from straps when we have paid for seats, and of enjoying the conversation of officials whose language recalls that of the cowboy of fiction. Could only a few of these drawbacks be removed we would gladly forgo even Mr. Heath Robinson's pictures of what an ideal Underground should be.

The Domestic Load and Thermal Storage.

The domestic load is at once an opportunity and a nightmare to the electricity supply engineer. He sees in it a chance of expanding his output and revenue, but is a little fearful of risking capital, as it must be risked, which will not become immediately productive. From the consumer's point of view, and from the engineer's, too, for that matter, electricity as a domestic aid has the disadvantage that it is not, as at present used, a means of providing that cheap and abundant supply of hot water which is a necessity in every household. It may be noted that it shares this disability with gas, and that therefore some sort of coal-heated boiler must be installed. This installation rather cuts at the roots of the all-electric home of which we dream, and it therefore behoves electrical engineers to seek a solution of the hot-water problem. Thermal storage seems to offer that solution. It is not a new idea—indeed, to some it is an exploded idea. But its past failure may be written down to its infancy, and there is no reason why ultimate success should not be gained. The thing to remember is that it is not a small quantity of very hot water that is required in the house, but a large quantity of warm water.

Trackless Trolley Results.

Those tramway engineers who are flirting with the trackless trolley system will be interested to read an article which recently appeared in the "Elektrische Kraft Betriebe und Bahnen," giving the results of ten years' experiences with a system which had been in operation between Hamburg and Marienhohe. The run was 2½ km. each way, the cars weighed 3 150 kg., and could carry 12 seated and 10 standing passengers. The wheels were fitted with solid rubber tyres, and the cars were driven by 15 h.p. motors with a silent worm drive. The trolley was pivoted on the roof

of the car in such a manner as to give a free swing through a full circle, so permitting the car to deviate as much as three metres from the route. The author of the article makes the following claims for the system: That the operating costs, including depreciation and renewals per passenger carried is the same as for rail traction; that the building cost of the trackless trolley system is only a third of that for the ordinary tramway; while the wear and tear on the road is less with the trackless trolley system, and the traffic obstruction is also far less. If this be so there is much support with the author's view that in the majority of cases it would be possible to install a trackless trolley system over existing well-kept-up roads with a minimum of invested capital and a maintenance cost about equal to that of the ordinary tramway.

The Electricity Supply Bill.

Unexpectedly good progress has been made with the Electricity Bill in the House of Lords. For, notwithstanding sixteen pages of amendments, numbering sixty in all, two days sufficed for the proceedings in Committee, and the Report stage was taken on Tuesday. The result is that the measure in its amended form now stands a reasonable chance of being passed this session. The alterations made are not so extensive as at one time we feared might be the case; and with one or two exceptions they do not appear to be of a vital character. Perhaps the worst part of the business was the way in which the speeches of many of the noble lords betrayed not only woeful ignorance but a total disregard of the interests of the supply industry. If some of them had had their way, in fact, each scheme for the organisation of a district would have to run the gauntlet of Private Bill procedure, with its heavy expense and its attendant worries and uncertainties, a course which is without any advantage except to the obstructionists. Fortunately, also the Minister in charge (Viscount Peel) resisted a proposal which was embodied in the foolish amendment of Lord Askwith to exclude local authorities from the category of those who could give financial assistance to Joint Electricity Authorities.

Convenient Forgetfulness.

The noble legislators seemed, indeed, to have forgotten that the provisions of the Bill are entirely permissive, and not compulsory in character, and that Joint Authorities are not to be exclusively entrusted with the reorganisation of electricity supply. In some areas, such as North Wales and the South-West Midlands, power companies will be in a dominant position, and in the remainder of the country, which has been provisionally determined into electricity districts, companies will have equitable representation on any authorities that may be formed. Moreover, orders setting up Joint Authorities must be approved by both Houses of Parliament, and yet noble legislators spoke as if none of these safeguards existed. The majority seemed to be actuated by a spirit of antagonism to municipal trading, and by a fear of increased rates, which quite destroyed all their usual sense of logic.

Amendment of the Bill.

To placate these critics, concessions were made by Viscount Peel. In the first place, local authorities with a population of less than 50 000, who are not authorised undertakers, were excluded; in the next place, the liability of other councils who are not undertakers is limited to a penny rate; and, finally, those municipal councils who are undertakers will not be called upon to meet more than the estimated annual amount of any capital charges, from which they will be relieved by taking a supply of electricity in bulk from the Joint Authority.

It may not be easy to make the last-mentioned calculation, but inasmuch as we believe Joint Authorities will be able to function without rate-aid, the point will not arise in practice. A new clause was inserted authorising a Joint Authority to take a lease of the whole or any part of the undertaking of authorised undertakers, and slight modifications were made in Clause 8 relating to the use of main transmission lines by Joint Authorities, and in Clause 10 relating to wayleaves.

Suspension of Purchase Powers.

An important new clause is one authorising the suspension of the purchase powers of the Joint Authority, London County Council, or local authority, provided consent to such suspension has been obtained. As the precise form of the clause could not be agreed to, it was postponed to the Report stage. This is an important amendment of the existing law, and will go far to remove the obstacles to the formation of a Joint Authority in the Greater London area.

A new clause, amending Sec. 12 of the 1919 Act, was also accepted, and provides full protection for power companies where an additional demand arises in any part of their area. Some alterations were made in Clauses 14 (revision of prices, &c.) and 16 (power of persons not being undertakers to supply electricity), and after an unsuccessful attempt had been made to amend Section 16 of the principal Act, which provides compensation for the loss of office, the remaining clauses were passed, certain amendments being reserved for the Report stage.

The Removal of Objections.

It will be seen that, while the main provisions of the Bill as introduced into the House remain, the alterations made should go far to remove the objections of the power companies as enunciated in their recent pronouncement. Many of these companies have rendered signal service to the industry, and no one desires to see them deprived of any advantage which their enterprise and energy have secured. We cannot, however, appreciate their claim that, while no local authority or County Council within the area of a power company should be allowed to give financial assistance to a Joint Electricity Authority, they should be enabled to participate in the financing of the power company. We cannot see the reason for this differentiation, and we hope that the Legislature will not adopt the suggestion. It must be remembered that power companies' areas do not cover the whole of the country. Joint Authorities will be occupied with the generation and supply of electricity at as near cost as possible, and we hope and believe that they can do this more cheaply than the existing undertakings. Local authorities (and supply companies, too), where they are undertakers, will be quasi-partners in the authority; they will be concerned with the retail distribution of the electricity they receive in bulk, and though the present Bill places limitations upon their liability on account of any financial assistance they may give to the authority, they may make a profit out of the supply of electricity. In many cases local authorities are as likely to get electricity as cheaply from a Joint Authority as from a power company, and, therefore, it would be as advantageous to them to support the former as the latter.

Speaking With One Voice.

The final informal meeting of the present session of the Institution of Electrical Engineers may be said to have been distinguished in two ways. The first was that, in spite of the high interest of the subject for discussion: "The Importance of Considering Finance in Electrical Undertakings," the attendance was small, and therefore the spectacle of two famous members attempting, somewhat inarticulately, to propound plans for the construction of a new electricity supply industry was observed by but a meagre audience. The excuse of those who were not present might well be: Why put forward plans for such a reconstruction in such a way? That is the second surprising thing. For though both speakers accorded praise to the work of the Commissioners, they implied that that hard-working body are ploughing the sands, and that unless we revert to undiluted private enterprise in every sense of the word we shall soon have to set about reaping the whirlwind. The electricity supply industry in this country, they both would have us believe, is in a bad way; and unless we are careful will never be anything else. Here is more than sufficient food for thought, and we are not surprised that the discussion was a little ill-sustained.

Rectifying Old Defects.

The opener of the debate, Mr. Arthur Wright, admitted that the Government was endeavouring to rectify some of the old defects which have prevented the development of the industry in the past. But he went on to say that nothing was being done to remedy the real cause of our backwardness, the continual discouragement of private capital and enterprise from entering the electricity supply field. Though the Commissioners were doing a great deal to consolidate electricity supply areas, no one had discovered the source whence would come the enormous amount of capital required to carry out the extensive development foreshadowed, and without that capital there could be no real development.

Private Enterprise the Sole Solution.

Further, Mr. Wright argued, only private money and enterprise could be relied upon to achieve the necessary progress, and this would not be forthcoming unless the financiers who provided it were assured of the entire control of their expenditure. Ratepayers, too, would not allow the rates to be mortgaged for enterprises operating mainly outside their own towns, enterprises in which they would not have the sole voice in questions of management and policy. With these arguments Mr. Highfield expressed his hearty agreement. The solution of our present difficulties must originate, he said, from the industry itself, and it must tell the politicians with one voice what the right line to take was.

Whose Voice?

Now it is quite open to Mr. Arthur Wright and to Mr. Highfield to hold the opinion that private enterprise is the best, and indeed the only way of developing the electricity supply branch and so the electrical industry at the present time. Recently we expressed much the same view, and it is also widely held in other quarters. We are also of the opinion that it is desirable that the electrical industry should speak with one voice in this as in other matters. The difficulty is how to square what is desirable with what is possible, and especially are we doubtful at the present time that if the electrical industry did speak with one voice that voice would be the voice of Mr. Arthur Wright and Mr. Highfield. Manufacturing interests, for instance, are anxious to move forward without delay and see in the support of the Commissioners the best way of doing this.

Past History.

If we retrace our steps with Mr. Arthur Wright into the past history of the electricity supply undertakings we do not find that enterprise was or is the entire prerogative of the companies. Considering the conditions under which they have had to work perhaps it is not altogether their fault, but that does not alter facts. To deal purely with finance the municipalities have, in general, supplied electricity more cheaply than private enterprise, and have done so with advantage rather than disaster to the undertakings they own and to the ratepayers who have backed them. These municipalities have encouraged the development of both the power and domestic loads, the show-room idea and the more technical advances in a way which the companies have often either not cared to do or have not been successful in doing. Moreover, until about ten years ago financiers were shy of the electricity supply industry, as represented by the private enterprise, and even the fact that money can now be more easily obtained at a high interest is not on Mr. Wright's own showing necessarily an encouraging sign.

The Brighter Municipal Prospect.

On the other hand, money raised on the security of the rates has generally been easy to obtain at a low interest, and even now flows in in a stream of gratifying volume when it is required. So that on the financial side the promise is apparently brighter for electricity supply when it is under municipal than when it is under private control. If, therefore, we tabulate the arguments for and against the official methods of reorganising the electricity supply of the country, and similarly tabulate the arguments and results for and against handing over the whole of that great development to private enterprise, we find, remaining as unbiassed as we possibly can in the meantime, that there is at least as much to be said for one course as the other; that there is at least as great a weight of opinion on one side as the other, and that municipal management of electricity supply is usually as enterprising as when the conduct of affairs is in private hands.

A Comparison for Example.

In another branch of human affairs at the present time where much active disagreement is found as to the best solution to adopt each side emphasises its desire for peace and promises to give up warfare—directly it gets what it wants. The parallel is rather close to the matter now under discussion. For both Mr. Arthur Wright and Mr. Highfield stress the importance of the electrical industry speaking with one voice, and we agree that it is most important that there should be one voice. But we find on examination that it is to be their voice with which they wish the industry to speak, and it is not surprising therefore to discover a reluctance among municipal electrical undertakings to sink their individuality in quite so wholesale a way. Neither do we quite see why they should. For with friendly rivalry real progress will come from real co-operation, whose foundation the Commissioners are working hard to lay. A real co-operation means each side working together, not one side dominating and the other side blindly following.

A Simple Generator of High Frequency Current for Measurement Purposes.

By J. M.

Postulating the importance of high frequency measurements in modern radio researches, the author goes on to detail the requirements of a generator of high frequency current for this class of work and to describe apparatus which has actually been used for the purpose. Examples of the measurements that have been undertaken are also given.

The use of a small oscillating arc for making measurements at high frequencies is by no means novel, and in fact the type now to be described has been used for this purpose for several years. Its proved usefulness, however, is such that it deserves to be more widely known, and these notes are written to that end. After a brief description of the construction of such an arc, the important conditions for its stable operation are outlined and three examples are given with full values of the constants of the various circuits employed.

The Importance of High-Frequency Measurements.

In the solution of everyday problems in high frequency engineering the experimental method has necessarily to be used to a much greater extent than when dealing with continuous currents or alternating currents of low frequencies. The increase of frequency makes prominent a number of additional factors in the electrical circuit and greatly complicates calculation, so that although measurements are also less simple at high frequencies they are usually more practicable than direct calculation.

Moreover by making certain measurements at the correct frequency, but at reduced power, it is often possible to obtain results of sufficient accuracy by further calculation.

Requirements of a Generator of H.F. Current for Measurements.

The lower limit of power is chiefly determined by the energy consumption of the measuring apparatus. This energy consumption ought to be practically negligible in comparison with that of the circuits in which the measuring apparatus is inserted, and the latter should itself be small compared with the power of the generator.

A generator capable of delivering 30 W of high-frequency energy, over a large range of frequencies, is sufficient for a very considerable number of measurements, in fact its sphere of usefulness may be compared with that of a battery in direct current measurements. In conjunction with such a generator, portable hot wire instruments, or thermo-couples with direct-reading moving coil instruments, may be used.

Since the invention of the Poulsen arc a number of types of small

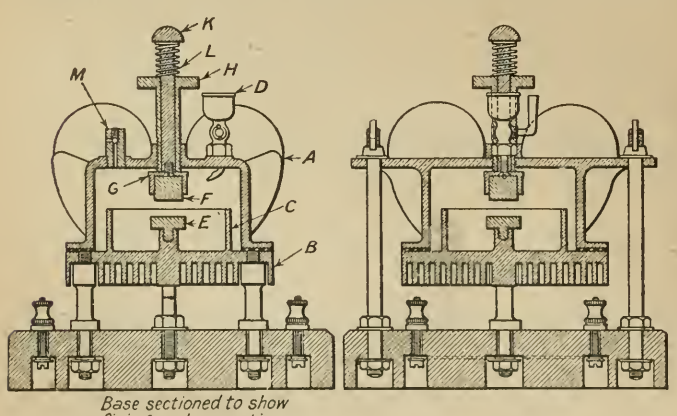


Fig. 1.—Sketch of Type "O" Arc.
C. F. Elwell, Ltd., London, Makers.

power arcs have been constructed by different experimenters with the object of obtaining not only a pure sine wave form and constant frequency, but also uniform amplitude.*

A small arc of this kind has advantages over a triode valve as a generator of oscillations, inasmuch as it is extremely simple and compact; its life is indefinite and there is nothing to get out of order; it is unbreakable and renewals of electrodes (which last a long time) are very cheap; it requires no special sources of supply, but can be run off an ordinary direct-current supply at 110 V or more. At the same time, it is possible to obtain from the small arc, provided suitable circuits are employed, the necessary power over a wide range of wavelengths, with a stability amply sufficient for many practical purposes.

* Zenneck—Wireless Telegraphy. Vollmer—Schwankungen der Frequenz und Intensität in der Lichtbogenschwingungen. Jahrb. de Drahtl. Telgr. 3, p. 117.

Details of Construction.

In the case of the small arc illustrated in Fig. 1, it has been found possible to simplify the apparatus without detriment to its satisfactory operation by dispensing with the magnetic field and water-cooling used in the larger Poulsen arcs, while a suitable atmosphere is produced by pouring into a dish surrounding the anode a little alcohol, which is vapourised by the heat of the arc. The arc is instantly struck, and works for long periods without adjustment. It is enclosed under a bronze cover A, having fins for effective air-cooling, which is bedded, with a joint on to a ring B, mounted on an insulating base. With the ring B is cast dish C which is fed with liquid alcohol from time

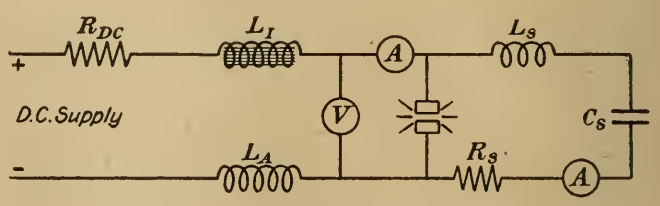


Fig. 2.

to time by the funnel and cock D; fixed to the centre of C is the copper anode E. The carbon cathode F, which is of sufficient section to ensure its uniform wear without the necessity of rotation (as in larger Poulsen arcs), is held in a carbon holder G, the stem of which passes through a hollow adjusting-screw H, and terminates in a knob K. The spring L keeps the carbon holder G up against the lower end of the adjusting screw H by means of which the gap between the anode and cathode is regulated; the arc is struck by pressing K momentarily. In the cover is a small relief-valve M. Two pairs of terminals, marked + and − are connected to the anode and cathode respectively, one pair for the d.c. supply, and the other for the oscillatory circuit.

Fig. 2 is a diagram of connections. The resistance R_{DC} in the d.c. supply circuit should, generally speaking, have a value such that the voltage drop across it should be at least equal to that across the terminals of the arc itself. The iron-cored choke coil L_I of about 0·1 henry, helps to steady the supply, especially when this is from accumulators, and the air-cored chokes L_A protect the d.c. supply circuit against high frequency in cases where the latter might cause trouble, although the H.F. voltage is never likely to exceed a few hundred volts.

The arc can deal with about 120 W d.c. continuously, without excessive heating, or with rather more for short period. The d.c. supply current is about 2 A, and the voltage across the arc between 50 and 100 V. The oscillating current should have a value equal to $\frac{1}{\sqrt{2}}$ times that of the d.c. supply current, and this condition will be obtained when the inductance L_S capacity C_S and resistance R_S of the oscillatory circuit have suitable values.

$\sqrt{\frac{L_S}{C_S}}$ should be greater than 100 O, and the value of R_S as large as possible compatible with the maintenance of the arc, which goes out if R_S exceeds a certain limit; the correct ratio $\left(\frac{1}{\sqrt{2}}\right)$ of oscillating current to d.c. supply current will then be obtained, and at the same time a good H.F. output, with pure wave-form and constant amplitude and frequency. The latter will be very close to the natural frequency of the oscillatory circuit, and its constancy will be improved by keeping the capacity C_S small.

When the arc is working on the true Poulsen cycle, with the ratio $\frac{\text{H.F. current}}{\text{direct current}} = \frac{1}{\sqrt{2}}$, the arc is extinguished once per period and re-ignited at the moment when the charge of the condenser has reached the voltage required to jump the arc gap. Now, the interval between extinction and re-ignition is the least well-defined portion of the period, and the shorter this interval is made, the more constant

will be the length of the period. The smaller the capacity of the oscillatory circuit, the more quickly will it be charged up to the ignition voltage, the shorter will be the interval of extinction and the steadier the frequency.

Very good results are obtained for frequencies varying between 15 000 and 100 000 periods. Between 100 000 and 300 000 the oscillations are a little less pure, but it is still possible to carry out over this latter range, a large number of measurements in which purity of wave form and constancy of frequency are not of great importance. A number of working points are shown in the table.

Table of a Few Working Points of the Arc.

The supply volts should be about twice the volts across the arc.

Oscillatory Circuit.			Supply.		Remarks.
λ Metres.	C μ Fds.	R Ohms.	Volts across Arc.	I Amps	
780	·001	4	58	2	
1 500	·001	5	65	2·1	
2 000	·0035	3	82	1·8	
2 000	·00175	7	70	2·2	
2 000	·0035	8	80	1·85	
2 000	·0035	13	96	1·7	Arc overloaded.
2 450	·002	8	90	1·65	
2 500	·001	5	80	1·75	
3 100	·0014	7	71	2·1	
3 300	·00175	7	77	1·7	
3 700	·007	7	75	1·6	
4 950	·0035	7·5	80	1·7	
5 900	·007	14	115	1·15	
13 000	·0105	15	100	1·8	Arc overloaded.

The curve in Fig. 3 shows an example illustrating the extent to which the wave length of the oscillations may fluctuate when the same frequency is obtained with different values of the capacity of the condenser.

The Use of the Small Arc.

Among the measurements for which the small-power arc is suitable, the following may be mentioned:

High frequency resistance of conductors, inductances and capacities. High frequency tests of dielectrics and condensers, by the use of suitable step-up high-frequency transformers. Calibration

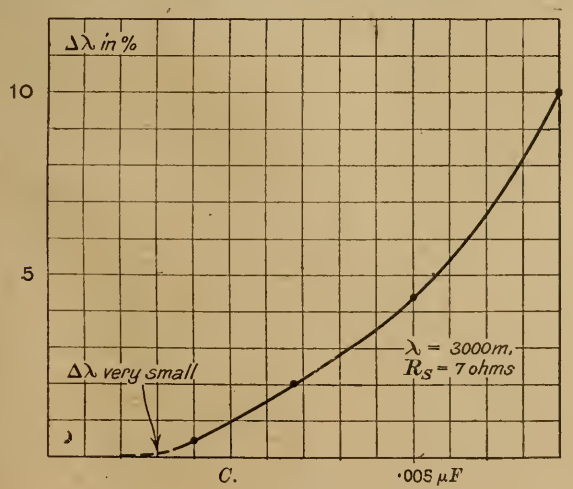


Fig. 3.

of high-frequency ammeters, for currents up to about 30 A, using suitable step-down transformers, and measurement of antennae constants, lecture demonstrations of resonance phenomena, &c., &c.,

Detailed Measurements.

The following examples of some measurements actually carried out with the type of arc generator described and illustrated above may be found useful:

Example 1.—Measurement of a non-inductive resistance wave-length, 4 500 metres (Fig. 4).

Circuit Constants.

Arc Supply Circuits:

Supply voltage—140 V.
Voltage at arc terminals—80 V.
Series resistance—17·5 O.
Supply current—1·75 A.

H.F. Circuits.

(λ=4 500 m.; $\omega = 2\pi f$ = 419 000).

Circuit No. 1.

Inductance Coil L_1.—83 turns, wound in a single layer on a wooden cylinder.

Diameter of turns—20 cm.
Number of turns per cm.—1·4.
Wire—No. 27 SWG. D.C.C.
High frequency resistance for = 4 500 m., 10 O. approx.
Inductance—1 830 microhenrys.

Coil l_1—Square single-layer coil, 10 cm. side.
Total number of turns, 20; several taps.
Turns per cm. = 1·4.
Wire—No. 27 SWG. D.C.C.

Condenser C_1—3 millimicrofarads.
i_1 = 1·2 A.
$L\omega$ = 767 O.
$L\omega I$ = 924 V.
Power absorbed by the circuit, 15 W. approx.
Coupling between the circuits No. 1 and No. 2.
M_1 = 2 microhenrys.
$M_1\omega$ = 0·84 O.
$M_1\omega I_1$ = 1 V. (E.M.F. induced in circuit No. 2 by circuit No. 1)

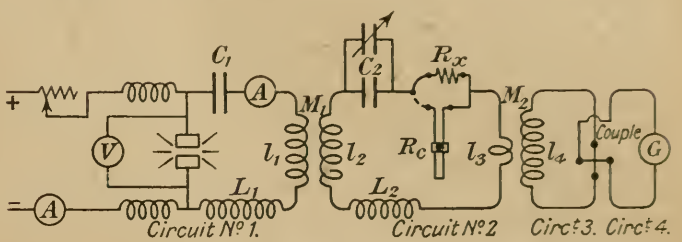


Fig. 4.

Circuit No. 2.

Inductance Coil L_2.—21 turns, wound in a single layer on a wooden cylinder.

Diameter of turns—20 cm.
Number of turns per cm. 1·4.
Wire—No. 27 SWG. D.C.C.
High frequency resistance for λ = 4 500, of the order of 7·5 Ohms.
Inductance—275 microhenrys.

Coil l_2—Square coil, 9 cm. side.
Number of turns, 5 (in a single layer).
Wire—No. 27 SWG. D.C.C.

Two turns are used, giving an inductance of one microhenry This coil was placed inside coil l_1 it was turnable about its diameter.

Coil l_3.—Same as coil l_2.

Capacity C_2 consists of a fixed condenser in parallel with a variable condenser. Total capacity at resonance — 0·0 208 microfarads.

Resistance R_x *and* R_c.—R_c consisted of constantan wire, 20 O, per metre two parallel strands of which were wound close side by side, the length of wire in circuit being varied by a sliding contact. The resistance was varied until the substitution of R_c for the unknown resistance R_x produced no variation of current in the circuit. The value of R_x found by this measurement was—2·8 O.

i_2 = 0·2 A.
$L_2\omega$ = 115 O.
$L_2\omega I_2$ = 23 V.
Power absorbed by the circuit—about 0·3 W.
Coupling between the circuits (2) and (3).
M_2 = 1·2 microhenry.
$M_2\omega$ = 0·5 O.
$M_2\omega I_2$ = 0·1 V.

Circuit No. 3.

Coil l_3—same as Coil l_1.

Coil l_4—was movable inside coil l_3.
Resistance of thermo-couple, 10 O.
ωl_4—10·5 O.

$$I_3 = \frac{M_2\omega I_2}{\sqrt{R^2_{\text{couple}} + \omega^2 l_4^2}} = 7 \text{ mA.}$$

Power absorbed by the circuit, about 0·5 milliwatts.

Circuit No. 4.

Resistance of thermo-couple, 10 O.
Difference of potential at the terminals of the used thermo-couple fc. a heating current of 10 mA. 2·2 mV.
Galvanometer resistance, 8 O.
Galvanometer constant, 100 divisions = 120 microamperes.
For I_3 = 7mA. the difference of potential at terminals of thermo-couple is 1·08 mV.

$I_4 = \frac{1{\cdot}54 \text{ mV.}}{18 \text{ ohms.}}$ = 60 microamperes. The galvanometer thus gave a deflection of 50 divisions when the unknown resistance R_x was inserted in circuit No. 2.

It can be seen from the data given above that the couplings between the coils were very loose and the power absorbed by the succeeding circuits diminished rapidly. Re-action between circuits was quite negligible. The power furnished by the arc permitted of accurate measurements being made.

Example 2.—Measurement of the resistance of an inductance coil. Wave-length $\lambda = 4\,500$metres.

The resistance to be measured was of the order of 10 O., and the inductance of the coil about 2 100 microhenrys.

The same circuits as Fig. 4 were used except for circuit No. (2).

Constants of circuit No. (2). (See Fig. 5.)

Coil $L_2 = 2\,900$ microhenrys.

Capacity C_2, variable *air condenser*, of 1·96 millimicrofarad.

$R_c = 6$ O.

Coils l_2 and l_3 similar to those described in the preceding example, except for re-adjustment of the coupling M_1 and M_2.

Procedure.—On short circuiting the added resistance R_c the galvanometer gave a deflection of 100 divisions. On inserting R_c the deflection was 43 divisions. Consequently :

$$\frac{R_x + R_c}{R_x} = \sqrt{\frac{100}{43}} = 1{\cdot}525, \text{ from which}$$

$$R_x = \frac{R_c}{0{\cdot}525} = 11{\cdot}5 \text{ O.}$$

The losses on the coils L_2' and L_2'' and the condenser C_2 may be

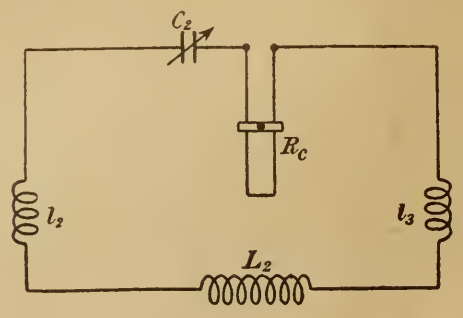


Fig. 5.

neglected. The reaction between the circuits is stronger here than in the first example, but the resulting error is still quite negligible.

Example 3.—*Calibration of a High-frequency Ammeter.*

Standard ammeter—

Full scale reading—35 A.
Resistance—0·009 O.
Inductance, between the terminals, of the order of 0·1 microhenry.

Ammeter to be calibrated—

Full scale reading—30 A.
Resistance—0·01 O.
Inductance between the terminals, of the order of 0·1 microhenry.

Circuit Constants and Calibration Conditions (Fig. 6) = 2 200 metres.

Arc Supply circuits—

Supply voltage—220 V.
Supply current—2·15 A.
Resistance R—57 O.
Voltage across terminals of the arc—98 V.
Power absorbed by the arc, 210 W.

(The arc was in this instance somewhat overloaded, but it would stand this for the short period required to carry out the calibration.)

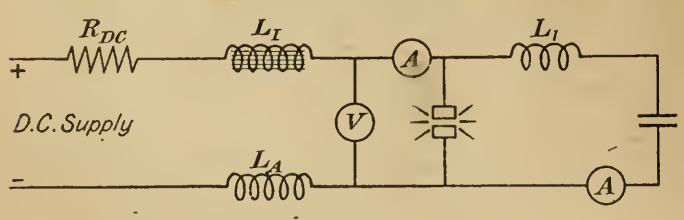


Fig. 6.

Circuit No. 1.

Capacity $C_1 = 3{\cdot}5$ millimicrofarad.
Inductance coil L_1, 600 microhenrys.
Cylindrical coil—20 cm. diameter.
40 turns.
12 turns per cm.
Diameter of wire, 0·45m/m.
Total resistance of circuit No. (1) for $\lambda = 2{\cdot}200$ metres, 7·5 O.
Current $I_1 = 1{\cdot}5$ A.
Power absorbed in circuit 1, 17 W.
Coupling between circuits (1) and (2).
$M = 12{\cdot}5$ microhenrys.
E.M.F. induced in the secondary by the primary $M\omega I_1 = 16$ V.

Circuit No. 2. (Fig. 7.)

Inductance Coil l about 5 microhenrys (one turn was variable and consisted of a spiral coil of 5 turns of bare copper strip 1 × 12 mm. outside diameter 20 cm.). This inductance was used to regulate the current i_2.

Inductance Coil L_2 about 0·4 microhenry. (One turn of bare copper strip 12 × 1 mm. wound round the middle of the coil L_1; diameter of turn, 20·5 cm.)

Inductance in the leads was reduced to a minimum by avoiding the formation of loops with the connections.

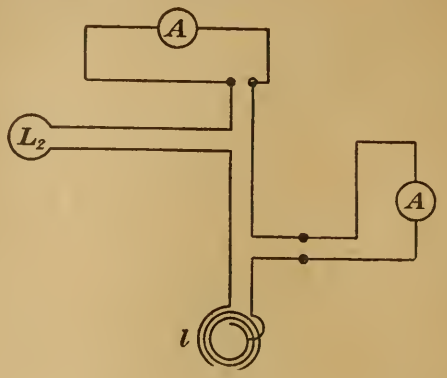


Fig. 7.

Current I_2.

First case, $l = 0$.
Total resistance of circuit No. 2 = 0·019 O.
Total inductance of circuit No. 2 = 0·58 microhenrys.
Total impedance of circuit No. 2 = 0·5 O.

Then $I_2 = \frac{16}{\cdot 497} = 32{\cdot}2$

Power absorbed by circuit No. 2 = 18 W. approx.
Total power furnished by arc = 35 W. high frequency.
Second case, $l = 5$ m. henrys.
Total impedance of circuit No. 2 = 4·28 O.

Then $I_2 = \frac{16}{4{\cdot}28} = 3{\cdot}75$ A.

The reaction of the secondary on the primary has a considerable effect on the wave-length, therefore when l is adjusted, the inductance of L_1 should be adjusted to keep the wave-length the same as before, this being checked by measurement on a wavemeter.

Three Useful Text Books.*

The first two books here noticed mark a breaking of new ground. Their object is to wed the elementary facts of chemistry and physics to their everyday applications in ordinary life, and to illustrate the facts of science by examples culled from the street and factory rather than from the laboratory. Thus in the book on "Chemistry" filtration and evaporation are illustrated by references to modern centrifugal filters, drying machines, and evaporators, while in the chapter on Combustion and Heat we are shown what Sheffield looks like on Sundays and on week days respectively, and thus draw the useful conclusion that the gas fire is a non-smoke producing heater which ought to be more widely used. Why electric heater should be left out it is best perhaps not to pause and consider. However, electricity comes into its own in the chapter on Combustion and Light, while in that on Oxygen and Nitrogen some details are given of nitrogen fixation processes.

In the book on "Heat" the same method is followed, and here a whole chapter is devoted to the electrical production of heat with illustrations of modern electric fires, electric kitchens, and other accessories, while electrical methods of measuring temperatures are given adequate space. The books are well and interestingly written, clearly printed, and adequately illustrated. They should fulfil the useful task of appealing to those who like their knowledge applied rather than pure. In the copy on "Heat," which we received pp. 149 to 156 were issued as a slip-in supplement, but we hope this is not usual.

The aim of the authors of the "Electrical Engineers' Pocket Book," which now reaches its second edition, is something more than a collection of tables and formulæ. Nevertheless there are a good many of both, and though the information which is given both in them and in the rest of the book is good and accurate, and the general get up, though the type is small, cannot be criticised, we really wonder at the increasing production of this type of work. The need for co-operation among the various branches of the electrical industry to avoid cut-throat competition is constantly being dinned into our ears. We suggest that a small association of those engaged in the publication of electrical books might be formed with the same end in view, as at present part of the ground is being trampled over by pressing crowds, while other parts upon which information is sadly required are being inexplicably left untilled.

*Heat, Part I., and Chemistry, Part I. By George Thompson and George H. Leslie. (London : Cassell & Company.) Pp. xii. + 160 and Pp. xi. + 159.

Electrical Engineers' Pocket Book. Second edition. (London : International Correspondence Schools.) Pp. xiii. + 487. 10s. 6d.

Electro-Farming.*

By R. BORLASE MATTHEWS.

Agriculture is the largest industry in this country. In England and Wales alone there are 418 000 farms and small-holdings, of which 36 000 have each an area of over 150 acres. There are 13 500 farms of over 300 acres each. Hence, there should be an enormous demand both for electrical apparatus and for current.

In this Paper it is proposed to give the results of an experimental investigation into the practical possibilities of the use of electricity in agriculture. The problem has been studied from a commercial standpoint, and the experimental work has been carried out on the lines of actual working farming. Nearly all the author's experiments have been carried out on his own farm of 600 acres at Greater Felcourt, East Grinstead, and at the same time Continental methods have been studied.

Various Facets of the Problem.

As in all other industries, the successful solution of the application of electricity is not merely a matter of belting a standard motor to existing machinery. The conditions and circumstances of farming are peculiar. The seasonal use of much of the machinery is limited and a large proportion of the labour available is prejudiced against, and unused to, machinery in any form. Special varieties of farming, *e.g.*, mixed, dairy, breeding, differ much in the requirements. The author considers that in future, for the most successful operation of farms, the use of electricity will be essential. If the efficiency of farming is to be improved, a change from present methods is imperative, and an increased efficiency, including the circumvention of adverse weather conditions, is easily obtained by electrical methods. Incidentally, the application of electricity to agriculture will do much to raise the status of the labourer.

The opportunities afforded for applying electricity on any farm naturally depend on its size. For farms of under 150 acres care is needed to ensure an adequate return for the capital expended, as the number of hours of use of each machine is limited. On larger farms, as the hours of use are longer, it is not so easy to make a mistake in this respect.

Electrical Applications on the Farm.

In the farm buildings electric lighting can be usefully employed in dairies, cow barns or byres, buildings, yards, &c., and for the intensive feeding of sheep, pigs, poultry, etc., during the winter. Electric driving may be applied to chaff-cutters and dust extractors, root pulpers and slicers, cattle cake breakers, corn crushers and grist mills, maizesheers, huskers and shredders, meat grinders and mincers, &c.

In the dairy there are many forms of machinery that can be electrically driven, including milk or cream separators, butter churns and workers, refrigerators, ice breakers, milk-churn transporters and elevators, milk-bottle cleaners, milk cooling and circulating pumps. Sterilisation of milk may be effected by an electrolytic bath and mercury vapour lamps. Incubators for testing bacterial contents of milk may be electrically heated.

In regard to poultry, electric light may be installed in the laying houses to increase egg production. There are electrical egg testers and electrically-heated incubators; opportunities exist for the use of electric fans and the electric driving of bone grinders, grain crushers, seed cleaners, sorters, and mixing machines.

General applications of electric power include pumping for domestic use, pumping liquid manure and sewage, and driving winches, hay hoists, elevators and transporters and milking machines. The workshop for repairs to farm machinery will contain much machinery that can be electrically driven.

Irrigation, Electro-Culture and Silage.

On the farm land there is irrigation by electric pumps, the distribution of artificial manure, ploughing by electric tractors, and cultivation and harrowing by similar implements, hay mowing, hay elevating, corn cutting and binding, and many other processes that may be effected by the electric drive.

The treatment of growing crops includes electro-culture by high tension, high frequency electric discharge, ozone treatment or mercury lamp treatment for stimulating growth, destroying insect pests, or strengthening plants and enabling them better to withstand changes in weather. Milk vans and lorries may also be electrically driven.

There are many processes in connexion with gathered crops which are assisted by electrical apparatus, such as the electrolytic conservation of greenstuffs, hay-drying and grain-drying by electric fans; desiccation of vegetables and fruit for supply to jam-makers, There are many machines, such as automatic silage stackers, threshing machines, grain graders, winnowers, and balers, potato-sorters, hop-dryers, flailing and malting machinery, clover, pea and bean hullers, which can be driven electrically. While finally, electricity can be used for lighting, heating and domestic uses in the farmhouse.

*Abstract of a Paper read before The Institution of Electrical Engineers.

Some Radical Changes Necessary.

Most of these applications of electricity are closely allied to procedure in other industries. Most problems associated with electrical drives inside the farm buildings are now solved—but in some cases radical changes will have to take place in the design of the actual machines. The biggest demand will always be for machinery which is practically self-contained and fool-proof. However, for the next few years the portable motor will serve most requirements.

On the land slower progress has been made in applying electrical methods, and certain changes will have to be made in British methods of agriculture, such as the gradual adoption of more intensive cultivation, the institution of soiling crops, inter-cropping, and the greater employment of artificial manures. These changes will favour the use of electricity on arable land, since the work will be more regular, and idle fallows will be eliminated.

Only a few days' work each year is required in any one field and even this short time is occupied with such diverse operations as ploughing, cultivating, harrowing, rolling, hoeing, reaping and gathering. Electrical methods of performing these operations have now passed the experimental stage. But few engineers have sufficient knowledge of the intimate details of farming methods to develop electrical methods. The problem might be simplified if the farmer were regarded as a manufacturer who, commencing with certain raw materials, puts them into a more refined condition—with possibly a second process if he converts his refined materials into the form of animal flesh. All by-products are—or should be—fully utilized. Present farming is based upon an abundance of cheap labour and a disregard for time. However, there are difficulties in modernizing a business in which the load factor of each machine is so low, though a completely electrically-equipped farm may have quite a satisfactory load factor.

Current Consumption.

The annual consumption of electricity in farm buildings alone averages 10 kWh per acre.

Figures may work out as follows:—

Area of farm.	Usual farm buildings, max. demand	Farm bldgs., kWh per annum.	Farm hand, kWh per annum.
Acres.	H.P.		
1	—	10	44
150	3	1 500	6 600
300	5	3 000	13 200
600	15	6 000	26 400

The Supply of Electricity to Farms.

As the outcome of experience, practice in electric power distribution for agricultural purposes is settling down to a simple standard. While the main distribution may be at any pressure over 50 000 V in Europe, a sub-distribution of 10 000 V, three-phase, 50 periods, is becoming usual.

For economic and other practical reasons the number and size of transformers are reduced to a minimum. For farm work 50 kVA is a useful minimum size. From this transformer, supply distribution lines can be conveniently run in any direction for a distance not exceeding 2 500 yds. Every farm within reach of this local distribution is connected, and a good load factor is obtained. In Denmark, overhead lines of 0·39 sq. in. are usually employed for farm supply. To allow for pressure-drop, motors installed at the ends of the lines are wound for a voltage 10 to 15 per cent. below normal.

Unquestionably the best and cheapest method by which the farmer can obtain power is from a public distribution network, but where this does not exist he must install a properly designed independent plant.

The author has devised an arrangement whereby the farmer's oil tractor can be made to give effective service until a permanent plant is available. The scheme comprises a special reinforced concrete runway, having strong side guiding kerbs. These kerbs always align the tractor in the same position facing the dynamo, which is mounted on a suitable pedestal and driven by an endless belt from the tractor pulley. The dynamo is attached by cam-clamping bolts to belt-tightener rails. The latter are provided with

an adjusting screw operated by a crank handle. Thus the belt can be very quickly adjusted as the tractor is taken away or brought in.

Power Rates.

It is to be hoped that central power supply undertakings will not stipulate for rates based on the horse-power of the motors connected. Such rates discourage a farmer from installing a number of motors. With the aid of suitable technical advice it can be demonstrated to farmers that they can obtain better terms on a self-restricted maximum demand. Agricultural-implement manufacturers are already catering for this requirement by providing such machines as threshers in such a form that the work is carried out in two separate stages. In one machine the corn is threshed and cleaned sufficiently for the farmer's own needs. In the second machine that portion of the corn from the thresher that is intended for the market is finally dressed, cleaned and sorted. Either of these machines can be driven by a 5 H.P. electric motor, as compared with the 12½ H.P. motor required for a standard full-size thresher.

Electrically operated farm machinery should be of a design and construction as rarely to need overhaul. A trouble often encountered with farm electric motors is damage by moisture, due either to rain or to condensation. Motors should be as waterproof as is feasible. Ball-bearing electric motors are to be preferred, if provided with good felt packings, as frequent lubrication is eliminated. Undoubtedly the most practical motor for farm use is the three-phase squirrel-cage type. For farms of over 300 acres the author favours three-phase power installations on this account.

Motor Problems.

On a farm where other than manual power is employed in the barns the machines most commonly in use are hay chaffers, root cutters and pulpers, grinding mills, cattle-cake breakers, and firewood saw benches. These are chiefly used during the winter time, and even then for only a few hours daily. At first thought, the load factor does not appear attractive. However, if electricity is available it will soon be employed for a variety of other purposes. An important use, where water is not already laid on, is for driving the water pump for general farm purposes and also for domestic use. Another essential service is the driving of a liquid-manure pump. If a dairy herd of more than ten cows is kept, it is advisable to employ a motor-driven cream separator and also a milking machine. For the driving of the milking machine 2 to 3 H.P. is required. Over 9 000 farms in New Zealand employ milking machines. The milking load comes on very early in the morning and again in the afternoon. The preparation of food for the live stock is usually carried out in the morning. If a threshing machine, and also a hay and straw transporter and elevator are added to the above equipment, there will be a fairly heavy load for twelve hours each day during the winter. In addition, electric lighting will be needed in the early morning hours and again at night. At the hay and corn-harvest periods, the driving of the barn machinery would be replaced by the operation of an electric fan for curing the hay and sheaves of corn, also for elevating hay and silage crops ; in addition a chaffing machine would have to be driven for cutting silage. If a number of sheep were kept, an electric shearing machine should be employed. Among the uses on the land that should be seriously considered nowadays are electric ploughing and cultivation, electro-culture of growing crops, and electric treatment of silage. After all, the requirements of each farm have to be specially studied, as the form of farming so often differs, as does also the arrangement of the buildings.

Sizes of Motors Required.

On a small farm of under 150 acres the barn machinery required can usually be driven by a 1 H.P. motor. However, for the chaffing machine it is preferable to employ 3 H.P. motors, as this size will do the work more quickly and provide an ample margin for the counter-shaft losses. On a farm of 150 to 300 acres a 5 H.P. electric motor is most suitable, as the barn machinery on these farms is slightly larger. On farms of over 300 acres at least 15 H.P. motors are required, as still heavier machinery has to be driven, inclusive of a full-size threshing set. The latter in itself requires, about 12½ H.P., and in addition a small margin is required for driving a small trusser and possibly a feeder in conjunction with the thresher. Where the electric drive is available on the larger farms, it will also be found advisable to incorporate with the chaffer a cyclone dust-extractor.

An air-pressure system for the supply of the water will be found to be the most efficacious. With a well 1 to 25 ft. deep, a pump of ½ H.P. will deliver 360 gallons per hour. With wells 50 to 600 ft. deep, ¾ to 3 H.P., delivering 200 to 1 500 gallons per hour, is usual.

Portable Motors.

With a view to eliminating counter-shaft drives and enabling each piece of barn machinery to be placed in the most convenient position, portable electric motors are now favoured. However, it is a moot point as to whether, in the course of the year's use, the value of the time lost in adjusting and fixing them would not pay the interest and depreciation on a direct-connected motor. Difficulty is often experienced with the installation of a suitable counter-shaft drive, owing to the fact that it has often to be placed in somewhat antiquated buildings. On some of the more up-to-date farms, counter-shafts fitted with ball-bearings are employed, and arranged for self-alignment. It is difficult to get farm labourers to keep the belts in order, especially as the machines are not in constant daily use. Where counter-shaft drives are employed on farms, it would be a good plan to mount the driven machines on slide-rails, like those used for an electric motor, as this would save much belt trouble.

Portable motors have one great point in their favour, *i.e.*, they enable new drives to be tried and experimented with in cases of doubt. For work outside the farm buildings they are often invaluable.

Portable motors for use on farms should preferably be provided with starting switches and fuses or circuit breakers mounted on the side of the motor frame. The flexible leads from the source of supply should form a cable in which an extra earthing wire is included. A convenient standard length of cable is 40 ft. If a longer length is necessary a light wooden reel should be supplied upon which to coil any excess length not in use. A double-width pulley on the motor spindle enables the alignment of the portable motor to be quickly made. The motors should preferably be of drip-proof type.

Small motors complete with starters and flexible cable can be obtained ready mounted on handle bars, enabling them to be carried from place to place by a couple of men ; alternatively the motors are mounted on timber skid frames or on wheeled frames, on which they can be drawn into convenient positions, being ready for service in their new location as soon as the belt is attached. Continental practice favours very substantial 3-point suspension horse-drawn enclosed vans, for motors of 15 to 40 H.P. For smaller motors, the author advocates a wooden platform, suitable for use with transporter or lifting trucks, as employed under modern factory conditions.

All-Electric Automatic Power Signalling on the Metropolitan Railway.*

By W. WILLOX.

In 1905 when electric trains commenced to run on the Metropolitan Railway, the system of signalling was mechanically controlled by Spagnoletti lock and block. The number of trains between Praed-street Junction and Aldgate—about 5 miles—was then 621 per day on both roads, and the number of signal sections was forty-nine. When the number of trains was increased, it was found necessary to introduce automatic signalling controlled by track circuits. The system chosen was all-electric, and the work was begun in 1908. This section was completed in 1909. Two power frames were installed, one at Praed-street Junction and one at Aldgate, to deal with the traffic at these places, but the existing mechanical boxes at the intervening stations were retained for shunting purposes, with the addition of the safeguards afforded by track control. The number of trains in 1913 at Praed-street Junction was 863, and from Baker-street to Aldgate 983, and the number of signal sections ninety-one.

Present Traffic Conditions.

There are about twenty hours daily of continuous passenger traffic, but from 7.30 to 10 a.m., and from 4.30 to 7.30 p.m., the traffic is so dense as to necessitate forty booked trains to and forty from the City per hour, and the automatic signalling deals with these successfully. Similar signalling was therefore installed between Baker-street and Neasden in 1911, the number of signalling sections being increased from twenty-four to fifty-one. At this date there was only one through line at Baker-street dealt with by two signal boxes, one at the north end of the station and one at the Circle end. This through line was track circuited, and full protection was afforded to train movements, allowing forty-eight through passenger trains to be run to and from the City. All the current used in these installations was direct.

First Automatic Installation.

In 1913 the new Baker-street Station was completed, and automatic signalling was installed between the Circle lines and the north end of the station. For this purpose a small signal box was constructed on a retaining wall so as to be out of the way, and in it a power frame of thirty-six levers (six spare) was installed. This power frame deals with over 1 500 trains a day, and it is interesting to note that the signalman has no view of the trains except those within station limits immediately in front of his box. Through the station all signals and points are controlled by d.c., but the track circuits are a.c. In 1913 two new fast lines were constructed alongside the old or local lines from Finchley-road

*Abstract of a Paper read before the Institution of Civil Engineers.

to Wembley Park, a distance of 5 miles. Through the junction at Finchley-road and on to Wembley Park a.c. track circuits were installed, but the signals are worked by d.c. as far as Neasden Power House. From this point to Harrow-on-the-Hill a.c. is used for the signals as well as for the tracks, and from the same point a.c. is used both for tracks and signals on the local lines to the junction north of Wembley Park Station where the fast and local lines converge. From Baker-street to Harrow-on-the-Hill before automatic signalling there were thirty-nine signalling sections, now there are sixty-nine, and on the through fast lines there are twenty sections. In 1919 the signalling from Praed-street Station to South Kensington, which was an automatic bar and treadle system controlled by d.c., was track circuited with a.c., but the signals continue to be controlled by d.c.

Power Supply Arrangements.

Current for the supply of power to operate the power frame at Praed-street Junction and at Baker-street is obtained from two 130 V 5 kW motor-generators through suitable cables. These supply power for the operation of the points, the signal lamps and train stops, the electro-magnets for back-locks and for the constant indication of power-worked points at Praed-street Junction, and also for working the power frame at Baker-street, the total required for both boxes being 2·08 kW.

For operating the track circuits, automatic and semi-automatic signals, and train stops, between Praed-street, Bishop's-road, and Edgware-road stations, and also between Edgware-road, Great Portland-street and Marlborough-road, and for the four large illuminated train indicators at Baker-street, power is obtained from one 15 kW and two 12 kW 70 V motor-generators in Baker-street sub-station, the maximum power taken being 14 kW. The mechanical locking in the power frames is ordinary miniature tappet locking controlled by levers in the ordinary way, the electric locking frame being behind the levers. Illuminated continuous diagrams are placed behind the frames lighted by 75 V 5-candle-power lamps.

Interlocking Devices.

All signals at junctions are electrically back-locked, an important safety device which in the further development of electric signalling has enabled point locking bars to be dispensed with. At all running stop-signals there are train stops which are not connected to the signals mechanically, but electrically, and are controlled by the track circuits in the same manner as the signals, coming to clear and going to danger with the signal. They are also controlled by the track circuit independently of the signal, so that, if a signal failed to go to danger, the arm of the train stop would still go to the danger position.

All electric signals are either automatic or semi-automatic, the former being controlled through the track circuits by the passage of the trains, and the latter from signal box when this is in use, but becoming automatic when not so controlled. Inside the tunnels the signals are lamp signals, outside they are upper quadrant semaphores worked by electric motors. Signals are held normally in the clear position by electric power; they go to danger by gravity. All signals are lighted electrically, and stationmasters light the signals halfway to the next station on either side by a switch at their station. One hundred yards behind each stop signal in the open fog repeater signals have been erected, the lights of which are placed at the level of the driver's eyes and as near as possible to the running line. By this means an indication is given to the driver whether the stop signal ahead is at clear or at danger, and if at danger he can slow up and avoid being tripped suddenly. The signalmen have fog repeater switches in the signal box by means of which they can light the fog repeater lamps when necessary.

Train Describers.

Between junctions it is possible to have a number of trains—*e.g.*, between Finchley-road and Baker-street it is possible to have ten trains—and Mackenzie Holland and Westinghouse Company's magazine train describers are installed, by which the signalman at Finchley-road is enabled to indicate to the Baker-street signalman whether the train terminates there or is a through train to the City. All points where there are power frames are worked by the Mackenzie Holland and Westinghouse all-electric point machines. These machines are enclosed in a water-tight cast-iron case divided into three compartments. At one end is the motor, in the centre are the gear wheels and motor switches, and in the other end the worm drum that operates the points and the bolt that locks them both ways. Both point blades, as well as the bolt lock, are individually detected through an electric detector fixed in the four-foot way before the signalman can get his signal for a train to pass over that route. These point machines are most successful.

Track Relays.

The track relays at Baker-street are of the single element vane type, the shunt by a train averaging 0·9 O. The relays used on the d.c. system are of the 3-coil polarised type, the shunt of which by a train averages 0·15 O. Where a.c. is used the track relays are of the two element galvanometer type and the shunt of these by a train averages 0·6 O. The most recent type of relay used is a two element vane relay, the shunt of which by a train averages 3·4 O. The cost of maintenance of this system of signalling is not excessive. Before automatic signalling was installed there were 645 levers in use, whereas at present only 311 levers are in use, while the number of signalmen were reduced from 86 to 27. This meant in 1908 a saving of £127 per week in signalmen's wages, which at the present date would amount approximately to £325 per week. During 1920 the whole cost of maintenance—wages and materials—of the signalling of the electrified lines amounted to £123 per route mile.

Charts have been kept from the commencement of automatic signalling in order to ascertain the number of delays to trains as compared with delays to trains with ordinary signalling, and the comparison comes out very favourably to automatic signalling.

Tests have also been made with a 3-position light signal as used on the Pennsylvania Railway in the United States of America. The cost of maintenance is about the same as with 2-position semaphores, but the light signal would appear to have advantages in some respects, *e.g.*, the entire absence of mechanical parts, and in the power of penetration of the light rays both in sunshine and in fog.

Review.

Practical Electricity. By W. E. Ayrton, F.R.S., and T. Mather, F.R.S. (London: Cassell & Company, Ltd.) Fourth Edition. Pp. xv. + 547. 15s. net.

This is an old friend—a friend to be treated with affection and respect, and one whose very failings have the savour of virtues. It was first published in 1887, and this is its twenty-third reprint and its fourth revision. On this occasion Professor Mather has taken the opportunity of bringing the symbols used into line with the recommendations of the International Commission—a valuable revision step. He has also rewritten the section on dry cells, and, according to the preface, has amplified that dealing with storage cells.

It is generally known, we presume, that the book is intended to be a laboratory and lecture course, and that the title "Practical Electricity" was designed to indicate that the subject matter dealt with the applied side of the science, and was not to be interpreted in the same sense as such titles as "Practical Physics" and "Practical Chemistry." The book under review covers a much wider area than a laboratory course, though in the main it does converge upon work in the laboratory and particularly upon work in the laboratory of the Central Technical College at South Kensington.

The course is intended for "first year" students—that is to say, for the type of students in the first year of the course at the Central Technical College, and not for absolute beginners. It also follows that it is intended for students who are full time students and who have time to cover the wide course which this book covers in a single year. This is not to suggest that other students cannot use the book profitably—they can, but they must take a longer time.

There are eleven chapters dealing in turn with current measurement, magnetic fields, galvanometers, electrodynamometers, and ammeters, difference of potential and resistance, galvanic cells, the laws and measurement of resistance, energy and power, quantity and capacity, induced currents, and the magnetisation of iron. The whole is a very excellent foundation course, although our view, given with all the deference due to a work which is classic, is that some of it could be cut with advantage. We can quite understand that Professor Mather had the feeling of a vandal when he armed himself with a blue pencil, though he might agree, in private, that more ruthless treatment with that weapon would not have weakened the tree of knowledge which the book represents. One of the very strong features of the book is the careful explanation of the principles and action of the various measuring instruments used in electrical work. We feel that this is too often neglected, and there is no doubt that students can take a much more intelligent view of the tests which they perform if they are thoroughly conversant with the instruments they use. At the same time we feel that much of the work on the tangent galvanometer might have been cut advantageously. We think, too that there is more about primary cells than is necessary, and we wish that Professor Mather had extended the section on storage cells very much more than he has done.

But, from the point of view of the educationist, our opinion of the book as a whole may be gauged from this: That it must be very pleasant and very comfortable to take a class of "second year" students all of whom have read, performed, marked and inwardly digested the contents of this first year course of "Practical Electricity."

J. Paley Yorke.

The Thermionic Triode as Rectifier.*

By E. B. MOULLIN, M.A., and L. B. TURNER, M.A.

The performances of the triode rectifier arrangements used in wireless telegraphy, with signals of various strengths and with or without a superposed local heterodyne oscillation, are investigated theoretically and experimentally. The results are illustrated numerically by reference to a certain well-known pattern of triode, and in the more fundamental cases the theoretical deductions are compared with precise experimental measurements made at low frequency. The agreement is found to be very close.

In the present Paper, the performances of the various triode rectifying arrangements have been calculated fairly exhaustively in terms of the parameters of the triode as exhibited in its static characteristic curves. The theoretical results obtained are in all cases illustrated by numerical calculations for a single typical pattern of triode, the well-known "R" triode, and they have been experimentally checked in the more fundamental cases by precise measurements with signal E.M.F.'s of low frequency (50 periods per sec.).

The rectifier arrangements investigated with these signals are classified as follows:

(R1).—Rectification by curvature of anode characteristic, called "anode rectification";

(R2).—Rectification by curvature of grid characteristic, called "grid rectification";

(R3).—The same with grid condenser, called "cumulative grid rectification."

Theory of Rectification of Sustained C.W.

The theory is well known, but may be stated briefly as follows (Fig. 1): Let the asymmetric conductor (the rectifier) have a curved

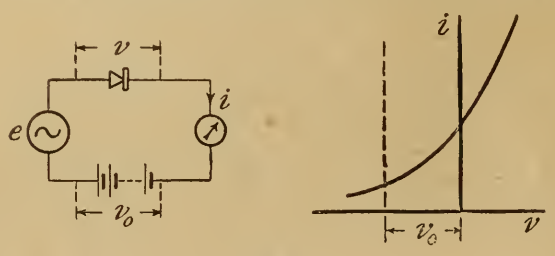


Fig. 1.

characteristic of the general form $i = f(v)$, and suppose, moreover, that it is possible to represent this function by an infinite series. Then $v = v_0 + e$,

$$\text{and } i = f(v_0) + ef'(v_0) + \frac{e^2}{2!}f''(v_0) + \frac{e^3}{3!}f'''(v_0) + \ldots$$

Let $e = a \sin pt + a_3 \sin 3pt + a_5 \sin 5pt + \ldots$

$$\text{then } i = f(v_0) + (a \sin pt + a_3 \sin 3pt + a_5 \sin 5pt + \ldots)f'(v_0) + \frac{1}{2!}(a \sin pt + a_3 \sin 3pt + a_5 \sin 5pt + \ldots)^2 f''(v_0) + \ldots$$

If the change of mean current due to the signal e is I_r,

$$I_r = \frac{(a^2 + a_3^2 + a_5^2 + \ldots)}{4} f''(v_0) + \frac{(a^4 + a_3^4 + a_5^4 + \ldots + 2a^2a_3^2 + \ldots)}{64} f''''(v_0)$$

Now suppose that the values of a, a_3, a_5, &c., and $f''''(v_0)$, &c., are such that

$$\frac{(a^4 + a_3^4 + a_5^4 + \ldots + 2a^2a_3^2 + \ldots)}{16} f''''(v_0)$$

is small compared with $(a^2 + a_3^2 + a_5^2 + \ldots)f''(v_0)$; then

$$I_r = \frac{\text{mean-square } e}{2} f''(v_0) \equiv \frac{\mathcal{E}^2}{2}\frac{d^2i}{dv_2} \quad \ldots\ldots\ldots\ldots(1)$$

Hence unless the characteristic curve is such that d^4i/dv^4 is very large, the rectified current from a very weak signal is proportional to the rate of change of the slope of the characteristic, and to the square of the strength of the signal P.D., whether the latter contains harmonics or not—a point not always noticed.

In the original Paper are shown curves relating to observed rectified current with the square of the virtual value of the signal E.M.F. They are all straight lines so long as the applied E.M.F. does not exceed 1·3 V (R.M.S.).

The rectified current from a 1 V signal is almost independent of mean grid potential over a wide range, and the rectified current is nearly $16\mathcal{E}^2$. The anode current characteristic of an "R" valve is very nearly a parabola and is therefore given by the equation:

$$i_a = \alpha + \beta v_g + \gamma v_g^2$$

If the signal much exceeds about 0·5 V (R.M.S) the terms involving $\mathcal{E}^4 . d^4i_a/dv_g^4$, &c., assume importance; but that if the signal is less than 0·5 V the rectified current varies very closely as the square of the signal strength. If, therefore, a constant weak signal is applied

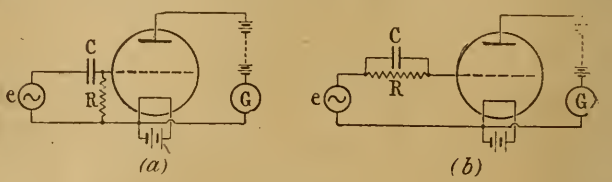


Fig. 2.

and the rectified current is measured with various mean grid potentials, it should be possible to deduce the value of d^2i_a/dv_g^2 for any mean grid potential.

Cumulative Grid Rectification.

In the method which goes under the name of cumulative grid rectification the grid is partially insulated by the insertion of a "leaky" condenser, as in Fig. 2. The signal current is now the change of mean anode current accompanying change of mean grid potential due to rectification in the grid circuit. The method is well known, but its quantitative theory has not been clearly set out. It is best approached graphically, as the significance of the necessary approximations made is then more clearly appreciated. The two methods of connection shown in the figure are electrically equivalent, and in each case the steady non-signal grid potential is found from the simultaneous solution of the equations.

$$i_g = f(v_g) \text{ and } i_g = -v_g/R$$

The shape of the grid current curve $f(v_g)$ is such that its analytical treatment is impracticable, and the solution can best be found graphically as shown in Fig. 3. The steady grid potential is given by OA, the abscissa of the point of intersection B of the grid and resistance characteristics.

Function of the Condenser.

The function of the condenser in the two methods of connection is slightly different. In Fig. 2 (*a*) its function is to interrupt the circuit RCe so far as steady currents are concerned; and C is supposed to be so large that the alternating current flowing through it produces no sensible alternating P.D. across it. In other words the full-signal E.M.F. may be considered to be applied between grid and filament. In Fig. 2 (*b*) the function of C is to provide a high-frequency shunt across R, so that again the full signal E.M.F. may be considered to be applied between grid and filament. The alternating potential of the grid makes the mean grid current increase; and since, in either method of connection, this increased current must flow through R, the mean grid potential is thereby lowered. The accompanying reduction of mean anode current is utilised to operate an indicating instrument.

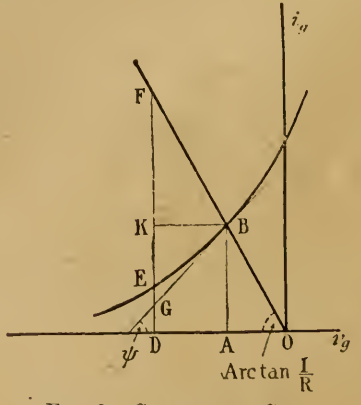


Fig. 3.—Cumulative Grid Rectification.

Theory of the Method.

Suppose that the E.M.F. applied to the grid produces a rectified current I_r. Find a point F on the line OB such that the intercept FE of the ordinate FD between the resistance line and the grid curve is equal to I_r on the scale of the diagram. The new mean grid current is DF, which may be analysed into two parts, FE

* Abstract of a Paper read before the Wireless Section of the Institution of Electrical Engineers.

called the rectified current, and FD the steady grid current associated with the new mean grid potential OD. The fall of mean grid potential is evidently DA, and hence the fall of mean anode current is $DA \times \frac{di_a}{dv_g} \equiv g \,.\, DA$.

The method checks closely with careful experimental verification. The fact also arises that it matters little whether the leak is connected to the positive or negative end of the filament, provided only that R is large, say at least 5 megohms.

The function of the condenser is that of a high-frequency shunt. In order to keep the time-constant of the circuit as low as possible, the capacity should be kept as small as is compatible with its efficient action as a shunt.

The condenser may safely be reduced to (say $50\mu\mu F.$; and as the equivalent resistance of grid and leak in parallel is about 1·5 megohms, the time-constant of the circuit can be reduced to about 75 micro-seconds. With these values, if signals of 3 000 metres wave length are being received, the signal current will attain its calculated value in about 40 periods.

In the circuit of Fig. 2 (*b*) it is possible to omit the condenser altogether. In this case calculation gives :

$$S = 55\mathcal{E}^2 \text{ if } \frac{di_a}{dv_g} = 300 \text{ micro amperes per volt.}$$

TABLE I.

Strength of signal $\mathcal{E}$ volts (R.M.S.).	Signal current in micro-amperes, with		Ratio.
	Anode rectification.	Cum. grid rectification.	
$<0{\cdot}1$	$16\mathcal{E}^2$	$500\mathcal{E}^2$	30
0·25 to 2	$16\mathcal{E}^2$	$150\mathcal{E}$	5 when $\mathcal{E}=2$
>10	$100\mathcal{E}-800$	1 000	1 when $\mathcal{E}=20$

These values may not appear to agree to the results obtained with practical wireless receivers, and this is due to the effect of a number of factors which are distinct from those now treated.

Anode Rectification with Heterodyne of Moderate Strength.

With the signal potential difference $e = a \sin pt$ and the superposed heterodyne potential difference $b \sin qt$, the amplitude of P.D. across the rectifier varies between $(b + a)$ and $(b - a)$ at an acoustic frequency small compared with the wireless frequency $p/2\pi$. Hence the high frequency mean of the anode current ranges from

$$\tfrac{1}{4}(b+a)^2 \,.\, d^2i_a/dv_g^2 \text{ to } \tfrac{1}{4}(b-a)^2 \,.\, d^2i_a/dv_g^2$$

The signal current is therefore

$$\frac{1}{4}\frac{d^2i_a}{dv_g^2}\left\{(b+a)^2-(b-a)^2\right\} = ab\frac{d^2i_a}{dv_g^2} \text{ as before.}$$

But the formulæ

$$\text{mean } i_a = \tfrac{1}{4}(b \pm a)^2 \,.\, d^2i_a/dv_g^2$$

are applicable only for values of $\mathcal{E} = (b + a)/\sqrt{2}$ up to about 2 V, and over this range for an "R" triode d^2i_a/dv_g^2 = constant $\doteqdot$ 32 micro-amperes per volt per volt. Hence the best signal current with a weak signal (namely, when $b + a \doteqdot b$ is adjusted to be about $2\sqrt{2}$ V) is

$$S = 128\mathcal{E} \text{ micro-amps.}$$

Anode Rectification with Very Strong Heterodyne.

The signal current tends towards the value $0{\cdot}45g \times \sqrt{2}a = 0{\cdot}90g\mathcal{E}$ as the heterodyne strength is increased, provided that the filament emission is adequate to prevent Q from reaching the convex upper end of the curve.

In most "R" triodes g is about 300 micro-amperes per volt; so that with a very strong heterodyne we have a signal current

$$S = 0{\cdot}90 \times 300\mathcal{E} \text{ micro-amps.}$$
$$= 270\mathcal{E} \text{ micro-amps.}$$

This value is to be compared with the value $128\mathcal{E}$ found in the last section for a heterodyne amplitude of 2 V. It is thus clearly worth while to use a heterodyne of adequate strength. A heterodyne strength of some 15 V would be suitable, and would give a sensitivity slightly exceeding the above $270\mathcal{E}$ micro-amps.

Cumulative Grid Rectification with Heterodyne.

Owing both to uncertainty as to the equation of the i_g/v_g characteristic and to difficulties of the integration involved in the cumulative action, it is not possible to write down an expression for the instantaneous anode current, as has been done in the case of anode rectification.

Admitting a number of assumptions,

$$S = Kab = \sqrt{2}Kb\mathcal{E}.$$

The value of K already found for a small potential difference on the grid is, for an "R" triode, 1 000; and if we take $b = 0{\cdot}14$ V, which is the highest value for which the formula is applicable, we get

$$S = \sqrt{2} \times 1\,000 \times 0{\cdot}14\mathcal{E} \text{ micro-amps.}$$
$$= 200\mathcal{E} \text{ micro-amps.}$$

If on the other hand b lies between 1 V and 5 V, the mean anode current (from Fig. 19) fluctuates between $150(b + a)/\sqrt{2}$ and $150(b - a)/\sqrt{2}$. Hence

$$S = 150\sqrt{(2)}a \text{ micro-amps.}$$
$$= 300\mathcal{E} \text{ micro amps.}$$

Comparison Between Anode and Cumulative Grid Rectification.

TABLE II.

Strength of heterodyne (volts, R.M.S.).	Signal current in micro-amperes, with		Ratio.
	Anode rectification.	Cum. grid rectification.	
0·1	$6\mathcal{E}$	$200\mathcal{E}$	30
2	$128\mathcal{E}$	$300\mathcal{E}$	2½
>15	$270\mathcal{E}$	Very small.	Very small.

Taking an example of rectification by curvature of the anode characteristic in comparison with damped waves of a frequency "n" of 10^5 periods per sec., decrement "δ" 0·1, and 500 sparks per sec. "x," the signal strength is only one-fortieth of what it would have been had the wave been undamped and of maximum value equal to the first maximum of the damped train.

The ratio of signal current when working with heterodyne to signal current when receiving a damped train of the frequency and decrement already stated is $(200a) \div a^2/5 = 1\,000/a$. If, for example, a has the value 0·1 V, this ratio is 10 000[1].

Probably a fairer comparison is between undamped waves and spark trains having the same R.M.S. value, rather than the same initial amplitude. The R.M.S. value over one spark period of the damped train $e = a\epsilon^{-mt} \sin pt$ is

$$\mathcal{E} = \tfrac{1}{2}a\sqrt{(x/n\delta)}$$
$$= \tfrac{1}{2}a\sqrt{(1/20)} \text{ in the numerical instance}$$
$$= 0{\cdot}11a$$

The signal current with a heterodyned undamped signal of this strength is therefore

$$S = 270\mathcal{E}$$
$$= 270 \times 0{\cdot}11a = 30a$$

The ratio $1\,000/a$ found for equal initial amplitudes thus becomes, for equal R.M.S. values,

$$30a/(a^2/5) = 150\,a$$

With $a = 0{\cdot}1$ V as before, this ratio becomes 1 500.

In the largeness of this figure, it is suggested, lies the chief explanation of the much superior ranges of continuous-wave transmitters as compared with spark transmitters of equal radiated power.

DISCUSSION.

In opening the discussion Dr. W. H. ECCLES thanked the authors for entering and enforcing order in a chaotic subject. He proceeded to show that for a theory based upon the static characteristics with constant anode potential there was a simpler method than that used by the authors, which avoided the use of Taylor's theorem. He pointed out the dangers of arguing from low frequency to high frequency. The apparatus in the anode circuit had a great effect at high frequencies. The authors had, by the use of a low frequency, grasped an ideal set of conditions but they had not proved that their theory fitted the high frequency case. He expressed his pleasure at the precision of meaning and good English used in the Paper and wished that patent specifications more frequently exhibited these qualities. The Paper, both in matter and in style, was worthy of the University of Cambridge.

Reaction or Slope.

Prof. C. L. FORTESCUE said that at first sight the Paper confirmed already accepted views, but the figures given showed much greater differences between different methods than were found in practice to be the case. This might have been due to the authors' reliance upon the static characteristic. Probably the reaction between

portions of the circuits which almost inevitably took place in ordinary receiving sets had more effect than the slope of the characteristic curves. Reaction in a receiver would draw out a damped wave train and so reduce the difference between them and C.W. There was controversy over the relative efficiencies of cumulative grid-leak *versus* anode rectification. Grid rectification did not respond to as large variation as anode rectification. The authors did not seem to have considered rectification at the top of anode characteristic curve. By combining cumulative grid rectification with rectification at the top of the curve there was a distinct gain in sensitivity.

Mr. J. Hollingworth queried the effect of the time constant of the grid circuit for cumulative grid rectification and Mr. F. J. Chambers gave particulars of experiments he had carried out to show how the anode potential actually behaves.

Mr. L. B. Turner claimed very little credit for his share in the Paper. He had only made suggestions for work to be carried out.

Rectification.

The Chairman (Prof. G. W. O. Howe) appreciated the Paper and its discussion. It was a good thing to have a variety of Papers and the present one came between two which contained no mathematics. Referring to the author's remarks on assymetric conductors he questioned the use of the word rectification and whether they were getting real physical rectification. Prof. Fleming's patent specification claimed rectifying properties due to the electrodes being in different states. The current could pass in one direction, but not in the other. Nevertheless, it was a fact that in use the Fleming valve had an anode battery and did not operate under conditions in which there was any attempt to pass current in a reverse direction. He (Prof. Howe) had used two hot filaments as electrodes, and thus made the device symmetrical. By the use of an anode battery he had obtained rectification by curvature of the characteristic curve. If he were to criticise a very excellent Paper it would be on the grounds of its absolute disregard of any previous work. Van der Bijl had shown the characteristic curve to be a parabola and had done much of the work covered by the Paper. Barkhausen also had done useful work. The Paper should have indicated what was old and what was new.

Mr. E. B. Moullin, in reply, engaged Dr. Eccles in argument over processes of mathematical expansion, and questioned whether the ordinary sets mentioned by Prof. Fortescue used voltages so negative as those of which the Paper treated. It was important to note that the Paper aimed at elucidating the problems only of plain rectification. He objected to Mr. Turner's modest disclaimer of credit for the Paper. His help had been very valuable.

The Institution of Electrical Engineers.

At the meeting of the Institution of Electrical Engineers on March 30, Mr. R. Borlase Matthews read a Paper on "Electro-Farming," which was illustrated by cinematograph films. Attracted either by the interest of the subject or the call of the pictures, the attendance was rather larger than usual. Considering the stuffiness of atmosphere that sometimes occurs in the lecture theatre, a praiseworthy attempt at ventilation was made by keeping all the doors open until the proceedings started. The attempt was certainly successful, as it was an hour later before we began to feel comfortably warm.

On the conclusion of the Paper and cinematograph demonstration, which together took about an hour, the President announced that the discussion would be adjourned until the following Thursday so that the speakers might have full scope. The lantern operator, who is usually so deft and speedy, on this occasion started Mr. Matthews' slides at the wrong end, and was only after some difficulty and long-distance elocution persuaded to alter his procedure.

All-Electric Milk.

Passing from theory through illustrative practice to actual practice, Mr. Matthews exhibited a bottle of milk which he said was the first supplied in this country by all electrical methods. The cows which produced it had been fed by electrically-cut roots, had been milked by electrical machinery, the bottle had been cleaned by an electrically-driven brush, and the cap had been fixed by heating a small quantity of casein electrically to form an efficient seal.

Unrelieved Pessimism.

Mr. Llewellyn B. Atkinson, in opening the discussion, said that in considering the desirability of adopting electricity as a motive power on farms, the small output in pounds sterling which could be obtained from a certain area of land and the small amount of time that any machinery would be required to work in a year must be remembered. For the seven years' cycle ending 1914 the average income per acre per annum from farms in this country was £5 15s. A large majority of the farms were less than 150 acres in extent, so that the revenue would be between £750 and £1 000 per annum. All the threshing on an ordinary farm in a year could be done in about thirty hours. The author placed the consumption of a farm of this kind at about 1 500 kWh per annum, with a maximum demand of 3 kW. That meant about one and a half hours' use of the maximum demand per day, and a total consumption of 4½ kWh per day. It must be remembered that for such operations as Mr. Matthews described, the small petrol and paraffin engine was a close competitor with electricity. Such an engine would cost about £16 a year for fuel, a sum that was the sort of revenue a supply undertaking might expect to get from such a consumer. If they took the author's figure of 4d. a unit the Supply Company would get £30 or £40 a year, but figures which had been given before the Agricultural Commission showed that the earning power of a 150 acre farm was only £112 a year, so that every item of expenditure had to be carefully considered. Another difficulty was that the number of men employed on a farm was so small that unless one could be dispensed with altogether a great deal of saving was not achieved. He thought the greatest use of electricity on the farm was to be found in electro-culture. Here the difficulty again was that the consumption was so small that no supply undertaking would want to be troubled with it. If, however, it increased the crop production to an appreciable extent the farmer would be tempted to adopt it.

The Electrical Engineer as Farmer.

Mr. Bernard Jenkin was even more pessimistic than Mr. Atkinson as to the economics of electric driving on farms, this attitude being the result of seven years' experience as a farmer. He gave detailed figures showing the useful hours worked by horses in ploughing and other farm operations, and the useless hours worked in hauling empty carts and going to and from work. For such operations it seemed to him electricity was eminently unsuited. Electric ploughing equipment, for instance, would have to be hauled about the farm by horses and would take considerable time to instal in the various fields, an operation which would have to be repeated about every two days. On the other hand a steam plough or a tractor could move from field to field by its own power, and, while he agreed that electricity was useful for driving machines in or about farm buildings, a small oil engine did it just as well. His remarks about electric ploughs were equally applicable to electric threshing machines, which had to be taken into fields, and it was more economical to use a common threshing machine or silo cutter than for each particular farm to purchase one. As regards the electrification of crops, the difficulty was supporting the overhead wires. Production depended more on the farmer than the methods used.

Mr. Ayton in a New Role.

Mr. Frank Ayton, appearing in a new rôle, gave a short lecture on the design of plough-shares. It was a fallacy that the higher the speed of the plough the better the production. There was a well defined limit to the speed at which land could be economically ploughed, for as the speed was increased the pull required increased in a very much greater proportion. Increasing the speed also meant an increase in the size of the plough breast, so that while a breast 6 ft. long would be necessary at three miles an hour, that length would have to be doubled at four miles an hour. No demand for electric ploughs existed at the moment.

Electro-Culture in Practice.

Mr. J. E. Newman agreed that petrol was a formidable competitor to electricity for almost all jobs on the farm. Turning to discuss his own subject of electro-culture, Mr. Newman said he had first been attracted to the subject by Prof. Lemstrom's book, published by the proprietors of The Electrician. Very complete experiments which he had undertaken in Warwickshire over a period of ten years showed that by the use of electro-culture an increase in the crop production of over twenty per cent. could be obtained. This included one year of drought when there was no increase. These figures had been confirmed by the Electro-Culture Committee, but he did not regard them as the maximum increase that could be obtained. The point to notice was that it was possible to over-stimulate the crops, and it was also an open question whether in a dry

year negative electricity might not give better results than positive.

An Unusual Retort.

The hour had been late when Mr. Newman started, and was still later when he showed no signs of concluding. The President suggesting that some consummation might be advisable, Mr. Newman retorted that he was not used to that sort of thing. Perceiving the combined horror and amusement among the audience he hastened to explain that he did not refer to being pulled up, but to public speaking, and added that the best thing he could do was to sit down. This he accordingly did, and the somewhat pessimistically-toned entertainment came to a conclusion at a late hour.

The Discussion Continued.

When the discussion on Mr. Matthews' Paper was resumed on Thursday, the 6th, though the attendance was much diminished, this was more than compensated for by the note of optimism sounded by the various speakers.

Perhaps this was due to the fact that the President announced that he was looking forward to hearing that electricity could be used on a large scale on the farm. Farming was a very old industry, and though we were apt to think that scientific methods in connection with it were a modern idea, they were in reality exceedingly old. The Institute for Research in Dairy Farming had issued instructions for the milking of cows and for the preservation of milk in a clean condition. The Bunyaro tribe in Central Africa had similar instructions, with the addition that failure to obey them was punishable by death.

An Optimist at Last.

After the author had exhibited some further slides of electric farming apparatus, Mr. H. W. Richardson said he had hardly recognised the Institution of Electrical Engineers at the previous meeting. Many of the troubles that had been enumerated had been overcome in other countries, and could also be overcome by British electrical engineers. The position of electro-farming was now much the same as that of electric cooking and heating a few years ago, and there was, in fact, no wider field to which the industry could devote its attention. There were 418,000 farms in this country, and if 60 per cent. of them used 2 kW for five hours a day, that would be 1 000 000 000 kWh per annum. The annual consumption of electricity in farm buildings alone on the Continent averaged 10 kWh per acre, which meant more than the total number of units supplied in this country in 1910. Among the advantages of electro-farming was the milking load, which came on early in the morning and late at night and was greater in the summer than in the winter. Electric fans in the cowsheds meant a great degree of cleanliness. Manufacturers should pay attention to switchgear. With regard to electro-culture, he was of opinion that it operated owing to some action on the ground, and experiments might be tried to see whether the ground itself before the crops were sown would be stimulated by wires placed close to it. Many farms made more than the £112 per 150 acres mentioned by Mr. Atkinson; and a great deal could be done by co-operation.

Mr. W. R. Cooper said the difficulty was the conservatism of the British farmer. He would want to know the actual results in £ s. d. In dealing with the plant at the Harper-Adams College the author had said the consumption was 1½ kWh per acre, but no time was given. To show the commercial value of electro-culture the author might give the normal yields of certain crops per acre, and the normal value of the crop might also be indicated, whether the increase was for a certain crop or generally through each year.

Electro-Culture on the Continent.

Dr. J. F. Crowley said that an examination of the electro-culture results obtained on the Continent would make for optimism, but Continental methods and machinery would have to be re-designed for use in this country. There was an increasing demand for power plant on the farm, and experience on the Continent had shown that where electricity supply existed it could meet that demand. In some parts of southern Germany almost every farm used electricity. In Germany a heavy type of plough was used, and in France a much lighter one, probably an intermediate weight would suit this country best.

Electric Pig Rearing.

Mr. H. A. Carney said that to obtain low prices and cheap living we must have efficiency, and he looked to an extended application of electricity as the best method of bringing about the disappearance of inefficiency in farming. Electric lighting permitted the prolonged feeding of animals, and would therefore produce greater results than electro-farming. It was equally useful in pig rearing, where it was a great advantage to reduce the time, the pig being brought to maturity in four months instead of six, meaning a reduction in cost owing to the less consumption of food. The smallholder was in greater need of cheap power than the large grower, and electricity was the only sort of power that would fulfil his requirements. Even if such a man were capable of looking after a petrol engine, he would be spending time in engineering which would be better spent in farming.

Mr. L. G. Hyde said that when a suburban railway was electrified, more traffic was obtained, and the same result would be obtained in electrified farms, as experience in Germany and Sweden had proved.

Fact or Prophecy.

Mr. C. J. Hopkins said the Paper was a representation of what farms might be in the future, while Mr. Atkinson's remarks described what they were at present. If farmers could be induced to install electric lighting he was sure they would never want to dispense with it, and if one or two progressive farmers adopted electric working, the rest would follow. There was a chance for electric ploughing when the corn was shocked. Unbroken furrows were not required when ploughing was done to kill weeds.

Mr. E. K. Scott suggested that farmers might make their own nitrates by the arc process and so save themselves hundreds of pounds.

The Author's Reply.

The Author, in reply, said that more than half the output of electric motors on the Continent since the war had been for use on farms. This country was the chief centre of distribution for agricultural implements for the world, and we should, therefore, be in the van as regards electro-farming. On his own farm the cost of one horse, including a proportion of the driver's time, worked out at £147 per annum, and electricity at 2d. per unit would have been cheaper for work to which it was applicable. The object of using electricity should not be to decrease the number of men, but to increase the produce by more intensive farming.

Books Received.

"The Structure of the Atom." By Stephen Miall. (London: Benn Brothers, Ltd.) Pp. 26. 1s. 6d. net.

"Marine Wireless Pocket Book." By W. H. Marchant. (London: Sir Isaac Pitman & Sons.) Pp. vii.+180. 6s. net.

"Model Questions and Answers on the Thermionic Valve." By Clifford Jones. (Glasgow: James Munro & Company.) Pp. 44.

"Kinematograph Studio Technique." By L. C. Macbean. (London: Sir Isaac Pitman & Sons.) Pp. xii.+109. 2s. 6d. net.

"Space—Time—Matter." By Hermann Weyl. Translated by Henry L. Brose. (London: Methuen & Son.) Pp. xi.+330. 18s. net.

The "Practical Engineer" Electrical Pocket Book and Diary. 1922. (London: Technical Publishing Company.) Pp. xcix.+610. 2s. 6d.

"Notes and Examples on the Theory of Heat and Heat Engines." By John Case, M.A. (Cambridge: W. Heffer & Sons.) Pp. 138. 7s. 6d.

"Electrical Engineering Testing." By G. D. Aspinall Parr, M.Sc. (London: Chapman & Hall, Ltd.) Pp. xii.+691. 16s. Fourth edition.

"Electric Accumulators, their Construction and Management." By Bernard E. Jones. (London: Cassell & Company, Ltd.) Pp. 152. 1s. 6d. net.

"Protective Relays. Their Theory, Design and Practical Operation." By Victor H. Todd. (London: Hill Publishing Company.) Pp. xii.+274. 12s. 6d.

"Physico-Chemical Problems Relating to the Soil." A General Discussion held by the Faraday Society. (London: Faraday Society.) Pp. 153. 10s. 6d. net.

"Land Magnetic Observations, 1914-1920." By L. A. Bauer, J. A. Fleming, H. W. Fisk, and W. J. Peters. (Washington: Carnegie Institution.) Pp. vi.+475.

"Year Book and Export Register of the Federation of British Industries for 1922." (London: Industrial Publicity Service, Ltd.). Pp. 454, 339 advertisements. 25s. net.

"Mechanical Testing." Vol. I., Testing of Materials of Construction. By R. G. Batson, M.I.C.E., and J. H. Hyde, A.M.I.C.E. (London: Chapman & Hall.) Pp. xiii.+413. 21s.

Report of the Inter-Departmental Committee on Methods of Dealing with Inventions made by Workers, Aided or Maintained from Public Funds. (London: H.M. Stationery Office.) Price 7d.

"The Dynamo: Its Theory, Design and Manufacture." Vol. I. By C. C. Hawkins, M.A., M.I.E.E., A.Amer.I.E.E. (London: Sir Isaac Pitman & Sons, Ltd.) Pp. xxiii.+615. Sixth edition. 21s. net.

The Properties and Uses of Micas.

A report on Mica Research covering the properties and uses of this material has now been issued by the British Electrical and Allied Industries Research Association. While a great deal of work has been done, and the investigation is by no means completed, as some of the results already obtained should be of immediate value, this report is issued.

Classification of Micas.

Great difficulties were met with owing to the absence of uniformity of nomenclature for the different kinds of mica. Considerable attention was, therefore, given to classification. The classification recommended by the Association is set forth in Table I., and it is urged that all investigators making tests on mica should adopt the nomenclature therein. Much of the work done in the past has suffered in value owing to the absence of adequate information as to the exact nature of the material tested. This will be appreciated when it is noted that the Association finds there are ten principal classes of mica and a large number of sub-varieties.

A large collection of representative micas has been prepared from materials supplied by F. Wiggins & Sons and Startin & Company, and the specimens have been named in accordance with Table I. This collection has been presented to the Institution of Electrical Engineers.

Table I.—*Trade Descriptions of Micas and Corresponding Characteristics.*

Class.	Mineralogical Group.	General Characteristics.	Relative Hardness.
Ruby	Muscovite.	Colour, pale reddish brown (ruby red in plates 15 mm. thick).	Hard.
Soft White	"Altered" Ruby Muscovite.	Slightly yellowish. Slightly calcined appearance.	Softer than ruby
Silver	"Altered" Muscovite.	Slightly calcined (silvery) appearance. Wavy surface.	Hard as ruby.
Green	Muscovite.	Inclined to have internal cracks.	In greater crystalline tension than ruby.
Brown	Muscovite.	Ditto.	Ditto.
Amber	Phlogopite.	Colour, very pale yellow to dark or opaque. Wavy surface. Great expansion at right angles to laminations.	Soft.
Altered or Silver Amber	Phlogopite.	Naturally altered amber. Colour same as unaltered amber, but more metallic. Silvery and opaque.	Softer than unaltered amber.
Black Amber ..	Biotite.	Very dark green or brown in thin sheets (about 0·003 in.). Black and opaque in thicker plates (0·01 and up).	More brittle than amber.
Lithia Mica ..	Lepidolite.	Light mauve, yellow gravish white or white. Will not stand heat and fuses at ordinary flame temperature.	Very hard and brittle.

Sub-Divisions.

Any class may, if required, be sub-divided as follows :—

Variety.		Quality.
Clear	Free from stains and spots (inclusions).	A. Free from all defects. B. Contains gaseous inclusions.
Slightly Stained	Free from spots (inclusions).	
Stained	Free from spots (inclusions).	
Heavily Stained	Free from spots (inclusions).	
Spotted	With solid inclusions.	

Specifications for Mica.

It has been found that the tests and characteristics required for mica which is intended to be employed for the various industrial uses have received very little attention in the past. It often happens, for instance, that the mechanical characteristics of mica are of a much greater importance than its electrical properties, but so far as has been ascertained these have seldom received much consideration, and there have been no generally recognised tests for mechanical properties. The suitability of the different kinds for high grade electrical work has never been investigated in a systematic way with a view to the definition of tests which can be applied for the purchase of materials for such purposes.

Specifications for mica too often fall back on the requirement that "only the best clear ruby mica shall be used," the obvious reason being the non-existence of any recognised tests to prove the suitability of the various classes of mica which might be available for the purpose in question.

In view of this absence of recognised tests, it has been found impossible to define with precision the test clauses suitable for a general mica specification, and the only course has been to schedule the principal uses to which mica is to be put, and for each of these uses to define the special characteristics required in the mica, leaving to further research the task of elucidating the standard tests to be applied for proving such characteristics.

Special attention has been given to the requirements of mica and micanite for commutators, and this is dealt with below.

Identification Tests.

Identification tests have been studied and are classified in Table II. A quantity of data has been obtained, but further study is required.

Preliminary researches have been made on the surface hardness of different varieties of mica, and whilst these tests are not promising as a means of classification according to kind, they may be of value in classifying according to use. Hardness and other mechanical tests are receiving further attention.

Table II.—*Identification Tests for Micas.*

The following are identification tests which may be supplied to micas described in Table I. :—

Calcining	Temperature at which calcination occurs.
Colour Characteristics....	Colour by diffused daylight (through thickness 0·5 mm.) in a direction normal to plane of plate. Nature of surface. Foreign matter (inclusions).
Optical	Axial angle and relation of its plane to the plane of symmetry. Percentage absorption of light.
Chemical	Nature of surface after acid treatment.
Electrical	Dielectric constant (Sp. Ind. Cap.). Dielectric loss.

Selection of Micas.

The numerous uses of mica in the electrical industry, as, for example, in commutators, condensers, sparking plugs, and pyrometers, have been classified, together with the appropriate characteristics so far as these are known.

A study of the above has already shown that certain kinds of mica are peculiarly suitable for certain purposes, and that the range of kinds suitable for some purposes is larger than has been recognised. Preliminary suggestions are made in Table III. which should prove of immediate service, but much further research is necessary to complete the schedule and to establish definite limits for purchasing purposes.

Table III.—*Micas Suitable for Specified Purposes.*

Commutators.	
Flush Segments	Amber and Silver Amber. Green and Brown.* Certain Grades of Soft White.
Undercut Segments	Any sound micas which will cleave readily.
Rings and Cones	Black Amber.*
Wrappings, Channels, Tubes and Washers.	
Extra High Tension	7 000 V and over: Ruby Clear A and B. Below 7 000 V: Any mica not spotted.
High Frequency	
Condensers.	
High Frequency ..... (above 2 000)	Ruby Clear A. Green or Brown Clear.* ,, ,, B, not considered suitable.
High Temperature Purposes.	
Spark Plugs	Ruby Clear, Ruby slightly stained or stained.*
Pyrometers	Green or Brown.* Ruby Clear A, and possibly other micas.*
Furnace Work	*Insulation:* Any mica which has the necessary mechanical characteristics. *Arc Resisting:* Muscovite where mechanical requirements predominate. Phlogopite where ability to resist great heat is required.
Heating and Cooking	Muscovite where mechanical requirements predominate. Phlogopite where ability to resist great heat is required.
Mechanical and Optical.	
Diaphragms	Lithia mica. Ruby Clear A.†
Windows and Spectacles .	Any clear mica.
Dials, Vanes, and Compass Cards.	Any uniform flat mica.

* Subject to research.

† Subject to research, especially in regard to fatigue.

Mica and Micanite for Commutators.

The leading manufacturers of commutating machinery have furnished full information of their practice and experience, and this has been reviewed in detail. A number of representative large users of commutating machinery have also been approached, their experience ascertained and opinions carefully sifted, As a result the Association is now able to present a comprehensive statement of facts ascertained. It is doubtful if any further conclusions can be reached on the evidence now available, but the Association has still in hand experimental work which should throw further light on some of the problems which have to be faced.

Commutator Segment Separators.

Pure Mica.—The material used for pure mica commutator segments is mostly stained and spotted, brown and green, light and dark in colour. Soft white and amber is also largely used. Separators in one length are obtainable up to about 16 in. or more, but on first cost it pays to use built-up material or micanite when the length needed exceeds about 6 in. In the smaller sizes pure mica is cheaper than micanite.

Built-up Mica.—With built-up separators, the pieces being stiff, a good deal of adhesive is required, and it is questionable if there is much benefit as compared with the use of a micanite specially made for the purpose. The built-up segment is preferred by some designers who have had trouble with micanite. It is essential to use a minimum of adhesive so that the material shall not " give " when hot.

Micanite.—Micanite separators should not contain more than 2 or 3 per cent. of adhesive, whereas ordinary micanite may contain 10 to 15 per cent. The micanite is made from clear mica, and from amber mica where called for. There is no reason why micanite for separators should not be made from spotted and stained mica, supplies of which are readily available. The price of clear mica is 100 per cent. more than spotted and about 25 per cent. more than stained.

Flush and Undercut Mica Separators.

Some makers undercut all commutators, but flush segments are still largely employed, especially on small machines, where hard brushes are used. Commutation on most modern machines is so good, that the machine may run for years on the first undercut. On important machines, however, where soft brushes are generally to be found, some makers use soft separators, so that, even if the commutator is worn down and undercutting is neglected for a time, trouble will not ensue, and are willing to pay the extra cost of amber mica to ensure this result. Where flush separators are used, the buyer sees the material is uniform and not too hard. The danger from hard spots is greatly reduced where the separators are built up in any way. Further research is in hand on the abrasive hardness of mica in order to determine what micas will give satisfaction with flush separators.

Mica versus Micanite.

From information obtained from large users and leading manufacturers of commutating machinery, the following conclusions have been arrived at with regard to the relative merits of the use of pure mica, built-up mica or micanite.

All three kinds of separators can be obtained finished to a sufficient degree of accuracy for the purpose. In general * 1 mil can be guaranteed without difficulty on mica segments and * 2 mils on built-up mica and micanite, but micanite is bought also under guarantee of * 1 mil. Pure mica makes the best mechanical job, is less liable to flake or change under the influence of heat. Micanite properly compressed and with a minimum of adhesive is successfully and extensively employed in both large and small machines. It is cheaper, except in small sizes. The cost per square foot varies but little with the size, so that in large sizes considerable saving may be effected. It is less liable to give trouble through hardness and is free from hard spots. Difficulty has been experienced where oil has got on to the micanite as the oil and adhesive together get carbonised, necessitating taking the commutator apart to remedy the defect. This applies also to built-up mica. This trouble, however, is one within the province of the designer to remedy and the user to avoid.

Rings and Cones: Materials Employed.

Rings are sometimes made up of the more flexible grades of mica butt-jointed or lap-jointed, but micanite is the principal material employed, the cones being built up from suitably cut pieces stuck together and pressed hot into shape. The adhesive left in may be of the order of 10 per cent. The thicker splittings are cut from block, but the thin splittings are the regular article of commerce.

Thin Splittings.

Splitting of Indian mica is more cheaply done by Indian labour, before shipment to Europe. It is a trade developed solely for the electrical industry, and the tendency of the individual buyer to play for safety in a matter over which he has no control and imperfect information, has resulted in the supply consisting almost exclusively of clear mica, whereas for many purposes there is no doubt that stained, spotted and dark coloured material could be used with considerable economy in first cost.

The Association is not prepared to make definite recommendations until the results are available on the nature and incidence of inclusions and impurities in mica from the electrical standpoint, showing their effect as conductors on breakdown voltage, surface leakage and dielectric losses. Research on this is now being put in hand.

Belfast's New Electrical Engineer.

Belfast City Council have appointed Mr. Johnstone Wright, M.I.E.E., of Bradford, to the post of city electrical engineer and business manager, at a salary of £1 400 per annum, in succession to Mr. T. W. Bloxam, who has retired on superannuation. There were five candidates on the short list—Mr. Wright, Mr. P. J. Robinson (Liverpool), Mr. C. W. Salt (Carlisle), Mr. Edwin E. M'Kenzie (chief engineer of staff of Charles P. Sparks & Partners), and Mr. Robert Owen (Wigan). Mr. Robinson withdrew his application, having made a new arrangement with Liverpool Corporation.

Mr. Wright received his general education at Perth Academy and his technical training at Glasgow Technical College. He served a five years' apprenticeship with D. Stewart & Company, Glasgow, passing through the various departments of their works, including the pattern shop, outside erection, and drawing office. In 1903 he left Glasgow to join the staff of the British Electric Plant Company (Alloa) as testing engineer, and was subsequently promoted to take charge of outside contracts. He was appointed assistant electrical engineer to the Oban Corporation in May, 1905, and held this position until December in the following year, when he joined the staff of the Cleveland & Durham Electric Power Co. This company were then just about to commence giving supply, and during the following thirteen years Mr. Wright filled several important positions with them, and took an active part in the whole development. He supervised the erection of five waste-heat power stations and large extensions to coalfields stations, including the Newport station, Middlesbrough, which was the first station erected to operate entirely upon exhaust steam by any public service undertaking in this country.

When the Newcastle-on-Tyne Electric Supply Company acquired a controlling interest in the Cleveland Company, Mr. Wright was appointed superintendent engineer for the ten power stations operated by the Cleveland and Durham Company, and held this position until September, 1919, when he was appointed chief assistant electrical engineer at Bradford. In June, 1920, he was promoted to the position of deputy city electrical engineer, since when the plant has been practically remodelled throughout and large extensions have been made, including the installation of two 15 000 kW turbo-alternators. A third set has been provided for, and will be ordered in the near future. A complete new boiler house is at present under connear future.

The Ignition of Fire-Damp.

After the reading of a paper on " Stainless Steel " by Lt.-Col. H. Rhodes, before the Midland Institute of Mining, Civil and Mechanical Engineers at Barnsley on Saturday, there was a discussion on Prof. R. V. Wheeler's recent paper on " The Ignition of Fire-Damp." Replying, Prof. Wheeler said that there was a need for further experiments on a larger scale, so that they could know one way or another whether it was possible to get an ignition of fire-damp by means of frictional sparks. With regard to the suggestion that the flame lamp was a danger, it did not follow as a natural law that they must exclude the flame safety lamp. The inventor of an electrical device for the detection of fire-damp (Mr. Williams) had brought his apparatus into a convenient and practical form. It had already proved capable of accurately indicating the presence of fire-damp, and was, therefore, quite a suitable substitute for the flame lamp. The only point against this was that this form of electrical fire-damp indicator would only show the fire-damp if this was looked for, whereas the flame lamp gave warning of fire-damp.

The members spent the morning in visiting the works of the Ceag Miners' Supply Company, Ltd., manufacturers of electric safety lamps for mines. This firm, which has been in existence for three years, was originally a German concern, the shares of which were bought by the present company from the Public Trustee. It is now an all-British firm, with Messrs. R. J. Plummer and C. A. Longbottom as directors. At the Barnsley and their other works the company turn out 700 lamps complete a day.

Salford's Electricity Supply.

Salford Town Council have agreed, on the recommendations of the Special Committee appointed to reconsider the question, to continue with the erection of the super-generating station at Agecroft, a suggestion of the Lancashire Electric Power Company to obtain a bulk supply from Manchester's Barton station being rejected. It has also been decided to retain the services of Mr. J. A. Robertson as engineer to design and construct, &c., the new station at an inclusive remuneration of £14 000, plus travelling expenses. Mr. Roberston is also to be retained for twelve months, as from the 1st inst., as consulting engineer in connection with the existing electricity undertaking, at an inclusive fee of £500, plus travelling expenses.

OBITUARY.

Sir John Benn, Bart., D.L., J.P., L.C.C.

We greatly regret to announce the death, on Monday, April 10, of Sir John Williams Benn, Bart., D.L., J.P., L.C.C., of "Stone Wall," Limpsfield, Surrey.

Sir John Benn, "Father" of the London County Council, and Chairman of Benn Brothers, Ltd., was seized with hemorrhage of the brain on March 31, and succumbed ten days later to pneumonia. He was in his seventy-second year.

Eldest son of the Reverend Julius Benn, Sir John, who was born at Hyde, in Cheshire, started his business life in London as an office boy, and rose to be the head of the firm of Benn Brothers. Ltd., the Leader of the Progressive Party in London, Chairman of the London County Council, Deputy-Lieutenant for the County of London, a Baronet and a Member of Parliament. His career in Parliament was confined to the years 1892 to 1895, when he represented St. George's-in-the-East, and 1904 to 1910 when he sat as the member for Devonport. He was the last survivor amongst serving members of those who were elected in 1889 to the First London County Council, of which Lord Rosebery was Chairman. Twelve months ago at a luncheon given in his honour as "Father" of the L.C.C., his thirty-two years of municipal work was referred to in a message from the King, which expressed His Majesty's interest and pleasure at hearing of the recognition of Sir John Benn by his friends and admirers for his long service in the government of London.

Sir John Benn, Bart.

A Romance of Journalism.

When questioned about the foundation of the firm of which he was the head, Sir John Benn always attributed it to his love of drawing. The story of the inception and launching of "The Cabinet Maker" in 1880 is, indeed, little short of a romance, the more so because of the complete justification which later years brought to the young enthusiast who had, in fact, sacrificed all he possessed to an ideal. As a youth John Williams Benn recognised the importance of cultivating his artistic talent, and by studying at South Kensington and devoting most of his youthful leisure to the subject he acquired a very thorough knowledge of architecture, decoration, and furnishing. To supplement his abilities on the technical side he served successively as draughtsman, salesman, manager, and eventually partner in a large furniture manufacturing concern. During this time he was a constant contributor to "The Furniture Gazette," and reviewed and illustrated the furnishing side of the Paris Exhibition of 1878. He subsequently abandoned cabinet manufacturing for journalism. It was a bold step and regarded at the time by cautious friends as highly imprudent, but it was characteristic of Sir John, who all his life had a habit of taking risks in pursuance of cherished ideals. Those were the days of the worst features of Victorian furnishing, and the young journalist consistently advocated a return to tradition and a development of the eighteenth century work of Chippendale, Heppelwhite, and Sheraton.

At the outset most of the illustrations in "The Cabinet Maker" were the work of Sir John's own hands, and he was later joined by his brothers Julius Taylor Benn and R. Davis Benn, both of whom have passed away, and Mr. H. P. Benn, who survives him. They devoted their attention to the business which their elder brother had founded, and left him free for his municipal and Parliamentary activities. Sir John lived to see the business which he established grow to be the largest trade and technical publishing house in the country. He had, in spite of the calls on his time made by his public work, found time to inspire, if not to direct, constant fresh developments in the firm of which he was the Chairman.

Expansion of the Business.

In 1900 "The Hardware Trade Journal" was purchased, and immediately became a power in the industry it represents. This was followed at short intervals by "Marine International Engineering" and "The Export World." Among the properties which have been acquired may be mentioned "Ironmongery," "Commercial Intelligence," and "El Comerciante." More recent developments include the acquisition of The Electrician, "The Fruit Grower," "The Gas World," "Farm and Home," "Gardening Illustrated," and "The Chemical Age." Side by side with the growth in the trade and technical journal publishing business there has also been developed a very large business in the highest class of technical and art books. This department first confined its attention to the well-known series of standard books dealing with electricity, gas, horticulture, cabinet making, and aeronautics, but more recently it has published fine art books in every branch of science, technology, and art.

A Pioneer of London's Tramways.

Apart from his connection with the electrical industry as proprietor of The Electrician, Sir John Benn will best be remembered by our readers as an ardent advocate of electrical tramways for London. For initiating and carrying through a forward policy for a municipally owned system, he displayed all his talents of enterprise and vision and soon succeeded in bringing London level with other large cities in this respect. It is not to be wondered at that many of the necessary changes were only effected after considerable controversy. The adoption of the conduit system was admittedly at that time an experiment, while the trolley system had been well tried out. The former was also more costly, and at first its operation gave considerable trouble. But, taking into account the special conditions of tramway working in London, it may now be said that the experiment was justified.

Sir John Benn's name will also be remembered in connection with his denunciation of the surface contact system, which was experimentally adopted in the Mile End Road against his advice. Certain letters which he addressed in 1908 to the *Times* and *Daily Chronicle* on this subject involved him in a libel action with the inventors. A special jury awarded the plaintiffs £12 000 damages, but Sir John was successful in having the verdict set aside in the Court of Appeal.

Connection with the Argentine.

Sir John Benn travelled widely and took a leading part in the Argentine Centenary Celebrations in 1910, traversing the whole of the continent to the Pacific coast. He was frequently abroad at the art centres on the Continent in search of material for the pages of the journal which he founded.

In the year 1874 he married Lily, the youngest daughter of the late John Pickstone, of "Silver Hill," Hyde. There were three sons and two daughters of the marriage. Of the former Mr. Ernest J. P. Benn, the present managing director of Benn Brothers, Ltd., succeeds to the title, Captain Wedgwood Benn, M.P., D.S.O., D.F.C., is Member of Parliament for Leith, while the youngest son, Captain Oliver Benn, was killed in Gallipoli in 1917. Lady Benn, who survives Sir John, has been an enthusiastic supporter of his public work.

Those of us who carry on the business which Sir John founded have sustained a great blow by the loss of his inspiring personality. He was amazingly versatile, successful not only as a newspaper proprietor and publisher, but in many other walks of life as well. During his allotted span of life he has played his part as a designer, playwright, lecturer, artist, journalist, sportsman, as one o the most energetic political personalities in London, and as the friend of hundreds of people who will sincerely regret his loss.

The funeral will take place at noon to-day (Thursday) at Limpsfield, Surrey. A memorial service will be held at the same hour at Christ Church, Westminster Bridge Road, London.

Correspondence.

TRAMWAY CHANGE-OVER ARRANGEMENTS.

To the Editor of THE ELECTRICIAN.

SIR,—During a recent trip abroad my attention was drawn to the very simple arrangements in use in the streets of Paris for changing from the underground conduit system to the overhead trolley. This seems such an improvement on the practise in and around London that I am astonished it has not been adopted by the London County Council.

At the present time many, I was going to say most, of the streets in Paris are under reconstruction in some way or another, and this necessitates the diversion of the trams off the centres of the boulevards and main streets for longer or shorter detours. There are also many points where the overhead and underground systems meet all round the centre portion of the town.

There is also, at least, one point where the cars cross from the south side of the river on to the Place Notre Dame, where they not only carry overhead collecting and conduit gear, but are also fitted with batteries to pass over certain gaps between the two systems where neither are possible. Here if I am not mistaken it is customary for the "skate" to be entirely taken off the cars at points of change over, and this occupies some time.

In Paris at each of these connecting points the conduit is provided with two hinged doors operated by a "point" lever. On the car coming to rest the man in charge of the points takes the controller key from the driver, opens the doors which are now under the body of the car, disconnects the skate electrically by means of a switch on the under side of the car for which he has a key, and with another key raises the skate till it lies parallel under the car, by means of a worm or rack, so that the skate is still fixed to and carried by the car, but clear of the track in every way. Meantime the conductor has released the trolley and got it on to the overhead wire. The key is then given back to the driver and he can proceed. The whole business takes less time than it has taken to describe and I repeatedly timed it at between 30 and 35 seconds from the time of stopping to starting again.

The men did not seem to be hurrying themselves in the least, and frequently found time for a joke, especially when the conductor was a woman as was frequently the case.

I do not know if this letter is of sufficient interest for you to publish it, but I should like to know how it comes about that we are so backward in our developments on the conduit system which I believe was first introduced in London.—I am, &c.,

Watford, April 8. M. J. E. TILNEY.

New Railway Rates for Electrical Goods.

For some time past the Railway Rates Advisory Committee of the Ministry of Transport has been considering the NEW RAILWAY RATES CLASSIFICATION proposed by the railway companies, and has been hearing objections by various traders concerning particular classes of goods. Under the present classification goods are divided into eight classes, leaving out of consideration exceptional rates in special cases, and the railway companies now propose that there should be twenty classes, Class 1 being the lowest rate, the rates increasing as the numbers progress. The question of the general classification of machines and machinery has been before the Committee, and after careful consideration it has been decided that machines and machinery should be charged at the Class 12, 14 and 16 rates, i.e., Class 16 for consignments of less than 2 tons. Class 14 for consignments between 2 and 5 tons, and Class 12 for consignments of more than 5 tons. This leaves it open for objections to be made in respect of particular goods.

During the hearing of a number of objections on Thursday, April 6, MR. BROADBENT, of the British Electrical and Allied Manufacturers' Association, brought up the question of iron-clad switchgear and meters for electric lighting and power. In the first place, with regard to the switchgear, he asked for concessions with regard to packing. With the development of the trade, he said, various descriptions had crept into the classification which were causing considerable confusion between railway companies and traders. The B.E.A.M.A. considered it was time for grouping certain types of articles under the one generic heading of iron clad switchgear Owing to the increased pressures now employed, and the very severe conditions imposed upon the electrical trade by insurance companies, the Home Office, and the Board of Trade, switchgear was now very much more robust than when first classified. This branch of the industry had grown tremendously of late years, and the Association had collected data from the principal manufacturers over a period of twelve months, which showed that the traffic in iron clad switchgear during that period was 15 752 tons. The average rate per ton was £3, making a total of £47 256 paid in carriage. The claims on that amount of switchgear were only £504 5s. 1d., or 1 per cent. of the amount paid in carriage, and the bulk of the goods were carefully packed. Switchgear provided good loading, up to 4 or 5 tons per truck, and the traffic was of a regular character. The Association suggested that there should be an entry in the new classification for "iron clad switchgear, with or without meters, Class 18." The shipping companies had agreed to class switchgear for use in connection with dynamos and motors as electrical machinery. Therefore, the Association would have been justified in claiming the machinery rates for switchgear from the railway companies. Mr. Broadbent explained that non-recording meters to-day were carried at Class 3 rates, equal to Class 18 in the new classification, and recording meters at the present Class 4 rate. The trouble was that when a switch was sent with recording meters—iron clad switch gear was at present in Class 3—it would have to be sent at a higher rate.

MR. PIKE, representing the railway companies, said that apparently they were asked to include meters with iron clad switchgear. He pointed out that meters were delicate pieces of machinery, and it was not reasonable that they should be included with switchgear, which was less damageable.

MR. BROADBENT, dealing with meters, said that the trade suffered severely from American and Continental competition. The Association had obtained information from ten of its members who specialised in meters, and had found that in twelve months 740 000 instruments had been sent, representing a tonnage of 3 100. including packing. The average rate was £3 per ton, making £9 300 paid in carriage. Owing to the very efficient methods of packing the claims for damages on that amount did not exceed £50, or about half of 1 per cent. of the freight cost. The railway companies proposed that meters should be in Classes 19 and 20 in the new classification, for the non-recording and recording types respectively. This represented an increase on the present rates, and he contended that the rates should not be raised. He handed to the Chairman a number of meters to show that they were quite strong, and not very liable to damage.

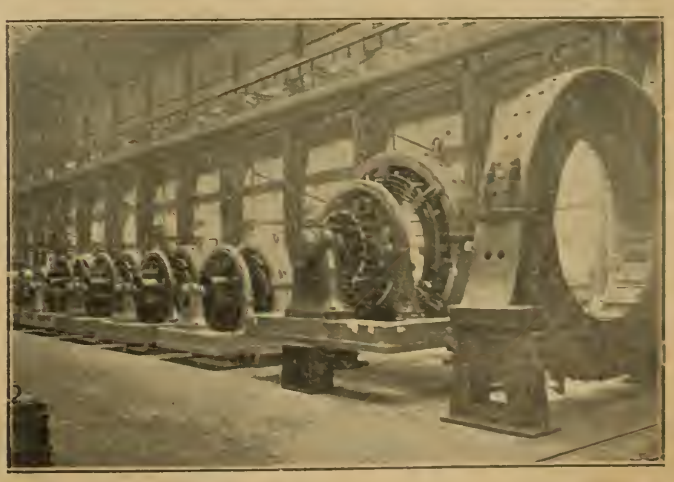
MR. PIKE said that the meters were first put into Class 3 of the present classification. The companies had applied to the Board of Trade, who had put them into Class 4, the entry being "Electrical Instruments for Electric Lighting and Power." The railway companies had asked for Class 5.

THE COMMITTEE said the classification should be maintained in both cases. Switchgear, iron clad, sent without meters, should be at the rate proposed by the railway companies, but with meters they should go at a higher rate, as proposed by the railway companies. With regard to the meters themselves, these should be in Classes 18 and 19 for non-recording and recording respectively, and not 19 and 20, as proposed by the railway companies.

English Electric Rotary Converters.

The illustration shows a number of rotary converters in various stages of construction. The frame on the right-hand side belongs to a very heavy current low-voltage machine designed to give a supply for rolling-mill work. The armature belonging to it can be seen at the extreme left-hand side of the photograph. This is designed to carry about 6 000 A, and the special double commutator construction can be clearly seen.

Next to the frame of this machine are a number of parts of a 1 500 kW machine for municipal service, designed to run at 428 revs.



A GROUP OF ENGLISH ELECTRIC ROTARIES.

per min., and still further to the left can be seen machines of 1 100 kW, 1 000 kW, 500 kW, 250 kW, and 200 kW.

In addition to the above, four or five more machines were running on the test bed at the time the photograph was taken, varying in output from 1 500 kW down to 200 kW.

We understand that the ENGLISH ELECTRIC COMPANY intend to build all their rotary converters for industrial or municipal service at the Siemens works, Stafford. Another part of the same works is devoted to the manufacture of the whole of the a.c. and d.c. switchgear for the rotary converters, while the step-down transformers for working in conjunction with the converters are manufactured by the company at their Coventry works.

Industrial Research.

The several researches undertaken by the British Electrical and Allied Industries Research Association are now reaching the stage at which a number of reports and technical publications can be announced, and several more will shortly be available. The publications on insulating materials include one giving instructions for the study of untreated papers for purposes other than cable manufacture. A full account of the researches on which these instructions are based is also to be published. In addition, there are similar reports upon the mechanical and physical testing of press-boards, press-spahn, &c., and on vulcanised fibres. The electrical testing of fibrous insulating materials is covered comprehensively by another publication; the scope of the research on electrical tests of all these materials is being extended to include standardised methods suitable for all insulating materials. Sheets, rods and tubes of composite insulating materials are dealt with in another publication. The researches upon which this is based have already proved of great value to the co-operating manufacturers, and marked improvements in their products are reported; a full account of these researches will shortly be issued. Work on the composite class of insulators (still under consideration), include the evolution of test methods for fire and heat-resisting properties, the practical application of these methods to materials on the market, and work on moulding properties and on the action of solvents and hot oil.

Synthetic Resins.

The Committee on synthetic resins has prepared a technical publication giving directions for the study of synthetic resin varnish-paper and varnish-fabric boards, and also reports on the possibility of establishing and safeguarding in this country manufacture of raw materials for these resins. Other work in this section includes a report on the requirements of Government Departments with reference to synthetic resin products, and tests upon moulded products. Samples of varnish-paper and varnish-fabric boards and of moulded products are being collected.

Mica for Condensers and Commutators.

The uses of mica for condensers and commutators is the subject of a report issued by the committee on mica and micanite. The report deals with the classification, identification and properties of mica; investigations are still proceeding on the mechanical and electrical tests of various kinds of mica. Steps have been taken to clear up the existing confusion in the classification, manufacture, and use of micanite, by bringing in close touch all parties interested in this material.

Insulating Oils.

The researches on the electrical strength and resistivity, and on the thermal properties of insulating oils are progressing. The former are to be carried out in close co-operation with Professor J. A. Fleming at London University, where a programme of research has been mapped out. In addition to these specialised researches on insulating materials, the general researches on dielectrics are being actively pursued. New work in this direction includes an investigation of the cathode ray tube as an instrument for the measurement of dielectric losses at high frequencies, and an examination of these losses at high voltages by the use of an electrostatic wattmeter.

Conductors.

Three reports are in preparation in the section dealing with conductors. The first will clear up outstanding points on the heating of buried cables, except dielectric loss problems; the second report will suggest material improvements, arising out of tests on standard wood poles for overhead lines. The third report in this section will treat with test results obtained on long overhead copper cables; the work on aluminium and steel cables is nearing completion.

Electrical Control Apparatus.

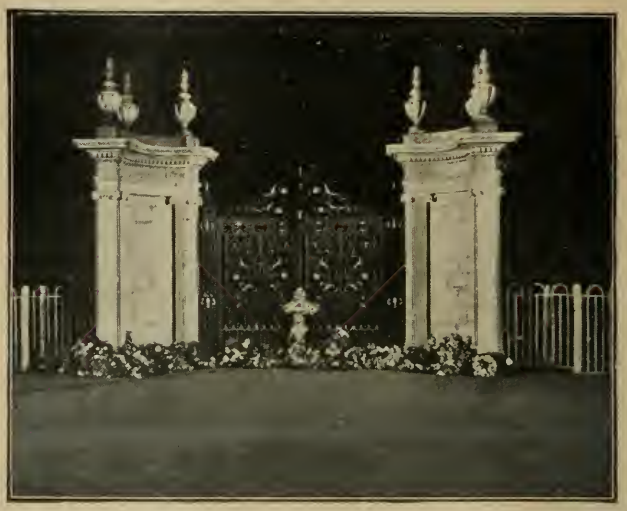
Several valuable researches, on a practical scale, are progressing in connection with electric control apparatus. These include tests on oil circuit breakers (for which the 6 000 kW alternator has now been prepared and its characteristics determined), on mining switch gear, fusible cut-outs and air-circuit breakers for d.c. This last research has the practical co-operation of the London County Council and the London and North-Western Railway Company, Ltd. A forthcoming paper by the National Physical Laboratory is also announced, giving the results of tests on the conductivity of joints in copper and aluminium bars.

Turbine Blading.

Recent researches on stainless steel have necessitated a revision of the programme previously mapped out for research on turbine blading. Good progress is reported in the tests on turbine nozzles at Manchester University. It is interesting to learn that Professor Callendar is undertaking researches on turbines and on the properties of high-pressure and high-temperature steam. Amongst the miscellaneous researches and new enquiries undertaken by the Association may be noted tests on the relation of the permissable variations of supply voltage to "flicker" of incandescent lamps, conferences with Government Departments on accumulators and batteries, and researches on the wave-form of generators. A full review of the progress of all the activities of the Association may be found in the Quarterly Progress Report for April.

Rugby War Memorial.

For three nights after the recent unveiling by Field-Marshal Lord French of the War Memorial Gates at Rugby they were flood lighted by the British Thomson-Houston Co. The lighting was particularly effective in this case, as, by day the beauty of the gates, owing to their surroundings, is liable to be overlooked. For the lighting, two B. T.-H. Floodlight projectors, equipped with



Rugby War Memorial Gates.

"Mazda" gasfilled lamps were employed, and to avoid any unevenness of light which might be caused by the reflection of the lamp filament diffusing mirror reflectors were used, which, in addition to reflecting the light, break up the rays in such a way as to eliminate striation. To keep the illumination within the limits of the monument, each projector was fitted with a spill shield—a device specially designed to give a definite cut-off to the beam.

The Greater London Scheme.

We regret to notice that attempts are being made by some of the local authorities in London to organise opposition to the draft scheme of the Electricity Commissioners for the Supply of Electricity in Greater London. A private conference was held at the Town Hall, Bermondsey, on Friday last, to which the Borough Councils of Poplar, Bethnal Green, Stepney, Hackney, Southwark, Woolwich, Shoreditch, Camberwell, Deptford, Greenwich, Lambeth, Lewisham, Stoke Newington, and Bermondsey; the Town Councils of West Ham and East Ham; and the Urban District Councils of Walthamstow, Ilford, and Leyton were invited. The agenda included consideration of the scheme, and also the steps necessary for securing the reversal of: (1) Over representation of private companies, (2) the complete ignoring of the claim for Labour representation, (3) the failure to examine the advantages which may accrue if the existing undertakings were thoroughly reorganised, (4) the refusal of the Government to advance loans for schemes involving large expenditure of capital that are problematic regarding their utility, (5) the extension of tenure as part of the settlement with the private companies throughout London.

Some of those invited (including Stepney) did not attend, as it was considered that the existing conference of local authorities was the properly constituted body to deal with the question.

A Large Electric Steam Generator.

The Belgo-Canadian Pulp & Paper Company is, according to the "Electrical World," producing its process steam with a 20 000 kW electric steam generator; 60 000lbs. of water are being evaporated per hour with a thermal efficiency of 98 per cent., including losses, in 100ft. of piping. It is reported that the company is saving $4 000 per month with the new system, which saves 75 tons of coal a day. Installation costs (about $25 000) were 40 per cent. less than the cost of the coal-burning plant replaced. Three-phase, 6 600 V power from the Shawinigan Water and Power Company is utilised directly in the tanks. The amount of steam generated and the pressure and amount of power used are governed by the depths of immersion of the electrodes in the tanks. Already generators of this type, with a total rating of 100 000 kW, have been installed or contracted for, according to F. Hudson, president of the Electric Furnace Construction Company, Philadelphia, who thinks that the most important applications of electric steam generators will probably be in industries situated within convenient transmission range of hydro-electric plants. Where savings in initial cost, space occupied, and operating expense are important the electric steam generator will have, it is claimed, many points in its favour.

Latin-American Engineering Notes.

A commission of engineers has been appointed by the Bolivian Government to consider plans for the ELECTRIFICATION OF THE YUNGAS RAILWAY, in Bolivia. At present the line is of little importance, only two passenger trains and one freight train being operated daily. The cost of electrifying the line, with a view to future development, and providing 1 800 H.P., is estimated at 246 000 gold dollars (£49 200).

Work has almost been completed upon an electric plant in the city of Léon, Nicaragua, power being derived from a waterfall in the vicinity. The plant will supply all the streets and buildings with electricity.

In Ypacarai, Paraguay, an electric plant has been installed, the first of its kind, which it is hoped to duplicate in a neighbouring town at an early date.

The town of Comayagu, in Honduras, is completing an electric light and power station, while a contract has lately been entered into for the construction of a new radio station in the neighbourhood.

A new 536 H.P. 400 kW turbine has been added to the existing electric light plant installed at Maracaibo, Venezuela.

It is expected that the electrical plant of 2 000 kW capacity, under construction in Cardenas (Republic of Cuba), will be completed this month.

Satisfactory progress has been made with the erection of the two electric Gronwal furnaces, each of 3 000 kW capacity, now being installed by a Brazilian metallurgical company, which holds the exclusive Brazilian rights for this furnace.

After considerable competition, the contract for lighting the grounds of the Brazilian Centennial Exhibition has been awarded to the General Electric Company, of New York, the estimated cost being $1 000 000 (£200 000). The company's chief engineer (Mr. W. D. O'Ryan) is in Brazil, making the necessary arrangements for starting the work. Mr. O'Ryan directed the illumination services of the San Francisco Exposition.

An electrically operated converter plant for refining all the matte and copper blister on the spot, instead of shipping it abroad for refining, is being erected at Santa Rosalia, Lower California, at a cost of over $1 000 000 (£200 000).

In Costa Rica a contract has been signed for the purchase of land for the construction of an electric light and power plant for the municipality of Alajuela and the surrounding towns. The installation contract has not yet been awarded.

REUTER'S TRADE SERVICE.

London Traffic Reform.

A long report on the present position of the LONDON TRAFFIC PROBLEM was presented to the London County Council on Tuesday by the Highways Committee. The time is considered opportune for raising the matter again, inasmuch as the Treasury have agreed to guarantee interest on the capital which will be expended by the Underground Electric Railways Company of London on widening and extending the tube railways. The report deals at some length with the various efforts made by the County Council to improve its tramway system and to co-ordinate traffic arrangements in Greater London. Extracts from the reports of the Royal Commission on London Traffic, Select Committees, &c., are included, and statistics are also given of the passengers carried by the tramways, omnibuses, tube and other railways in order to show the importance of the facilities offered by the tramways and the effects of competition.

The Committee state that, although they have been influenced in submitting the statement with regard to the present traffic position in London primarily by reason of the announcement recently made of the guarantee proposed to be given by the Government to certain enterprises of the underground companies, they have also felt that on other grounds the time has arrived for seeking from the Government a clear declaration of its policy and intentions on a question that is all-important to the people of London. They regard the matter as one of such pressing urgency that they think the time has arrived when the Council should place the position before the Government, and ask it to take the matter in hand without further delay, without indicating in any precise way the action which the Council suggests should be taken to provide a remedy for the present difficulties. Therefore, they recommended that the attention of H.M. Government be again directed to the resolutions of the Council on the subject of London traffic arrangements; that the Government be informed that, in the opinion of the Council, the organisation of London traffic on satisfactory lines is endangered by the continued delay in adopting measures to give effect to the repeated declarations of Royal Commissions and Select Committees as to the pressing need for reform; and that the Government be further informed that the Council considers that the difficulty of reaching a settlement of the traffic problem as a whole will be enhanced by any steps that may be taken by the Government that have the effect of assisting particular traffic undertakings operating in London and the surrounding districts, without recognising the essential community of the traffic interests of the entire area.

The INTERNATIONAL RAILWAY CONGRESS, the first to be held since 1910, will take place at Rome from the 18th to the 28th inst. Every aspect of railway and light railway construction and administration will come in for consideration, and reports will be presented on the technical and financial sides of electric traction. There will also be papers and reports on permanent-way construction, locomotive design, signalling, &c.

Electrical Plant for Japan.

Referring to the recent large contracts secured by the Metropolitan-Vickers Electrical Company, in connection with the electrification of the South African railways, a correspondent of the "Manchester Guardian Commercial" states that: "Further large contracts could be secured if British firms would turn their attention to Japan. The greatest open market in the world to-day for high-grade electrical apparatus lies in the project of the Japanese authorities for the ELECTRIFICATION OF THE IMPERIAL GOVERNMENT RAILWAYS and in the schemes for hydro-electric developments throughout the empire. The estimated cost of these plans is $1 000 000 000 (gold).

As Japan may be unable to carry the load of financing these huge new industries there is a hope in Japan that past successful Anglo-Japanese co-operation will now be reciprocated in part by British participation in financing the projects. The Japanese promoters are ready to offer bonds paying 10 and 12 per cent. on the investments, which are both substantial and stable.

Water power is not a new experiment in Japan. It has been utilised for centuries in a primitive way. Modern hydro-electric plants are now seen perched on the hillsides draining the maximum amount of power out of the many small but swift rivers. Over 1 000 000 kW are furnished from this source for railways and industries. Even when this amount of energy is enormously increased as planned it will not, according to Mr. Kyuchi Hasegawa, chief of the Rivers Section of the Home Department, supply enough power to dispense with coal for power purposes."

According to the "Yokohama Chamber of Commerce Journal" the Electricity Bureau of the Department of Communication has reported a striking development of the electrical industry in Japan in 1921. In the investment in the industry there was an increase up to the close of October of approximately 166 million yen.

At the end of October, 1921, there were 830 electrical enterprises including 728 electric power supplying concerns, 52 electric tramways and railways, and 50 other companies transacting similar business. The total number showed a decrease of four as compared with the close of 1920, which means the consolidation of electrical power supply companies during the year through merging, amalgamation, or the formation of trusts more or less in response to Official encouragement. Eleven plants were absorbed by larger interests in October alone. There was a decrease in the power generated during the year, however, attributed to the decrease in power consumption.

The Minister of Communication recently gave an exposition of his policy toward electrical enterprises in Japan, which was plainly meant to accelerate the combination of such enterprises. According to him, Japan's electrical industry stands out as one of the most prominent of all industrial lines in the country, it having absorbed capital to the amount of 1 600 million yen, while its capacity to supply power is up to 1 340 000 kW. It was beyond doubt that the combination of and systematisation of enterprises in the line was one of the prime conditions for its further development.

Having observed that his repeated utterances to urge their amalgamation had been well responded to, and that an increasing number of combination schemes were reported, he went on to remark that it was necessary to give greater impetus to this tendency among the electrical enterprises, while at the same time urging those engaged in the electrical industry to attain the prime object in view of those favouring combination by re-adjusting power transmission systems of management of plants, and thereby increasing their efficiency.

Electric Pumps in Marine Salvage.

Addressing the members of the BIRMINGHAM AND DISTRICT ELECTRIC CLUB on Saturday on the progress made during the war in the method of salvaging sunken vessels by means of electrical apparatus, Mr. V. H. Pearson gave as an example the transport "Admiral Cochrane," which was torpedoed by a German submarine off the South Coast of England. In this case the vessel had taken on a list of 33 deg., the whole of the after-decks being submerged. It would have been impossible to salve the ship by means of steam pumps owing to the degree of list. The electric pump could be lowered into the hold of the ship and could be kept running under water. The transport was lifted within seven days and placed on an even keel on the beach. After slight repairs in dry dock the vessel was put into commission again.

Resources of the Crown Colonies.

The Council of the BRITISH EMPIRE PRODUCERS' ORGANISATION have decided to appoint a Committee of representative producers from all the Crown Colonies and Dependencies to consider what steps should be taken: (a) To promote the development of natural resources and encourage the investment of British capital in the Crown Colonies; (b) To improve means of communication between the said Colonies and other parts of the Empire; (c) To re-adjust tariff arrangements so as to ensure that the products of such colonies in cases where import duties are imposed in Great Britain should be admitted on special terms, and that the tariffs of these colonies should be re-adjusted so as to give the largest preference possible to imports of goods produced in Great Britain.

In order to ensure effective representation on the Committee of the principal interests of the Crown Colonies some little time will be taken in selecting members.

Legal Intelligence.

Litigation Over Telephone Poles.

Last week the Railway and Canal Commission (Mr. Justice Lush, Mr. Tindal Atkinson, K.C., and Sir Lewis Coward, K.C.) heard an appeal by the Postmaster-General from a decision of Judge Crawford awarding an Essex landowner rental against him of from 5s. to 20s. each for poles on his property. The Postmaster-General said there were nearly a million poles on private property in this country, and, on the precedent of this decision, landowners had been sending in asking for 10s. for each pole, and the thing would create a revolution in the public service.

For the Postmaster-General, Mr. HAROLD MURPHY explained that the appellant (the Postmaster-General) sought a new trial of the case because of the fixation of rent of six telegraph poles on land of Mr. H. E. Brooks, of Stafford Lodge, near Grays, Essex. For three other poles Judge Crawford, at Romford, apparently said there should be no charge because, under a judgment of Mr. Justice Lush, those poles were upon a road. Counsel thought Mr. Brooks' main defence was that, having given up his right to the telephone owing to increased charges, he deemed himself entitled to exact a much heavier rental than the National Telephone Company, which paid 1s. a pole. The Postmaster-General contended that the rates he should pay should depend on the present damage, and there was no damage whatever to Mr. Brooks.

Mr. JUSTICE LUSH: So he is to be paid nothing? You are in occupation of his land. You cannot put up poles on somebody else's land and say, "You ought not to have any acknowledgment for the user."

Mr. MURPHY: I am given a statutory right to place poles on the land, and of coming to you if he fails to give consent. What you have to consider is whether such conditions as he seeks to impose are contrary to public interest. If there is no detriment or loss of amenity the imposition of any pecuniary payment would be contrary to public interest, and the imposition of a heavy rental would be ruinous to a public service.

Mr. JUSTICE LUSH: It would be contrary to public interest that you should pay him nothing. I dare say you would like to pay him nothing.

Counsel went on to explain that the judge's award worked out at 60s. for six poles. There were 818 000 poles on private property, and the average payment was 1s. 4d. Thirty per cent. were free; 95 per cent. were less than 1s. More was paid for telephone standards with stays on the top of buildings and in private gardens. The rent proposed would be a revolution of the whole system, and on its precedent landowners were coming in with demands of 10s. a pole.

For the appellant, Mr. CHARLES J. EVE said there were nine heads of damage under which he usually assessed damage, and in Mr. Brooks' case he could find no damage under any of them. The poles took nothing from the plough; they were in a wood; they hurt no grass, growing crops, fences, or hedges; there was no risk of telegraph men leaving gates open for cattle to stray; there were no gates; there was no game to be disturbed and no cover; no hedge to plash; no spoiling of commercial value, or any other damage, and as to unsightliness, there was no house near to see the poles. The only development value of the property was in minerals and forestry. If Mr. Brooks was going to build, quarry, or make an avenue he could give notice to have the poles removed.

Stating his own case, Mr. BROOKS contended that there was present damage, and that he should receive payment in respect of his interest in the land and its amenities. He was director of a cement company, and that chalk land would eventually be worked for cement. He had been in negotiation with his colleagues for the purchase of the property. When he gave the Postmaster-General notice to move the poles, three weeks passed and then he was presented with a polite bludgeon—told, in effect, "We will not get out and we are going to use our compulsory powers, and we give you notice accordingly." Such a threat of litigation did not attract a purchaser. He wanted to sell the estate as a whole, but if a purchaser shied at the telegraph poles 11 acres would be cut off from the property on the other side of the road, and he should be left with those 11 acres and £2 000 or £3 000 worse off than if he had sold it all. Nobody would buy the 11 acres for building. Ten shillings a pole was not adequate compensation for "putting this fear in the heart of a purchaser." If the Postmaster-General was presented with a notice to remove on account of quarrying he might be expected to be just as obstructive and litigious as now.

On the subject of the price paid for rents, Mr. J. SINNOT, engineer to the Post Office engineering department, put in returns of consents to the erection of poles.

In closing the enquiry, Mr. JUSTICE LUSH said the situation was an interesting one, and it was the first of its kind that the court had had since the Telegraph Construction Act of 1916. There was the question whether a capitalised sum should not be paid instead of rent. He understood Mr. Eve had mentioned a period of 16 or 20 years for capitalisation. The court desired to look into the matter, and, as that was the first case of its kind, judgment would be delivered next term.

Dawson v. Douglas.

This action, in which Sir Philip Dawson, M.P., sued Lord A. Douglas for libel, was mentioned to Mr. Justice Horridge on Monday, when it was announced that the parties had arrived at a settlement.

Mr. CROOM-JOHNSON (for the plaintiff) said that in August last Sir Philip Dawson was Conservative candidate for West Lewisham; the defendants were Lord Alfred Douglas, then editor of "Plain English," the directors of the North British Publishing Company, who published the newspaper, and Messrs. G. Holder & Sons, the printers. On Aug. 27 "Plain English" published an attack on Sir Philip, and the gravamen of the charges was that he was a naturalised alien and that in the course of his duties he advised people who consulted him, as an engineer, to employ persons who were not British subjects. Lord A. Douglas now assured him that at the time that the libel appeared he was away, and had no knowledge that the article was going to appear, and that he did not authorise or consent to it in any form, and this assurance the plaintiff had accepted. At the same time, Lord A. Douglas had recognised his responsibilities as editor and director, and in his defence he expressed regret that the article ever appeared. The other parties concerned apologised at once and paid a sum of money into court. It had been agreed that there should be judgment for Sir Philip Dawson for an agreed amount of damages and costs.

His Lordship.—The plaintiff's character has been absolutely vindicated, and judgment was entered on the agreed terms.

Parliamentary Intelligence.

Electricity (Supply) Acts.

The House of Commons has approved the following Special Orders made by the Electricity Commissioners and confirmed by the Minister of Transport in respect of the urban district of Amble in Northumberland; the parish of Distington, in the rural district of Whitehaven; the urban district of Ammanford; part of the borough of Wareham; the urban districts of Great Harwood and Rishton and the parishes of Wilpshire, Clayton-le-dale, and Ramsgreave, in the rural district of Blackburn.

Electricity (Supply) Bill.

The Committee stage of the Electricity (Supply) Bill was concluded in the House of Lords on the 5th inst.

VISCOUNT PEEL moved an amendment to Clause 10 (Power to continue way leaves) in order to reserve to railway companies the protection afforded to them under the Act of 1919. These were agreed to.

LORD MONK BRETTON moved a new clause to follow Clause 11, dealing with the power to make agreements as to working of generating stations, authorising the Electricity Commissioners by order to suspend for such period as they thought fit the powers of purchase of a joint electricity authority, or the London County Council, or any local authority in the case of any transfer or lease to a joint electricity authority of any part of an authorised undertaker's undertaking, provided that consent to such suspension had been previously obtained.

VISCOUNT PEEL accepted the amendment, and it was adopted.

Some other amendments were made, and the Bill was reported to the House.

Ayr Provisional Order.

The Ayr Burgh Provisional Order, which seeks power to extend the Corporation tramways and to carry out street improvements, &c., has been considered by a Parliamentary Commission (Lord Chalmers, chairman, Lord Meston, Sir Henry Craik, M.P., and Mr. J. A. Murray MacDonald, M.P.)

Mr. H. P. MACMILLAN, K.C., said the Order originally contained important provisions relating to the Loch Doon electrical scheme; but the Chairman of Ways and Means had directed that that portion of the Order should be dealt with by private Bill, as schemes for the supply of electricity for lighting and other purposes were not included in the topics with which the Commissioners might deal. The Order now consisted of nine portions, but the only portion which had aroused controversy was that dealing with tramway extensions and the widening of certain streets. It was proposed to acquire strips of garden ground in Carrick-road to enable that thoroughfare being widened to 46 ft., so as to permit the doubling of the tramway track. At present the traffic caused considerable congestion, and the doubling of the tramway track was dependent upon the widening of the street. By acquiring the land proposed is would be possible to have the statutory prescribed distance of 9 ft. 6 in. between the kerb and the nearest tram rail. The proprietors and occupiers were objecting to portions of their land being taken for widening the road. The maximum amount to be taken at any point was 7 ft. 8 in. The promoters had been advised that the tram rails in the thoroughfare must be relaid. It would be unfortunate if they had to relay the single rails again, and their opinion was that advantage should be taken of the opportunity to have the road put into a proper state. Several witnesses gave evidence in support of the Order, and ultimately the preamble was found proved.

Centre Poles for Princes-street.

Replying to Mr. W. GRAHAM, in the House of Commons on Monday, Mr. NEAL said that he had received the report of the Commissioners appointed to inquire into the tramway problem in Princes-street, Edinburgh, and he had decided to adopt the recommendation contained in it, namely, that the request of the Corporation for permission to put up centre poles to carry the overhead electrical equipment, and to alter the position of the rails on the northern side of the street, should be granted.

Electricity Supply.

HAWARDEN Rural Council have applied for a Special Order to extend the area for the supply of electricity under their 1914 Electric Lighting Order so as to include East Saltney, Higher Kinnerton, Hope, Llanfynydd, Sealand, and Tryddyn, and so much of the parish of Hawarden as is not included under the principal Order; to make new provisions as to maximum prices; and to authorise the Council to take a supply of electrical energy from the North Wales Power and Traction Company, or any other company, authority, or person. Any objections must be sent to the Electricity Commission by May 4.

The Mayor of Swansea on Thursday opened the new AMMAN VALLEY extension of the Corporation electricity department by switching on the current from the Manselton Sub-station. The new undertaking, which will provide power for the growing anthracite coal district of the Amman Valley and Gorseinon, will cost £45 000. Already the Gorseinon Electric Lighting Company, the Gellyceidrim, New Cwmgorse, and the North Amman (Cawdor) Collieries have contracted to take current to a guaranteed minimum of £11 000 a year, whilst an ultimate revenue of £25 000 is in sight. For a short distance the cables are underground, but overhead cables have been erected as far as Gellyceidrim Colliery in one direction and the Gorseinon Colliery in the other. When the system is extended right round the valley there will be a circular route covering about forty miles. The supply voltage is 33 000.

A petition, signed by a large and representative body of consumers of electricity for both power and lighting, has been forwarded to the Electricity Commissioners and the Town Clerks of Liverpool and Bootle, protesting against the proposed sale of the BOOTLE electricity undertaking to the Liverpool Corporation. The agreement has been signed by both corporations, and awaits confirmation by the Electricity Commissioners. The petitioners maintain amongst other things that the agreement leaves the future prices to be charged for electricity for private and public lighting and trade purposes in the absolute discretion of the Liverpool Corporation and does not provide for a cheap and abundant supply; and that if it is advisable for the two electricity undertakings to become a joint undertaking (which they submit is not necessary), then they should be worked on a partnership basis.

New Schemes and Mains Extensions.

MAIDENHEAD Town Council has applied for a loan of £5 300 for extensions to the generating plant.

An inquiry into the application of NAVAN Urban Council for a loan of £10 000 to carry out an electricity supply scheme is to be held by a Dail Eireann inspector in the Council Chamber on the 22nd inst.

KILMARNOCK Town Council have been granted a Provisional Order authorising them to supply electricity to places outside the borough, including the burghs of Ardrossan, Saltcoats, Kilwinning Stewarton, and Cumnock.

A scheme of extensions to GUILDFORD electricity undertaking, amounting to £20 000, has been drawn up by Mr. Spencer Hawes, consulting engineer, and approved by the Town Council. Application is to be made to the Electricity Commissioners for their approval and for sanction to borrow the money.

In connection with the loans of £40 000 and £12 473 sanctioned by the Electricity Commissioners, for plant and buildings in connection with STEPNEY electricity undertaking, the sums of £20 000 and £12 473 are to be taken up on loan from the trustees of the Union Savings Bank at £5 10s. per cent. per annum, repayable within twenty and thirty years respectively. The Council's scheme of extension at Limehouse generating station has been generally approved by the Commissioners, but they are of opinion that the extension should be limited to the installation of two 10 000 kW sets and boilers instead of three.

Alteration of Charges.

BOOTLE Electricity Committee have decided to reduce by 25 per cent. the additional charges made for electricity during the war. The reduction is to take effect from Jan. 1 last.

BURNLEY Electricity Committee have reduced the price of electricity supplied to the Tramways Department from 2·1d. to 2d. per unit. The charge will be again reviewed at the end of three months.

WATFORD Urban Council has reduced the price of electricity for power from 70 to 50 per cent. above the pre-war rate, and for lighting from 8d. to 6d. per unit, after the minimum number of units used during the summer and winter quarters.

The recommended revision of the charges for electric lighting and power in BELFAST have been approved by the Corporation. It is announced that the feared deficit of £38 000 on the last half-year's trading has been converted into a surplus of £16 000. This was chiefly effected by saving on coal charges and increased charges for current to consumers. The revised rate is as follows :—For lighting supply under maximum demand, first hour 8d. per unit as at present, but subsequent hours charge to be reduced from 7½d. to 5d. The general flat-rate charge is to be reduced from 8d. to 7d. per unit; for power, the charge is to be reduced from 6d. per unit for the first hour and 4d. afterwards to 5d. for the first hour and 2¼d. afterwards; for combined light and power, it is proposed to fix the charge at 2·4d. per unit, subject to a minimum consumption, the present price being 6d. for the first hour and 4d. thereafter.

Electric Traction.

LIVERPOOL Tramways Committee has received from the Ministry of Transport sanction to the borrowing of £132 200 for the reconstruction and doubling of the Liverpool and Prescot Light Railway.

A strong opposition is being offered to the RAILWAYS (NORTH-WESTERN AND MIDLAND GROUP) BILL, which enables the railway companies to run road vehicles, and its second reading in the House of Commons was only carried by five votes on Tuesday.

Ald. Higham, chairman of BLACKBURN Tramway Committee, stated last week that it was not proposed to revert to penny fares. Experiments in this direction elsewhere had ended in disaster, and if tried locally they would lead the department to bankruptcy.

By a majority of 13 votes, it was decided last week at a joint meeting of GLASGOW Tramways, Statute, Labour, and Lighting Committees to recommend that the electric standards in Great Western-road should be removed from the centre to the side of the roadway.

BLACKPOOL Tramways and Electricity Committee has decided to advertise for a successor to Mr. C. I. Baker, the chief traffic superintendent, who, as we announced in our issue of March 10, has been appointed general manager of the Ashton-under-Lyne Tramways. The Committee's report for February shows an increase of 117 440 units compared with last year. The Education Committee have made a grant towards the cost incurred by school children using the cars.

The Ministry of Transport has informed NEWPORT Corporation that the reasons given by the Corporation do not adequately justify their refusal to grant a licence to the South Wales Commercial Motors, Ltd., to run their Newport-Chepstow omnibus service to the centre of the borough. The Ministry consider the licence should be granted on conditions, one of which is that the terminal point of the company's service should be Clarence-place, Newport. The Tramways Committee have decided that their chairman should interview the Ministry of Transport on the subject.

Writing from PARIS last week, the correspondent of the "Daily Telegraph" states that reference to the death of M. Bulot, Procurer General, who was fatally injured by a vehicle when alighting from a tramcar, led to a discussion of TRAFFIC RULES at a meeting of the Municipal Council. The Prefect of Police said that all vehicles were required to proceed slowly past tramway halts, but he could not have police at every point to enforce the law. It is proposed to institute a system of signals to be applied by the tramway and omnibus companies, so that following traffic will be warned of impending halts.

The minutes of the Highways Committee, submitted to the LONDON COUNTY COUNCIL on Tuesday, referred to several tramway matters. It was agreed to apply the agreement of the 31st ult., between the Metropolitan Municipal Tramways Council, the E.T.U., and the Transport and General Workers' Union, as to rates of pay of electrical workers on tramways rolling stock work, to the employees concerned in the tramways department, including the light and power attendants in the permanent way branch. The revised rates will mean a saving of £4 950 a year. The following estimates were approved : £1 000 for the electric lighting of the central repair depot at Charlton, £1 500 for the provision of protective relays of a modern type on the tramways distribution system, and £1 985 for excess expenditure on the lay-by at Stamford Hill and junctions at Tooting Broadway and Stockwell.

Trade Inquiries.

A limited company established in TUNIS since 1901 desire to be put in touch with United Kingdom manufacturers of mechanical and electrical supplies, agricultural and industrial plant, building supplies, &c. Particulars can be obtained from the Department of Overseas Trade (Reference No. 395).

H.M. Trade Commissioner at WINNIPEG (Mr. L. B. Beale) has received an inquiry from Vancouver, British Columbia, for supplies of electric light meters. The annual consumption of electric meters used in Vancouver is stated to amount to about 5 000, delivery of which runs into about 400 per month all the year round. The type required is a bottom connected single-phase watt hour meter, the sizes ranging from 10 A to 800 A. The 10 A size is in greatest demand and now costs $8.75 laid down at Vancouver, all charges paid. The inquirers are anxious to receive in duplicate from United Kingdom manufacturers full particulars and lowest prices. Further particulars can be obtained from the Department of Overseas Trade.

A firm of mechanical and electrical engineers at MELBOURNE, with branches at Sydney and Adelaide, who represent United Kingdom manufacturers of electrical switchgear, are desirous of representing manufacturers of the following lines, viz. :—cables, and wires, lamps, a.c. and d.c. motors, insulating and jointing material, electrical porcelain, including insulators, consumption meters, dynamos and alternators, and general accessories. The firm are also desirous of acting as local agents for the presentation of tenders for Australian Government and Municipal contracts, being well accustomed to this class of service. A director of the firm is now in this country and will be pleased to discuss matters personally with firms who are interested. Application for names and addresses must be sent to the Department of Overseas Trade (Reference No. 379).

Personal and Appointments.

London County Council have appointed Mr. E. T. Bancroft motor school superintendent in the tramways department.

Mr. I. C. Brown, electrical engineer to the Oudh and Rohilkhand State Railway, has resigned his appointment.

Mr. H. Dickinson, Liverpool City electrical engineer, is to undertake the duties of city lighting engineer and official inspector of existing electric meters.

Our readers will join us in tendering to Mr. J. A. Robertson, borough electrical engineer of Salford, our sympathy on the death of his wife, which took place last week.

Mr. E. E. Hoadley, Maidstone, electrical engineer, has been re-elected one of the two representatives for the smaller towns of the country on the Council of the Electrical Development Association.

Mr. W. H. Wardle, principal assistant in the Liverpool Electric Lighting Department, has been recommended for an increase in his present salary from £300 per annum, plus E.P.E.A. bonus, to £350, plus Corporation bonus.

Mr. R. H. Pitts has been appointed to act as Staff Officer for the Underground Companies. He will hold this post in addition to his duties as Secretary to the Joint Standing Committee of the Companies.

The retirement in July is announced of Mr. H. J. Spooner, head of the Polytechnic School of Engineering, London, for the past forty years. A presentation is to be made to him, and old students desiring to contribute should communicate with Mr. F. R. S. Rice at the Polytechnic, Regent-street, London, W. 1.

Prof. J. A. Fleming has been compelled, on account of illness, to cancel all engagements for the present, and will consequently be unable to deliver the course of lectures on "Modern Improvements in Telephony" at University College, which has been announced to begin on April 26. It is hoped that Prof. Fleming will be able to deliver the course in October.

Business Items, &c.

The telephone number of the Sheffield Branch of English Electric and Siemens, Ltd. has been changed to Central 3 535.

As from the 1st inst. the address of Mr. L. B. Reale, H.M. Trade Commissioner at Winnipeg, is 703, Union Bank Building.

Owing to ill-health Sir Edward Capel Cure has resigned his appointment of commercial counsellor at Rome. His successor has not yet been announced.

Barimar, Ltd. are now granting licences to responsible engineering companies, founders, &c., to operate the Barimar Metallurgical (Patented) Process for recovering scrapped castings in their own shops.

C. A. Vandervell & Company have turned their magneto factory at Brighton into one for the production of small tools, the magnetos now being entirely manufactured at Acton, where all communications relating to these apparatus should be addressed.

Mr. Ralph M. Sitterley announces the establishment of his offices at 149, Broadway, New York, where he will act in the capacity of foreign sales manager of American manufacturers of electrical specialties, marine supplies, automotive products and equipment.

Institution Notes.

At the meeting of the Institution of Electrical Engineers on the 6th inst. the President announced that arrangements had been made for members to dine together at the Engineers' Club, Coventry Street, after the meeting on April 27, and he asked members who proposed to attend to send in their names beforehand.

Glasgow Electricity Department Engineering Society brought a successful session to a close on Monday evening, the 3rd inst., in the Lecture Room, 75, Waterloo-street, Glasgow, when a paper on "Heat Balance" was read by Mr. John Bruce. This paper won the prize offered at the beginning of the session by the management for the best essay on the subject named submitted by a member. The Society, which has a membership of 300, is serving a useful purpose in providing an opportunity for the discussion of those problems which confront engineers in the performance of their duties, and this cannot but be to the advantage of the members and of the department.

Obituary.

We regret to record the death of Dr. Andrew McWilliam, head metallurgical adviser to the Government of India from 1911-1920, and previously Professor of Metallurgy in Sheffield University.

The death took place at Sidmouth on the 7th inst. of Mr. J. J. Easton. Mr. Easton entered Siemens Brothers' offices at 3, Great George-street, Westminster, in 1868, at the age of nineteen, and remained with the firm and with the succeeding company—Siemens Brothers & Company, Ltd.—until June 30, 1919, when he retired. During this period of fifty-one years he was largely instrumental in furthering the growth of the company's business, and for many years had charge of its commercial organisation in relation to all classes of cables and telegraphy.

Telegraph and Wireless Notes.

A new telephone exchange to accommodate 400 subscribers was opened last week at Cambuslang (Lanarkshire). This is the third new exchange to be opened in the Glasgow district within a few months.

It is reported that negotiations between representatives of the Finnish and Swedish telephone administrations have resulted in a preliminary agreement, under which the two countries are to be connected by a cable between Helsingfors and Stockholm comprising nine lines.

Mr. A. W. M. Dyke, of Neath, delivered an address last week on "Elementary Principles of Telephony" at a joint meeting at the Wireless College, Cardiff, of the South Wales Wireless Society and the South Wales Section of the Permanent Way Institution of Engineers. Mr. W. M. Drysdale gave a wireless demonstration, and Mr. H. F. A. Sanderson, using his set, enabled the audience to hear signals from the large European commercial stations and music picked up from The Hague.

A dispute has arisen between the Association of Wireless and Cable Telegraphists, which has a membership of 5 000 to 6 000 (95 per cent. of the total of British wireless operators), and the London District Association of Engineering Employers, representing the shipowners and the wireless companies. The men's secretary states that, in addition to a reduction of wages, the telegraphists were to be called upon to perform "other duties" besides telegraphic work. They had attempted to get a definition and a conference, but only a vague reply was given which would leave them entirely at the mercy of the shipowners and the captains. The question of wages alone could no doubt be satisfactorily settled. The men had been instructed to refuse to sign on any ships, and already 300 to 400 men were "out."

Exhibition Notes.

It is proposed to hold an International Exhibition of Ideas, Inventions, and Discoveries at Amsterdam from June 24 to July 23.

In view of the interest at the present moment in the housing question, our readers will be interested in Stand 128, Row G, at the Building Trades Exhibition, where Vickers, Ltd., are exhibiting their portable concrete machinery, which includes brick machines, roofing tile machines, partition slab machines, and colour mills.

The first official commercial Fair to be held in Luxemburg will take place from Aug 14 to 22. The Fair is divided into thirty trade groups covering nearly every product except the heaviest metal goods Applications for space, forms for which are available at the Department of Overseas Trade, must be sent to the Organising Committee, by June 15.

A Bureau of Information will be maintained by the Trade Commissioner Service in Canada at the Annual Canadian National Exhibition which is to be held at Toronto from Aug. 26 to Sept. 9, and United Kingdom manufacturers are invited to send for free distribution catalogues of electrical machinery, appliances, and equipment, electrical railway equipment, chemical plant, scientific instruments, &c. Catalogues should be sent direct to H.M. Trade Commissioner, 24, West Adelaide-street, Toronto, not later than June 30. Firms who desire space at this year's exhibition should apply at once to the Secretary, Canadian National Exhibition, Lumsden Buildings, West Adelaide-street, Toronto.

Institution of Engineers, Australia.

At the Engineering Conference arranged by the Institution of Engineers, Australia, and held early in February, Prof. R. W. Chapman, one of the organisers of the Institution, was installed as its president for the current year. The annual report sets out the numbers of members in the principal towns in the Commonwealth, the total of all grades being 2 020. Mr. W. J. Newbigin, the retiring president, said, in the course of his presidential address, on the inauguration of the Federal Engineering Council, they might look forward within a short period, to having from four to five thousand trained engineers banded together for the technical and scientific development of their country. It was necessary to induce the younger men to join the Institution, and he suggested that employers should give a preference to members of the Institution. He contrasted the methods of engineers and politicians, saying that the former worked upon a basis of reason and calculation, while the latter depended for their success upon an appeal to the emotions. Engineers could do something towards improving Government Departments. Engineers had enabled Australia to reach her present position, and her future would also depend upon them. During the Conference the Lord Mayor received the members at the Melbourne Town Hall, and in the course of the meetings Sir John Monash (chief of the Victorian Electricity Commissioners) delivered a lecture on "The Victorian State Electricity Scheme." Mr. H. N. May read a paper on 'The Jolimont Workshops and Sub-Station "—a part of the Melbourne and Metropolitan Railway electrification scheme—and Mr. R. Lawson a paper on "The Collingwood (Melbourne) Automatic Telephone Exchange.'

The French Minister of Public Works is introducing into the Chamber a Bill authorising the construction, at l'Aber Vrach (Finistère Department) of a tidal power station.

Imperial Notes.

Work has been commenced on the carrying out of the St. George's (N.S.W.) County Council's electricity supply scheme for Bexley.

Electrical imports into South Africa last year amounted to approximately £2 000 800, compared with £1 680 000 in 1920 and £1 040 000 in 1913.

"The British and South African Export Gazette" states that there is a considerable demand in Dar-es-Salaam, Tanga, and other towns for electric lighting and heating apparatus.

The Customs Duty on electric light bulbs imported into British Honduras in now 5 per cent. *ad val* under the British Preferential Tariff, and 10 per cent. *ad val* under the General Tariff.

The Reid-Newfoundland Railway Company has withdrawn its proposition for extensive water-power development and the establishment of paper-making and other industries along the Humber river, on the West Coast of Newfoundland. The proposition called for Government guarantee of certain securities.

Bathurst (N.S.W.) Council have engaged Mr. R. J. Franki to report on the desirability and the best means of providing electricity supply for the town. The Council have approached the Kendos Cement Company with regard to a supply by the company, but this would necessitate transmission over about 50 miles.

During the nine months ended Dec. 31 last the total imports into India of electrical apparatus advanced from 2·43 to 3·35 crores. British shipments advanced from 1·81 to 2·32 crores, American from 0·39 to 0·71, and Italian from 0·04 to 0·14 crores. There was a falling off in imports from Japan.

The South Gippsland Creamery and Butter Factory Company's electric supply powers for Yarram (Victoria), have been transferred to the Yarram Hydro-Electric Company. A condition of the transfer is that the Hydro-Electric Company will bear the cost of substituting a.c. for d.c. motors on consumers' premises.

Tenterfield (N.S.W.) Council's electricity undertaking has not been paying its way. Mr. Corin, chief electrical engineer of the Public Works Department, has been consulted on the question of a hydro-electric supply for the district, and calculates that this could be provided by means of power from either Tenterfield Creek or Boonoo-Boonoo for an expenditure of from £30 000 to £35 000.

The chairman of the Electrolytic Zinc Company of Australia (Mr. W. L. Baillieu) states that the daily average output of zinc is 68 tons, and a production of 80 tons would be reached within the next two or three months by making arrangements with the Hydro-Electric Department for a further supply of power over and above the 15 000 h.p. now available. It is anticipated that the full 30 000 h.p. will be available in August or September next, by which time the Risdon plant would be completed and the production will be 120 tons daily.

Montreal Chamber of Commerce has ranged itself among the opponents of the St. Lawrence canalisation scheme. It is said that dual control of the scheme would probably lead to friction between the United States and Canada. The estimated cost ($252 728 2[illegible] exclusive of interest during construction and cost of improvements to ports on the Great Lakes) is so high that leading business houses are doubtful of the financial position. The standing charges on the Lake Ontario-Montreal section alone will amount to over $20 000 000 annually. More than 60 per cent. of the water-power available is on the Canadian side of the river, but all the proposed locks, dams, and other water-controlling devices will be placed on the American side.

Foreign Notes.

It is announced that the Siemens-Schuckert Werke, of Berlin, have made an arrangement with the Furukawa Mining Company under which the Siemens Company will construct a large factory in Tokyo for the manufacture of electrical machinery. Twenty German engineers, accompanied by technical experts, have left for Japan.

According to the "Journée Industrielle," Prof. Otto, of the Sorbonne, has invented a process for seasoning timber by the use of ozone. The process is said to give the same result in about 20 days as would naturally be obtained in the course of several years. The wood is subjected to the action of a current of air containing a certain percentage of ozone. Samples of oak and walnut, which have been treated by the process, are said to show the same characteristics as seasoned wood. The treatment does not change the colour of the wood. The Otto process is being worked by a French Company at Serengo, near Milan, but new works will shortly be built in the neighbourhood of Paris.

A correspondent of the "Times Trade Supplement" states that the representative of a British engineering firm, after making a tour of inspection of Mauritius sugar estates, has reported that a great saving would be effected if the owners of the factories made use of electricity generated by water power, instead of steam raised by coal, wood, or cane refuse for operating their machinery. He contends that "thousands of horse-power of electricity are going to waste and that this ought to be developed to electrify the Government railways and also to operate all the sugar mills from a central power station." The scheme drawn up by Mr. G. McAlpine, when he was Official Electrical Adviser, for the electrification of the local railways using the waterfalls at Tamarin as motive power, has recently been revived and is now engaging the serious attention of the authorities.

Miscellaneous.

The late Mr. H. S. J. Booth, managing director of the Electrophone, Ltd., has left estate valued at £6 929 (net personalty £6 030).

Mr. G. Washington Talbot, of Anerley-road, Penge, Postmaster-General and Director of Telegraphs, Burma, has left estate valued at £2 732.

In view of the need for economy in public expenditure it has been decided to suspend the post of commercial secretary (Grade II.) for Chile. The post will be closed on May 1.

The offer of a company to pay £5 per sign per annum for illuminated electric signs affixed to tramway and gas standards has been approved in general principle by the Swansea highway authorities.

Speaking at the annual dinner of the Institution of Mining and Metallurgy last week, Mr. W. C. Bridgeman stated that, in spite of the recommendations of the Geddes Committee, it had been decided not to abolish the Department of Mines.

Birmingham University has received from the Trustees of the James Watt Memorial Fund the sum of £5 000 towards the establishment of a Chair of Research in Mechanical Science, to be known as "The James Watt Chair."

The revenue from advertising on the Cardiff Corporation tramcars for the past year amounted to £3 161, an increase of over £1 000 on the receipts for 1920. The tramways manager has been authorised to rearrange the spaces let for advertising with a view to bringing in a still larger revenue.

The Select Committee of the House of Lords' Offices report, with reference to the suggestions in the third report of the Geddes Committee that the fees for private Bills should be increased by 50 per cent., that it is inexpedient to make any further increase in the ordinary fees for private bills.

A fatal accident occurred at the Worcester Electricity Works on the 8th inst., W. J. T. Whitehouse (26), a fitter's mate, being caught by a sprocket wheel on some shafting while tightening a "grub screw" in a "collar" on a rod which worked the grates. A verdict of accidental death was returned at the inquest.

Sir William Mackenzie, K.C., sat as an arbitrator appointed by the Minister of Labour at Cardiff, on the 4th inst., to investigate a claim by the employers' side of the South Wales & Monmouthshire Joint Industrial Council for the electricity supply industry for a reduction in wages of the skilled and semi-skilled men by 6s. a week and the unskilled men by 4s. Mr. Moxon, chairman of the Newport Corporation Electricity Committee, conducted the case on behalf of the employers, and Mr. J. L. Davis and Mr. F. Quick represented the interests of the employees. Sir William Mackenzie reserved his decision.

The Fuel Problem in Germany.

Owing to the internal industrial situation, it is interesting to see how Germany's power requirements are being increasingly met by the use of water and lignite. In 1913 about 75 per cent. of the whole of the electricity supply was produced by ordinary coal, water-power and brown coal (lignite) accounting for about 15 per cent. of the balance. It is now stated that only about 50 per cent. of black coal is used, the proportion of lignite having increased to nearly 35 per cent. The annual production of lignite in Germany was 111 635 000 tons in 1920, that of black coal being 131 428 000 tons. In eight or ten years it is calculated that, by an extension of existing hydro-electric stations, together with new water-power projects, it will be possible to generate 50 per cent of the whole of the power required for industrial and private uses and for traction by means of water-power alone. In Bavaria and the South German States hydro-electric developments will enable the use of ordinary coal for industrial work to be almost entirely dispensed with, and make possible the electrification of the whole of the railways of South Germany.

Forty Years Ago.

"The Electrician," April 15, 1882.

A Long Telephone Line.—News from America says that telephonic communication has been effected between Alpena and Bay City on the telegraph wire between those places. The line worked well, though the distance between the two cities is 130 miles.

American Patents.—An American contemporary says: "Taking the subject of electrical patents as a whole, the most activity has been exercised with the following during the past three years: 1, electric lights; 2, dynamo machines; 3, telephones and their appliances. Prior to Jan. 1, 1878, there were only twenty patents on electric lights; July 1, 1881, there were 192. Prior to July 1, 1879, there were only nineteen dynamo and magneto machine patents; July 1, 1881, shows 111."

Quick Work.—On Thursday last a letter was received by Messrs. Crompton & Company, electric light engineers, asking them to light Woolpit Church, in Norfolk, for Easter Sunday. The firm wrote on Thursday evening to their Norwich engineer, Mr. S. Baynes, giving the necessary instructions. He succeeded in taking over, installing, and getting to work a set of tackle, and the church was successfully lighted for the evening service on Easter Sunday. As Friday and Saturday were the only two working days, and as traffic was greatly impeded on those days by the holiday makers, this is smart work.

Companies' Meetings, Reports, &c.

Brush Electrical Engineering.

The thirty-third general meeting of the Brush Electrical Engineering Company, Ltd., was held on Monday at 88, Kingsway, London, W.C., Mr. E. Garcke presiding.

The secretary (Mr. F. M. Hodson) having read the notice convening the meeting,

The Chairman said that the directors were glad to be able to report a further substantial improvement in the general prosperity of the company. Including the amount brought forward from the previous year, they had a total profit balance of £374 585 to deal with. It was proposed to apply to depreciation of buildings, plant, patents, &c., £15 000, to pay a further 4 per cent. interest on the prior lien participating debenture stock, to add to the reserve fund £73 190, bringing it up to £150 000, and to pay a dividend on the ordinary shares of 15 per cent. for the year. The amount to be carried forward—namely, £214 074—was subject to the settlement of the excess profits duty for 1920 and previous years' income and corporation profits tax. The cash position was a strong one, and since the close of the year their liquid cash resources had been still further increased. Last year he mentioned that the directors thought it advisable, owing to change of values, to have a valuation made of the capital assets of the company, and he was glad to say that the valuation showed a considerable appreciation—nearly double the amount of the book figure.

Record Output in 1921.

They were fortunate in entering 1921 with a good order book, so that the trade depression which prevailed so generally during the year did not affect their activities in the same degree as those of many engineering undertakings. All departments of the works were fully employed, and although the deplorable coalminers' strike in the spring and summer of the year was a disturbing factor, they were able to carry on without serious dislocation, with the result that the output for the year was the largest in the history of the company. They were concentrating on specialities which, to some extent, placed them outside the rigours of extreme competition, and the greater the need for fuel economy in industrial enterprises, the greater was the inducement of users of electrical plant to install the company's Ljungstrom turbine. There was no doubt that last year some orders were lost, not because of the depression in trade, but because they were unable to quote sufficiently early dates for delivery. With the increased manufacturing facilities they had now provided this difficulty would be remedied to a large extent in the future.

At present they had a very substantial amount of work on hand, and with the anticipated revival of business they were justified in looking to the future with confidence, provided that the labour unions recognised the altered circumstances of to-day and settled down to production under conditions which permitted of successful competition for work both at home and abroad. If the members of the Amalgamated Engineering Union did not return to work soon it would become a question with many firms either of shutting down completely or endeavouring to replace the skilled men by training others to do their work.

Progress of the Brush Ljungstrom Turbine.

On previous occasions he had referred to the development of the company's Brush Ljungstrom turbo-generator plant, and had drawn attention to the change which the installation of this plant had brought about in the fortunes of certain electricity supply undertakings. The merits of the design were now generally recognised, and evidence of the economies which it effected in steam consumption continued to accumulate. Taking, for instance, the Loughborough Corporation Electricity Supply undertaking, which was equipped throughout with turbine plant of the company's manufacture, although some of it antedated the introduction of the Brush Ljungstrom type, this station, which had an output of 3 736 296 units sold in 1921, occupied the third most favourable place for low working costs in a group of 114 electric supply undertakings in Great Britain, having an output of between 3 000 000 and 15 000 000 units, and was first among such stations in the Leicestershire area. Of course, the bigger the output, the larger margin there was for saving on generation costs. An examination of the published lists of electricity supply undertakings disclosed many similar cases. With the advantages he had mentioned, he thought they might look forward with confidence to the further development of this section of their business.

The company's output in transformers was also a record for the year, and the product of this department appeared to have given general satisfaction to buyers, both as regarded efficiency and reliability. On the rolling stock side the output was well maintained. They were well equipped for securing their fair share of any business offering, not only for tramcars and trucks and motor-'bus bodies, but also for railway rolling stock.

The report and accounts were unanimously adopted, and the Chairman announced that the dividend warrants would be posted that evening.

A full abstract of the report and accounts appeared in our last issue.

Edison Swan Electric.

The thirty-eighth ordinary general meeting of this company was held on Tuesday, Mr. C. Jermyn Ford (chairman and managing director), presiding.

The Chairman, in the course of his speech, said: "The period covered by the accounts has been the most disastrous for industry which this country, and the commercial world has ever known. The strike of the moulders, and the coal strike, caused losses of millions of pounds. These strikes were followed by the strike of the shipwrights, which in turn was followed by that of the ship joiners, which continued for nearly twelve months, until August last. The loss shown by the accounts is largely attributable to the unprecedented fall in values of all raw materials and manufactured goods, and to stagnation in trade. The fall in values of all raw materials and manufactured goods varies from 20 per cent. to 75 per cent. We have made the most careful and minute valuation of our stocks, and the figure at which they appear in the balance sheet (£618 000), represents bedrock prices; the depreciation amounts to £346 000, and is responsible for the greater part of the loss shown.

"Our sales department and our depots throughout the Kingdom have lost no possible opportunities to stimulate sales, and I am satisfied that we have had our full share of such trade as was available. The board have explored every avenue in the company's organisation, and savings have been made, aggregating between £50 000 and £70 000 per annum, but the accounts before you have only benefited by these to a very small extent. This company in common with other manufacturers of electric lamps reduced the price of lamps by 15 per cent., and this involved allowances to traders, which cost the company £26 000 in hard cash. One of our subsidiary companies recently tendered to an Indian Railway Company for goods to the amount of £6 000, and this was absolutely rock bottom price. What happened?—the Germans took the contract at £2 500. This figure would not pay even for the labour on the job in this country, and we are meeting with this class of competition everywhere.

"We are now faced with the lock-out of the Engineers, and have had no option but to lock out certain employees.

"We have, during the last few months, introduced two new types of lamp, one is the "Fullolite," an opal lamp, designed to obviate the glare, and this has caught on beyond our most sanguine expectations. The other is a daylight lamp, constructed of special tinted glass, which gives a daylight effect. Considering the slack times we are moving in our lamp sales have been good, and this branch of the business should largely develop.

"It has been suggested in certain quarters that far too heavy stocks have been held. When these stocks were originally acquired, trade was extraordinarily active, and prices were booming, and the stocks did not appear to be excessive. In numerous cases, by the time we had obtained delivery of materials and manufactured the goods the slump had arrived, and orders were cancelled by customers, and this all helped to increase our stocks. The balance standing to debit of profit and loss is £344 720, and the board recommend that £55 000 now standing to reserve, be transferred to profit and loss account, thus reducing the debit balance to £289 720. The board have been asked how they propose to treat this debit balance, and whether they intend to bring forward a reconstruction scheme, embracing a reduction of capital, in order to wipe it out. They have obtained the views of some of the largest shareholders, and it has been agreed that no good purpose would be served by bringing forward any scheme at this juncture. Mr. A. F. Berry, chairman and managing director of the The British Electric Transformer Company, has consented to join the directorate. It is also suggested that a further addition be made, but a final decision has not yet been come to with regard to the gentleman who will go on the board. Mr. Ellice-Clark and Mr. Quilter have signified their willingness to retire from the directorate. I shall part with these two colleagues with the deepest regret, as their sound judgment and knowledge of the business have been of incalculable assistance. The company has, I am convinced, a marvellous reserve of recuperative strength, centered mainly in its widespread sales organisation, represented by its twenty-six important depots in the United Kingdom and Australia, and I am convinced that with a moderate revival in trade, we ought to do fairly well."

He concluded by moving the adoption of the report and accounts, and the motion was seconded by Mr. E. C. Quilter and carried unanimously.

A number of questions were asked, and in reply the chairman said the action against the Philips company was subjudice and could not be discussed.

Metropolitan-Vickers Electrical.

In the course of his speech at the annual meeting of Metropolitan-Vickers Electrical Company last week, the chairman (Mr. J. Annan Bryce), who presided, said that the output of the year had been the largest during the history of the company, exceeding by 35 per cent. the output of 1916. This high degree of efficiency was obtained in spite of a decrease in the number of workmen and of delay caused by the coal strike, to meet which some of the boiler furnaces were converted to oil firing. The average rate of wages showed a slight decrease from that of 1920, but was still about double the pre-war rate. The benevolent fund had now been running for twelve months, and the number of members had increased considerably. It had proved of great benefit in relieving many necessitous cases which could not have been assisted in other ways. There had lately been formulated a provident fund scheme for the benefit of all the employees of

the company. The number of accidents showed a steady decrease. They were now less than half as numerous as in the year 1916. This happy result had been accompanied by a corresponding reduction in cost to 3s. 7d. per cent. of the wages paid—by far the lowest figure ever reached.

The activities of the Research and Education Department continued unabated. The new research buildings had been fully staffed and equipped during the year. It was believed that they probably comprised the best-designed and equipped laboratories for industrial research in the kingdom. A special feature of the Research Department was the Intelligence Branch. It aimed at providing information drawn from world-wide sources about all matters concerned with the company's technical and commercial interests. It possessed a library which all the employees were encouraged to use. Improvements were constantly being made in the methods of training the works apprentices, who numbered over 1 000. The works foremen had shown their interest by presenting a valuable trophy for competition among the apprentices, and the first award had recently been made. The courses of instruction for University and Public School students were maintained, and a comprehensive scheme of evening classes had been conducted during the winter to prepare the junior female staff for more responsible work. Special facilities were now provided for the instruction of adult workers to fit them for promotion, and special study was made, particularly in the case of the younger people, as to the possibilities of selection for particular vocations.

Folkestone Electricity Supply.

The accounts of the Folkestone Electricity Supply Company for the year ending December 31 last, including the receipts from hired installations, show a profit for the three undertakings amounting to £17 681, an increase of £2 767 over last year's gross profit. This amount, with the sum of £632 brought forward and interest on investments, &c., and after allowing for interest on debenture stock and bank overdraft, and dividend on preference shares, shows a balance of £12 317. Out of this the directors have carried £7 561 to the depreciation fund, bringing it up to £69 324, and £1 525 to the reserve fund, bringing it up to £12 600, and they recommend the payment of a dividend at the rate of 4¾ per cent. (less income tax) on the ordinary shares for the year, which will require £2 375, leaving a balance of £855, which it is proposed to carry forward. The payment of the dividend recommended is subject to the consent of the Electricity Commissioners. Application has been made to the Commissioners for extended powers in the district by incorporating the urban district of Cheriton and the parishes of Saltwood, Newington and Hawkinge in the company's area of supply, but the formal Order has not yet been obtained. Since the last annual meeting the board have approved a scheme entailing substantial extensions to plant, and orders have been placed for additional machinery. Some portion of this has already been installed and the remainder is due for delivery during the next few weeks, and will, it is hoped, be running in time for the season load. Up to Dec. 31, 1921, the equivalent of 212 180 eight-candle power lamps was being supplied, being an increase of the equivalent of 13 372 eight-candle power lamps over those connected at Dec. 31, 1920.

Urban Electric Supply.

Presiding at the annual meeting of the Urban Electric Supply Company on March 28, Mr. P. D. Tuckett (chairman of the company) said that most of the undertakings showed very satisfactorily increased earnings, and but for the set-back experienced by the Cornwall Power Company and by Hawick, the increase would have been some £12 000 larger. Last year's output fell by nearly 1 000 000 units, a drop of over 40 per cent. While it was a satisfaction to them that they were able to recommend the resumption of a dividend payment, they deplored the necessity of adding still further to the arrears of cumulative dividend. After payment of this half-year's dividend there would be four years' preference dividend (a total of £50 000) in arrear. He calculated that their inability to conduct the business on a commercial basis had deprived them of something not far short of £150 000. Now, however, with the higher rates which they had at last been conceded, and with falling costs, they would be disappointed if they could not resume payment of the full preference dividend a year hence; but, in face of their limited cash resources, and the necessity of conserving them till their position was still further strengthened, they were unanimous in feeling that they could not prudently recommend a larger distribution on this occasion.

London Electric Wire Co. & Smith's.

Presiding last week at the annual meeting of the London Electric Wire Company & Smith's, Ltd., Sir G. H. Fisher (chairman) said that, although the profit for the year showed a slight decrease, the balance available for distribution, after the interim and final dividends on the preference shares and an interim dividend of 1¼ per cent. on the ordinary shares had been paid, was higher by £5 619. It was proposed that a final dividend be paid on the ordinary shares of 6¼ per cent., less tax, making a total of 7½ per cent., less tax, for the year, and leaving £44 546 to be carried forward into 1922. There had been a considerable falling off in customers' orders, and the good showing was to a great extent due to customers' orders carried forward from 1920 into 1921. It was not easy to forecast the future, but it was hoped that the Government would insist upon rigid economy and reduce taxation, and all must endeavour to remove the existing industrial unrest. He had no hesitation in saying that, with a revival of trade, the electrical industry would be one of the first to reap the advantage, so that their company had good reason for hope in the future.

The Montana Power Company has declared a quarterly dividend of 3¼ per cent.

Listowel Electric Light and Power Company recommend a dividend of 10 per cent., tax free.

The net income of the Consolidated Gas, Electric Light, & Power Company for the past year amounted to $3 064 045.

The Central Argentine Railway has declared an interim dividend on the consolidated ordinary stock of 2 per cent., less tax.

The directors of the Madras Electric Tramways (1904) Company recommend a final dividend to holders of preference share warrants to bearer at the rate of 6 per cent. per annum, less tax.

The total earnings for 1921 of the New York Telephone Company amounted to $21 393 035, less $8 148 492 for interest charges, leaving a net profit of $13 244 543. Dividends amounting to 8 per cent. have been paid, leaving $403 296 carried forward.

The Anglo-American Telegraph Company announces a dividend for the quarter ended March 31, 1922, of 15s. per cent. on the ordinary stock and £1 10s. per cent. on the preferred stock, less tax, payable May 1, to holders registered March 31, 1922.

An extraordinary general meeting of the Rangoon Electric Tramway and Supply Company will be held in Rangoon on April 20 to pass resolutions to increase the capital of the company to £800 000 by the creation of 300 000 new shares of £1 each, and to make various alterations in the articles of association.

An offer of £110 000, it is stated, has been received by the North Melbourne Electric Tramways & Lighting Company from the State Electricity Commission of Victoria for the undertaking, and in addition certain stores are to be taken at a valuation not to exceed £4 000. Payment will be made of £25 000 in cash, and the remainder in Victoria Government 6 per cent. debentures, having a currency of twelve to thirteen years, at par. As the price offered is insufficient to pay the debenture holders in full, there will be nothing left for shareholders.

The Railway Commissioners for New South Wales have issued their report on the working of the Government railways and tramways for the quarter ended Dec. 31, 1921. There was an increase of two and a half miles open on the tramways. Revenue amounted to £920 715, an increase of £40 683, while expenditure rose £66 014 to £795 258. The number of tram miles run were 7 482 043, an increase of 202 687 miles. Earnings per tram each mile rose ½d. to 2s. 5½d., but expenditure increased 1½d. to 2s. 1½d. The percentage of expenditure to earnings was 3·50 higher at 86·37. A decrease of 1 217 161 occurred in the number of passengers carried.

The report of the Chiswick Electricity Supply Corporation for 1921 states capital expenditure on works at Chiswick and Aberystwith was £3 893. Revenue for the year was £43 722, against £41 987. After paying sinking fund premium and trustees' fees the profits were £17 373, compared with £15 770. After deducting interest on first mortgage debenture stock the balance to the credit of net revenue was £14 029, making with the balance brought in £16 064. The directors recommend a dividend of 8 per cent. The sum of £8 000 had been placed to depreciation reserve, leaving £3 040 to be carried forward.

The net profit of the British L. H. Ericsson Manufacturing Company for 1921, after writing down stocks to present-day values and charging £22 107 for annual depreciation of buildings, plant, &c., £9 977 for income-tax, £9 122 for interest on debentures and loans, and £600 for debenture issue expenses (balance), was £68 997, making, with £43 897 brought in, £112 894. The directors recommend the payment of 10 per cent. (free of tax) on the ordinary shares; to reserve account, £30 000; to special reserve, to meet future contingencies, £15 000; carrying forward £51 893 (subject to Corporation Tax). Loans in last year's balance-sheet, totalling £109 727, have been paid off.

The Eastern Telegraph Company, and The Eastern Extension, Australasia & China Telegraph Company, Ltd., announce that, owing to unavoidable delays in obtaining the necessary returns from foreign stations and administrations, it will be impossible to issue the audited accounts and balance-sheet for the year ended Dec. 31, 1921, in time to allow of the annual general meeting being held next month, but the directors will convene the meeting as soon as the full accounts can be submitted. The directors have, however, decided to pay on May 15 next a final dividend for the year 1921 of 2½ per cent., free of income tax on the ordinary stock. This will make the distribution for the year 10 per cent., free of income tax, the same rate as was paid for the previous year.

The report for 1921 of the Canadian General Electric Company shows a net profit of $706 092. Undivided profits at December 31, 1920, were $778 672. Deducting dividends paid—7 per cent. on the preferred and 8 per cent. on the common stock—there is a balance at the credit of the profit and loss account at the end of December last of $557 726. The sum of $3 800 000 (portion of appraised depreciated values of plants reported by the Canadian Appraisal Company in excess of book values) was added to reserve. Deducting $1 800 000 for stock dividend of 20 per cent. to common share-

holders, the reserve account at the end of December stood at $7 000 000, making, with the balance of the profit and loss, a surplus of $7 557 726.

The gross revenue for 1921 of the Windermere & District Electricity Supply Company amounted to £8 382, an increase of £1 725. Working expenses amounted to £5 677, an increase of £818. Keswick Electric Light Company has again paid 5 per cent. on account of arrears of interest on its debentures, and this company's net revenue account has been credited with £334 on its holding. The balance of the revenue account, including the interest on Keswick debentures and the balance brought forward from last year, amounted to £3 364. Debenture interest and bankers' charges amounting to £1 083 have been paid, free wiring rents written off capital account (£90), depreciation reserve account (£1 000), leaving £1 191. The bank overdraft was reduced at the end of 1921 to comparatively small dimensions, and the directors recommend that a dividend of 3 per cent. be paid on the preference shares, amounting to £750, and that the balance of £441 be carried forward.

The report of the Argentine Tramways and Power Company for the year to September 30, 1921, states that the gross receipts of the tramway department were $690 657 paper, an increase of $128 271 paper. The gross receipts of the light and power department were $336 314 paper, an increase of $66 447 paper. The net receipts from operation totalled £28 028, an increase of £5 442. The profit on exchange was £255. Including interest and transfer fees, revenue was £28 559, against £26 893. After charging interest and sinking fund on debenture stock and London expenses, and transferring £5 000 to reserve for renewals, there remains £10 245. A scheme of arrangement approved by holders of preference and ordinary shares on March 22 provides, *inter alia*, that £18 323 standing to the credit of the revenue account at September 30, 1920, shall be carried to reserve and shall not be treated as profit available for dividend. Subject to the scheme being approved by Court and to £50 000 of the Five per Cent. Debenture stock, subscriptions for which have been conditionally promised, being allotted, the directors propose a dividend at rate of 5 per cent. (less tax) on the preference shares in respect of the past year, carrying forward balance, subject to income-tax and corporation tax (if any).

Tenders Invited and Accepted.

UNITED KINGDOM.

Glasgow Corporation. April 17.—Electric wiring and fitting of Blackfriars Parish Church, Dennistoun. Specifications, &c., can be obtained at the Office of Public Works, 64, Cochrane-street, Glasgow.

Glasgow Electricity Department. May 1.—Supply of (1) cables (including small IR cables and flexibles); (2) meters; (3) carbons, for a period of twelve months. Particulars from R. B. Mitchell, Engineer, 75, Waterloo-street, Glasgow.

ASIA.

Department of Posts and Telegraphs, Bangkok. June 5.—Telegraph and telephone materials to the value of £10 000. Tender forms can be obtained from the Chief Electrical Engineer, Telephone Exchange, Bangkok.

Liverpool Corporation have accepted the tender of the English Electric Company for 100 40-h.p. D.K. motors, including roller bearings.

Ferranti Ltd. have lately been entrusted by the Public Works' Department of the New Zealand Government, with a contract for the supply of seven 4 000 kVA, 110 000 V single-phase, oil immersed, forced-cooled transformers, in connection with the Mangaho Hydro Electric Power Scheme.

Stepney Borough Council have accepted the following tenders :—The Enfield Ediswan Cable Works, Ltd., at £20 917 13s. 4d., for the supply of cable during period ending March 31, 1923; Cambridge & Paul Instrument Company, for an indicating outfit for measuring the discharge of carbon dioxide from one of the boilers at Limehouse station, at £52 13s.

Benalla (Victoria) Council have accepted tenders amounting to £13 056 for plant and material for their electric supply undertaking. The bulk of the orders have been given to Australian firms. Wm. Adams & Company have the contract for power plants, £6 409; A. H. Frost & T. Dolan, poles, £800; Holmwood & O'Neill, bare copper cables, £1 200; and Thomas Bros., meters, £1 250.

Maidenhead Town Council have accepted the following tenders :—Ruston & Hornsby, four-cylinder oil-engine set of 250 kW capacity, for the electricity works, at cost of from £5 224 to £5 239 according to the make of dynamo finally selected; Drake & Gorham Wholesale, Ltd., "Xcel" electric irons, for hiring out, at 14s. 4d. each; Ferranti, Ltd., for transformers.

Wolverhampton Electricity Committee have accepted the tender of the Stirling Boiler Company for two 40 000 lb. water-tube boilers with superheaters, complete with the necessary accoutrements, to be erected ready for the raising of steam, at over £8 000, and a further tender of the Underfeed Stoker Company for four self-contained draught travelling grate stokers and four cast-iron hoppers for the sum of £5 122.

The Government of New Zealand has accepted the tender of the Metropolitan-Vickers Electrical Company, amounting to £30 764, for the supply of switchgear for the Mangahao hydro-electric installation, which will provide the Wellington district and city with electricity. The installation will have the highest electrical pressure in Australasia, and the best and most reliable controls were necessary. The lowest tender received was one for £24 666 from America.

New Companies.

Anti-Vibration Electric Lamp.

Anti-Vibration Electric Lamp Company, Ltd. (180 973). Private company. Reg. April 6. Capital, £500 in £1 shares. Manufacturers, exporters, and importers of and dealers in electric goods and accessories, etc. Subscribers : W. Lennard and R. C. Radeglia. Solicitors : H. Crafter & Company, 7, Southampton-street, W.C. 1.

British Horo-Electric.

British Horo-Electric, Ltd. (180 855). Private company. Registered April 3. Capital £50 000. in £1 shares. To adopt agreements (1) with H. Binggueley and F. G. Trollope and (2) with the Compagnie Generale Horo-Electriques; to develop and turn to account the inventions, patents and rights comprised in the first agreement and to carry on the business of manufacturers of, and dealers, in electrical and other watches, &c. First directors : F. G. Trollope, L. W. N. Hickley, M. P. Favre-Bulle, H. Binggueley, and Lieut-Col. H. W. Snow. Secretary : V. G. Frohman, 34, Waldgrave Road, Ealing, W. 5. Solicitors : Clowes, Hickley and Heaver, 10, King's Bench Walk, Temple, E.C.

Burndept, Ltd.

Burndept, Ltd. (180 745). Private company. Registered March 30. Capital, £20 000 in £1 shares. To acquire from Burnham & Company, of St. Paul's Wharf, Deptford, S.E. 8, the benefit of certain existing inventions relating to wireless telegraphy or telephony, &c. Subscribers : A. W. Slade and F. A. Saxon. Registered office : 391, Strand, W.C. 2.

Cambrian Electrolytic Zinc Company.

The Cambrian Electrolytic Zinc Company, Ltd. Registered March 30. Nominal capital of £50 000 in 185 000 participating preference shares of 5s. each and 75 000 ordinary shares of 1s. each. To acquire the undertaking of the Lisburne Development Syndicate, Ltd., and the Welsh Mines Corporation, Ltd., to acquire any mines, oil, or mining rights and metalliferous or other land in the U.K. or elsewhere, to adopt the process known as the "Electrolytic deposition of zinc," and to carry on the business of miners, preparers for market of ores, metals, precious stones and minerals, &c. First directors : Newman Goldman, C. S. Quartermaine and E. A. Wakefield. Registered office : 80, Bishopsgate, E.C. 2 The file number is 180 746.

Globe Supplies (Electrical), Ltd.

Globe Supplies (Electrical), Ltd. (180 704). Private company. Registered March 29. Capital, £500 in £1 shares. To carry on business as indicated by the title. Subscribers : F. Bruce and J. R. Whitehouse. Solicitor : C. H. R. Taylor, 17, Charing Cross-road, W.C. 1.

C. E. Heinke.

C. E. Heinke, Ltd. (180 856). Private company. Registered April 3. Capital £50 000 in 49 950 ordinary shares of £1 each, and 1 000 employees' shares of 1s. each. To enter into an agreement with F. H. Sprang, E. C. Lacey, and J. H. Blake, and to carry on the business of manufacturers of internal combustion and other engines, manufacturers of vacuum, compression and other pumps, mechanical, scientific and surgical instruments and machinery, electrical and chemical engineers, &c. First directors : F. H. Sprang, E. C. Lacey, and J. H. Blake. Secretary : W. Norman. Registered office, 87, Grange-road, Bermondsey, S.E. 1.

Hill & Boll (Bridport), Ltd.

Hill & Boll (Bridport), Ltd. (180 935). Private company. Reg. April 5. Capital, £2 000 in £1 shares. Mechanical, electrical, and consulting engineers, engineering contractors, &c., and to adopt an agreement between F. W. Boll and S. R. Edwards. First directors : F. W. Boll and S. R. Edwards. Secretary : T. W. Cockeram. Registered office : 71-73, East-street, Bridport.

Kilrush Electric Lighting and Power.

Kilrush Electric Lighting and Power Company. Private company. Reg. in Dublin March 31. Capital, £5 300 in £1 shares. To carry on at Kilrush the business of an electric light company in all its branches. Subscribers : D. Ryan (500 shares), T. J. Mahony (1 000 shares), G. Brew, J. Saunders, P. O'Shea, P. Tubridy, and G J. Cantwell. Registered office : Burton-street, Kilrush.

Neon Lights.

Néon Lights, Ltd. (180 617). Private company. Registered March 25. Capital, £10 000 in 7 500 10 per cent. cumulative participating preference shares of £1 and 5 000 ordinary shares of 10s. each. To acquire the rights and other interests in the agency and concession for the U.K. granted to E. Bailey, trading as the Electrograph Company, of 9, South Side, Clapham Common, S.W., under an agreement between himself and Paz & Silva, of Paris, for 3 500 fully paid 10 per cent. preference and 3 000 fully paid ordinary shares, and to carry on in the U.K. or elsewhere the business of manufacturers and factors of, agents and advertisement contractors for, and dealers in Néon lamps and lights and any electrical, scientific, mechanical and other device in which the said lamps and lights can be used, &c. Life directors : A. G. Read (Read & Leney, advertising agent and managing director) and E. Bailey. Registered office : 115, Baker-street, W. 1.

A. Peckston.

A Peckston, Ltd. (180 849). Private company. Registered April 3. Capital £1 000 in £1 shares. To take over the business of an electrical engineer carried on by Austin Peckston at 42, Wilson-street, Middlesbrough. Permanent directors, A. Peckston, (managing director), and A. W. Foster. Registered office : 42, Wilson-street, Middlesbrough.

COMMERCIAL INTELLIGENCE.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

BLISS, Mr. E. H., 19, Westbourne-crescent, Canton Bridge, Cardiff, electrical goods dealer. £42 2s. 11d. Feb. 10.

CALDWELL & SONS, 26, Victoria-road, Hale, electrical engineers. £11 14s. Feb. 10.

CLYNE & DEAKIN, 84, Tilton-road, Small Heath, electrical engineers. £18 8s. 2d. Feb. 8.

ELECTRICAL MACHINERY COMPANY, 22, Pownall-square, and 36, Smithfield-street, Liverpool, electrical engineers. £39 16s. 10d. Feb. 7.

ENGINEERING PLANT CONTRACTORS, LTD., 377, Waterloo-road, Cheetham Hill, machinery merchants. £17 15s. Jan. 31.

FRANCIS, Mr. W., 4, Prospect-place, Cheam, electrical engineer. £16 4s. 6d. Feb. 7.

RAWLINGS & COMPANY, 33, Broad-street, Hereford, electrical engineers. £28 6s. 1d. Feb. 10.

VENN BROS., 39, Turnham Green-terrace, W. 4, electrical engineers. £18 0s. 3d. Feb. 2.

WELLINGS, Mr. H. R., Ironmarket, Newcastle, electrical and sanitary engineer. £23 7s. Feb. 7.

Receivership.

BRITISH DIATORIC MANUFACTURING COMPANY, LTD. W. J. Kershaw, of Talbot House, 9, Arundel-street, Strand, W.C., ceased to act as receiver or manager on Feb. 22, 1922.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Company Winding-up.

SWIFT ELECTRICAL, LTD. Registered office, 6, Cork-street, Old Bond-street, London. Winding-up order, April 4.

Bankruptcy Information.

BATE, Douglas Clavell, 16, John Dalton-street, Manchester, electrical manufacturer and supplier. Receiving order, April 4. Debtor's petition.

CAMP, William, Carr-lane, Slaithwaite, Huddersfield, under the style of WILLIAM CAMP & COMPANY, electrical engineer. Receiving order, April 4. Debtor's petition. First meeting, April 21, 1.15 p.m., and public examination, May 8, 11 a.m., County Court House, Queen-street, Huddersfield.

OLDFIELD, Herbert, 51, Milton-terrace, High-street, Heckmondwike, electrical engineer. First meeting, April 20, 10.45 a.m., and public examination, May 4, 11 a.m., County Court House, Dewsbury.

Notice of Dividend.

WORMULL, Frederick Alfred Stanley, 17, Bellingham-terrace, Bromley-road, Catford, S.E., electrical engineer, and at 273, High-street, Lewisham, as the LEWISHAM ELECTRIC WIRING COMPANY. Amount per £, 4s. 10¾d. First and final. Payable, April 24, 29, Russell-square, W.C. 1.

Notice of Intended Dividend.

BECKETT, Samuel, Junior, 50, Deane-road, Bolton, Co. Lancaster, electrician. Last day for receiving proofs, April 22. Trustee, J. G. Gibson, Byrom-street, Manchester.

Partnerships Dissolved.

LEITCH, John, and SMITH, Thomas, designers and manufacturers of electric light fittings, 4, Ramillies-place, Oxford-circus, under the style of THE MARYLEBONE ELECTRIC FITTINGS COMPANY, by mutual consent as from March 13, 1922. Debts received and paid by J. Leitch, who will continue the business.

THORPE, George, WILLERS, Hugo Hermann Carl Johann Ludwig, PRECIOUS, Halliday, and PRECIOUS, Alfred, general importers of electrical goods, &c., at 78, Olympia-street, Burnley, under the style of THORPE, WILLERS & COMPANY, by mutual consent as from Feb. 24, 1922.

VINCE, Henry James, and HUNT, Henry James, electro platers, at Whippet Works, Falcon-terrace, Clapham Junction, S.W. 11, under the style of JAMES VINCE & COMPANY, by mutual consent as from Jan. 1, 1922. Debts received and paid by H. J. Hunt, who will continue the business.

Edinburgh Gazette.

BRASH, James, and RUSSELL, Robert M., trading as BRASH & RUSSELL, electrical, &c., engineers, 438, Baltic-street, Bridgeton, Glasgow. Firm dissolved, by mutual consent, as at March 31, 1922.

M'KINNON, Hugh, and BUCHANAN, John R., under the name of THE AUTO ELECTRICAL EQUIPMENT COMPANY, at 119 and 121, Bothwell-street, Glasgow. Firm dissolved March 18, 1922. The business will be continued by J. R. Buchanan, who will receive and pay all debts.

Bankruptcy Proceedings.

KERSHAW, Arthur, and WOOD, Charles Herbert, trading as KERSHAW & WOOD, 9, Bradford-road, Dewsbury, Yorkshire, electrical engineers and merchants. The application for discharge of these debtors was heard last week. The Official Receiver stated that they filed their petition in 1920, when the ranking liabilities amounted to £4 796 and the assets realised £1 437. A first and final dividend of 4s. in the £ was paid, and the debtors now offered to pay jointly a sum of £25 a quarter for two years, making a total of £200, for the benefit of the creditors. The discharge was granted, subject to the payment of the quarterly sums of £25 for two years.

LUDLOW, Jesse Frederick, and LUDLOW, Robert Redvers, in partnership as LUDLOW BROS., 196, Church-road, Redfield, Bristol, electrical contractors. The receiving order in this matter was made on March 29 on debtors' own petition. The statement of affairs shows liabilities of £307 against net assets of £53, a deficiency of £254. Debtors attribute their failure to want of capital, bad trade, and depreciation of stock. It appears that in October, 1919, with a total capital of £15, they started business as electrical contractors at their present address. The business does not seem to have been successful from the start, and they became aware of their position in March, 1921. A full set of books has not been kept.

Catalogues, Price Lists, &c.

A new price list of SIMPLEX ELECTRICAL ACCESSORIES (List No. 939), has just been brought out by Simplex Conduits, Ltd.

An illustrated leaflet has been received from J. H. Jerrim & Company, giving details of the "FIXIE" GRIPS manufactured by the firm. The stock sizes vary from 7½ in. by 3½ in. to 34½ in. by 13 in., and the prices from £2 14s. 6d. to £29 5s.

A new illustrated list of L.T. IRONCLAD SWITCH AND FUSE GEAR for lighting and power purposes has just been published by the Midland Electric Manufacturing Company, and includes many entirely new designs and many improvements on old patterns.

THE RAWPLUG COMPANY have just issued an attractive sixteen-page booklet, in which the use and application of Rawplugs, as applied to the various trades interested, are fully described and enumerated. A substantial reduction in the price of Rawplug toolholders is announced.

In view of the great variety of purposes for which PARSONS' ENGINES are now used as power units, the firm have published in book form a collection of illustrations and designs of engines employed for dynamo driving, pumping, &c. The book does not deal with prices, weights, and other technical information, all of which the firm will forward on application.

The latest pamphlet of the ELECTRIC CONSTRUCTION COMPANY deals with the multi-speed induction motors which are now being manufactured by the firm under Creedy's patents. The general design and the advantages claimed for this machine are well known to readers of THE ELECTRICIAN, and it is not unlikely that for certain applications it will find an increasing use, especially with the development of three-phase distribution. The pamphlet contains a great deal of both technical and commercial information, and should be referred to by all those interested in the subject.

Arrangements for the Week.

TUESDAY, April 18th.

INSTITUTION OF ELECTRICAL ENGINEERS.
EAST MIDLAND SUB-CENTRE.

6.45 p.m. At Loughborough College, Loughborough. Lecture on "Electric Vehicles," by Mr. R. J. Mitchell.

WEDNESDAY, April 19th.

INSTITUTION OF ELECTRICAL ENGINEERS.
(SHEFFIELD AND DISTRICT TERRITORIAL SUB-CENTRE.)

7.30 p.m. At Royal Victoria Hotel, Sheffield. Visit of the President, Mr. J. S. Highfield, and Smoking Concert.

FRIDAY, April 21st.

ELECTRICAL POWER ENGINEERS' ASSOCIATION.

7 p.m. At Essex Hall, Strand, London, W.C. General Meeting.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Paper entitled "Condenser and Choke Coil Protective Apparatus," by M. S. A. Stigant.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Complete Specifications.

145 698 Balslev, J. V., & Thode, A. Automatic maximum electric switches. (15/12/17.)
145 755 Ohio Brass Co. Electric insulators. (29/5/16.)
145 778 Siemens-Schuckertwerke Ges. Electrodes for vacuum electric discharge apparatus. (7/12/18.) (Addition to 145 676.)
146 517 Western Electric Co., Ltd. Telephone systems. (14/6/19.)
146 532 Radio Corporation of America. Methods of and apparatus for radio signalling. (6/1/16.)
146 534 Radio Corporation of America. Apparatus for dealing with feeble electric impulses as in wireless telegraphy. (24/2/15.)
146 535 Radio Corporation of America. Receivers of electrical oscillations. (25/4/14.)
146 537 Radio Corporation of America. Thermionic valves. (10/3/17.)
146 353 Siemens & Halske Akt.-Ges. Electric amplifiers. (7/7/16.)
146 357 Stoekle, E. R. Thermionic vacuum tubes. (13/6/17.)
146 864 Compagnie General d'Electricite. Electric lamps, particularly those for motor vehicles. (4/2/19.)
146 903 Siemens & Halske Akt.-Ges. Method of detecting the effects induced by alternating currents flowing through conductors laid in fairways for vessels. (18/12/18.)
147 013 Siemens & Halske Akt.-Ges. Method for reducing the overtalking and overhearing in long-distance two or four-wire circuits. (22/3/19.)
147 434 Ges. für Drähtlose Telegraphie. Wireless telegraph transmitters. (20/10/17.)
147 465 Soc. Francaise Radio Electrique. Electro-magnetic wave transmission systems. (9/7/19.)
147 554 Marks, E. C. R. (Siemens-Schuckertwerke Ges.). Electric arc welding apparatus. (2/7/20.) (Convention date not granted.)
147 821 British Thomson-Houston Co. Ltd. Brush shifting apparatus for alternating current electric motors. (13/2/18.)
147 831 Gross, F. Method of and means for manufacturing electric incandescent lamps. (29/6/20.)
147 837 Ges. für Drähtlose Telegraphie. Multiplex telephony. (14/12/18.)
147 949 Cohn, Sen. A. (Firm of). Secret combination electric selecting or like devices. (22/4/19.)
148 134 British Thomson-Houston Co. Ltd. Electron discharge apparatus. (29/12/13.)
148 312 Huth Ges., Dr. E. F., & Loewe, S. Telephony. (31/12/15.)
148 315 Huth Ges., Dr. E. F. Aerial conductors for wireless telegraphy and winding apparatus therefor. (1/7/15.)
148 319 Huth Ges. Dr. E. F. Reels and the like for winding and unwinding aerial conductors. (16/5/18.)
148 401 Lorenz Akt.-Ges. C., & Schmidt, K. Methods and circuit arrangements for generating pure continuous electric currents by means of machines. (13/2/19.)
148 423 Signal Ges. Electro-magnetic vibratory devices. (12/7/15.)
148 444 Ges. für Drähtlose Telegraphie. Multiplex telephony. (27/5/19.) (Addition to 147 837.)
148 530 Ges. für Drähtlose Telegraphie. Antenna systems for receiving electric waves. (18/6/18.)
152 327 Etablissments Deesse. Distributor for magneto. (8/10/19.)
158 215 Rail Welding & Bonding Co. Electric arc welding. (26/1/20.)
164 298 Herrmann, H. Electric insulators and their manufacture. (4/6/20.)
169 768 Automatic Telephone Manufacturing Co., Ltd., Bates, P. T., & Newall, A. V. Arrangement for controlling the length of conversions for telephone or like purposes. (23/6/20.)
169 772 Barker & Sons, Ltd., J. & Saxton, J. Locking devices for electric and other hoists. (24/6/20.)
169 773 Plant, J. W. Method of electrically welding steel. (24/6/20.)
169 788 Codd, L. B., & Martin, C. Holders for electric incandescent lamps. (2/7/20.)
169 795 Simms, W. H. (General Railway Signal Co.). Electrically operated switch machines for railways. (2/7/20.)
169 812 Haines, L. F. Automatic distant control of hydro-electric and other machinery. (6/7/20.)
169 817 Murray, J. Erskine-. Electrical resistances of the thermionic type. (6/7/20.)
169 818 Carney, H. A., Bowden, J. H., Thompson, H. F. J., & Johnson & Phillips, Ltd. Protective devices for electric alternating current distribution systems. (6/7/20.)
169 822 Ziegenberg, R. Galvanic batteries and electric safety lamps. (6/7/20.)
169 845 Ree, J., Radio Communication Co., Ltd., & Turner, L. B. Three-electrode ionic tubes. (13/7/20.) (Addition to 139 867.)
169 849 Hill, T. H. Wireless directional transmission and reception apparatus. (16/7/20.)
169 853 Conner, M. S., & Puckette, C. C. Driving of magneto-ignition apparatus for internal combustion engines. (19/7/20.)
169 889 British Thomson-Houston Co., Ltd. (General Electric Co.). Vacuum tube devices, especially such devices in which an electron current is controlled by a magnetic field. (25/8/20.)
169 899 Moy, E. F., & Bastie, P. H. Automatic electric circuit-breakers. (13/9/20.)
169 904 Hunt, A. H., & Goddard, J. W. Electric lamp holders. (21/9/20.)
169 915 Metropolitan-Vickers Electrical Co. (Westinghouse Electric & Manufacturing Co.). Electrical transformers. (4/11/20.)

APPLICATIONS FOR PATENTS

March 27, 1922.

8 721 A. M. Taylor. Regulation on long distance transmission lines.
8 756 Petro-Flex Tubing Co. & A. E. MacDonald. Insulated wires, &c.
8 763 J. H. Broome. Device for transmitting electrical impulses by means of balls, discs, &c.
8 765 J. H. Broome. Device for receiving and transmitting electrical impulses.
8 773 F. Krupp Akt.-Ges. Overland circuit breakers. (25/4/21, Germany.)
8 785 W. Morell Akt. Ges. Counting and indicating device for telephone calls, &c. (17/10/21, Germany.)
8 786 Western Electric Co. Vacuum pumps. (20/6/21, U.S.)
8 787 Metropolitan-Vickers Electrical Co. Systems of electrical distribution. (3/6/21, U.S.)
8 793 Siemens & Halske Akt.-Ges. Telephone systems. (31/3/21, Germany.)
8 811 S. G. Barker. Multi-filament electric lamps.
8 813 B. T.-H. Co. (G. E. Co.). Vibration indicators.
8 822 C. F. Killar. Short-circuiting devices.

March 28, 1922.

8 825 E. Y. Robinson. Systems of reception for modulated wave telegraphy and telephony.
8 830 H. S. Hutchison. Sparking electrode for sparking plugs.
8 842 E. Marchesi. Electric furnaces.
8 848 H. T. Boothroyd. Reversing gears operated by electro-magnetically actuated friction clutches.
8 880 P. W. Corless. Self-indicating sparking plug.
8 881 W. S. Kelly. Electric switches.
8 887 F. Krupp Akt.-Ges. Overland circuit breakers. (20/6/21, Germany.)
8 890 F. Krupp Akt.-Ges. Overland protective systems. (26/5/21, Germany.)
8 899 E. E. Kleinschmidt. Indicating mechanism for printing telegraphs.
8 904 B. T.-H. Co. (Cie Française Thomson-Houston). Braking systems for electric machines.
8 906 M. J. Railing & C. W. Saunders. Locking device for securing lamps to holders.
8 909 Coventry Automatic Telephones, Ltd. (Adams). Terminal banks.
8 910 Coventry Automatic Telephones, Ltd. (Arter). Machine switching telephone systems.
8 914 Western Electric Co. Telephone exchange systems.
8 915 C. A. Youldon. Electric motor for gramophones, &c.
8 917 G. C. Reed. Electric signalling system.
8 941 Felten & Guilliaume Carlswerk A. G. Equalising pairs of coils for loading pupinised 4-wire telephone lines. (22/10/21, Germany.)
8 943 Siemens & Halske Akt.-Ges. Telephone systems. (7/14/21, U.S.)

March 29, 1922.

8 952 S. P. Christie. Ignition circuit makers.
8 953 L. J. Rich. Three-electrode thermionic valves. (2/4/21, U.S.)
8 965 V. R. Nicholson. Electrically-driven lathes.
8 966 J. Timms. Storage batteries.
8 973 R. W. Dobson. Devices for wireless telegraphy, &c.
9 005 H. Cooper & B. Radley. Multiple-way switch for signs, &c.
9 009 L. T. & G. A. Walsh. Electrical illuminating machine.
9 021 Franco-British Electrical Co. & A. H. Brackensey. Time switches.
9 023 Cosmos Lamp Works & J. A. Orange. Metal filament incandescent lamps.
9 032 J. E. Calverley & W. E. Highfield. Electric converting apparatus.
9 034 P. T. Nielsen. Hand tools for connecting telephones, &c., wires to insulators.
9 063 P. C. Rushen (Siemens-Schuckertwerke). Electricity meters of electrolytic type.
9 083 H. Kennedy & Co. & P. Davey. Electric spark-gap apparatus.
9 084 L. S. Scher. Telephone mufflers. (21/4/21, U.S.)

March 30, 1922.

9 109 A. J. R. Riley. Electric lamps for cycles, &c.
9 114 F. L. Heppell. Electric egg tester.
9 122 Imperial Engineering Co., G. W. Close, & W. T. Pearson. Electric water heaters.
9 125 E. H. Cardwell. Electric ignition apparatus.
9 133 W. J. Beaver. Electrolier chains.
9 143 V. Hutchinson. Intercommunication telephone systems.
9 154 C. E. Garratt. Electric heaters or stoves.
9 159 Bartons & Sons & R. E. Barton. Electric conduit fittings.
9 178 E. Peruzzi & S. Preti. Multiplex printing telegraphy and radio-telegraphy. (31/3/21, Italy.)
9 179 M. J. Railing, F. J. Holtson, & T. Taylor. Electric switches.
9 180 M. J. Railing & A. E. Angold. Speed control of electric motors.
9 210 James Antifouling Appliances, J. B. Wilkie, & H. Neville. Mounting electrodes or electric discharge points in hulls of ships, &c.
9 219 B. T.-H. Co. & K. F. Hingwell. Telephone apparatus.
9 231 Soc. La Metallurgique Electrique. Electric installations 28/12/21, France.)

March 31, 1922.

9 252 J. Greenhalgh. Coupling for electric cables.
9 275 W. A. Powell & J. E. Price. Insulation for conductors.
9 291 H. Fletcher. Electric incandescent lamps.
9 294 Callender's Cable & Construction Co. & A. C. Wilson. Insulators.
9 296 G. V. Twiss. Means for attaching conductors to insulators.
9 298 M. Zeiler. Electric pocket lamps.
9 302 G. Alfani & L. Mazza. Commutators for automatic telephone exchanges. (1/4/21, Italy.)
9 306 H. Richardson. Trolly heads.
9 311 E. W. Hill & G. F. Shotter. Alternating current instruments.
9 320 Western Electric Co. & L. Polinkowsky. Call indicator circuits.
9 326 T. Dobson. Terminals for electric couplings.
9 333 Tilling-Stevens Motors, Ltd. & H. K. Whitehorn. Electric transmission for vehicles.
9 350 A. C. Goolden, A. G. Warren, & V. E. Pullin. X-ray tubes.
9 353 Ferguson, Pailin, Ltd., & G. Pailin. Automatic air and oil break switches.
9 355 J. McGrath. Fuse-wire holders.
9 364 O. Poching. Regulation of hydro-electric power stations. (1/4/21, Germany.)

April 1, 1922.

9 378 Fuller's United Electric Works & R. E. Beswick. Galvanic batteries.
9 401 A. J. Wheeler. Automatic metering for telephone calls.
9 412 J. Russell. Magnetic lifting apparatus.
9 419 N. A. Block & J. W. Coward. Electric switches for motor vehicles.
9 435 E. Elmes. Device for indicating burn out or failure of electrical apparatus.
9 442 C. M. E. Franklin. Automatic devices for charging accumulators.
9 454 C. Ruffin. Electric fly-killer.
9 459 Automatic Telephone Mfg. Co. Telephone systems. (1/4/21, U.S.)
9 463 G. W. Humphry. Tubular metal casings for conductors.
9 464 W. Brandt. Measurement of high electrical resistances or ionization strengths. (2/4/21, Austria.)
9 467 E. Y. Robinson. Antenna systems for wireless communication.
9 469 S. Strauss. Measurement of high electrical resistances or ionization strengths. (2/4/21, Austria.)

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CONTENTS.

Notes of the Week.

The Straight Tip.

Placated by the concessions granted by Lord Peel and perhaps soothed by the shadow of the coming Easter holidays, the opposition to the Electricity Supply Bill died down into a distant rumble, which we hope presages the departure of the storm. If, however, it is but the calm before the renewal of the attack, we should like to draw the attention of those who are operating the thunder equipment behind the scenes to Lord Monk Bretton's straight tip. "Unless," he said, "the Bill went through in its present beneficial form the [London County] Council would have to consider whether the London companies should be granted an extension of tenure." Now the London electricity supply companies have always claimed, with some justice, that the menace of purchase in 1931 militated against their development. The Bill would remove that menace, and, as we showed the other day, the London companies are not definitely opposing the Bill. The opposition comes from another quarter, and, if persisted in, will bring punishment to the guiltless and leave the guilty much where they were before. This is realised by those concerned, to some extent, for the suggestion is now made that London is a separate problem which should be treated separately. This is a little ingenuous and will not excuse the opposition if their efforts bring about an *impasse*.

South-East Lancashire Electricity District.

With slight modification the Electricity Commissioners have sanctioned the scheme for the reorganisation of electricity supply in the South-East Lancashire Electricity District, and have thus made a concession to the independent, self-reliant Lancastrian spirit of which we hear so much. This has not been done without question, for the Commissioners evidently have a doubt, which we share, whether the proposed Advisory Board will be in as good a position as a Joint Authority to undertake comprehensive schemes of extension, or be able to provide adequate supplies in unoccupied areas. It has, however, been decided, in view of the almost unanimous support given to the voluntary arrangements made by the supply authorities, to set up an Advisory Board, though the number of representatives suggested is to be reduced, and the newly added areas of Buxton, Macclesfield, and other urban and rural districts are to have representation. If the parties cannot agree as to this necessary modification, the Commissioners will provide a scheme of their own.

Details of Technical Scheme.

The Engineer of the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board is to be a member of the Engineering Advisory Committee for limited purposes, and the Yorkshire Electric Power Company will not be required to submit plans of new works, but only such statistics as may refer to supplies in the company's areas in Saddleworth and Springhead. General approval has been given to the technical scheme, but it is thought that the actual layout of the lines and the method of working interconnected stations so as to produce the most economical results will be best effected by an officer of the Board appointed for that purpose. This officer would carry out the programme laid down by the Engineering Committee and approved by the Board. A scheme embodying this suggestion, which seems to us a necessary one under the circumstances, will have to be submitted for the approval of the Commissioners, and the Board are also required to submit, within two years, proposals for securing a supply in areas at present without one. It will thus be seen that the Commissioners' decision, while conciliatory towards conflicting interests, is eminently practical and joins up the loose ends of the administrative side of the original scheme.

A Useful Entente.

The subject of the closer co-operation or federation (whichever term is preferred) of engineering institutions

was toyed with by Mr. W. Noble Twelvetrees in his recent presidential address to the British Section of the Société des Ingenieurs-Civils de France. This section, it will be remembered, was founded some two years ago from those engineers who reside within the British Empire and yet are members of the parent society, the premier engineering institution of France. Its object is the furtherance of intercourse between British and French engineers, and the recruitment both of British engineers into the French Society and of French engineers into the corresponding British institutions by modifying the qualifications for membership to include equivalent British and French diplomas.

Federation or Progress.

These objects are most laudable, and we wish the section every success in its endeavour, as the mutual permeation of French and British ideas in this way must not only be for the good of the profession, but may also have the profoundest effect on the world's peace. But Mr. Twelvetrees, rather led away by natural enthusiasm for his theme, wishes to go a step further and bring about a federation of engineering institutions in this country with the same idea of advancing engineering progress. But though we agree most heartily as to the desirability of the end, we are not so sure about the means. Mr. Wordingham, in fact, called attention to the serious difficulties in the way of producing workable schemes for the federation of the engineering institutions in this country, but ascribed these to the jealousies and opposition of the smaller societies. But there is something much bigger than that in the way. For though concerned with the progress of engineering, the views of the three principal engineering institutions on how this progress is to be attained are widely dissimilar. To federate them would mean an emulsion rather than a mixture, and what is more important, a check to the advance of the more progressive among them. Though such federation would bring undoubted advantages in the establishment of a central library and other relatively minor matters mentioned by Mr. Wordingham, we are rather afraid that its disadvantages would outweigh them.

Mid-Lancashire Electricity District.

With two exceptions, schemes for the reorganisation of electricity supply in the whole of the Electricity Districts have now been prepared, and inquiries have been held by the Electricity Commissioners into the majority of them. So far there has been no local investigation by the Commissioners into any of the draft orders issued, though a start will be made next month, when the scheme approved for the South-West Midlands will be further considered. This slow progress is partly due to the absence of suitable legislation, and partly to the difficulty of getting the supply authorities to agree upon definite proposals. In the case of Mid-Lancashire, though the district was provisionally determined in May, 1920, it was only last week that a scheme, prepared by Blackburn and Preston Corporations, was submitted to the Commissioners, and even now the support of all the local authorities has not been secured, as some of the supply undertakings in the area from Accrington to Rawtenstall are submitting a scheme for a portion of the district.

The Parish Pump at Work.

In this district the position is not complicated by any company undertakers, and the delay has arisen solely owing to the lack of agreement between the local authorities. Even now the scheme, from the administrative point of view, is somewhat nebulous, and the responsibility for its ultimate shape rests upon the shoulders of the Commissioners. For instance, a Joint Electricity Authority *may*, and, if required by the Commissioners, shall be established, and the number of representatives appointed by each local authority is also left for the Commissioners to determine. The Authority *may* provide and maintain a capital generating station or stations on sites to be approved by the Commissioners, as well as main transmission lines or cables, transforming plant, and other incidental works, and it *may* provide for the supply of electricity in areas not at present supplied, either by including them in the district of adjoining distributors or by supplying such areas direct. The italics are ours.

Technical Details.

The technical side of the scheme, for which Mr. J. A. Robertson is responsible, is much more definite and more satisfactory. The supplies available in the district, which is an important industrial and manufacturing centre, are obtained from old stations, equipped with reciprocating sets, and nearly all produce direct current, though some of the works have modern turbine plant. Nearly all the stations are badly located for cheap generation, and it is, therefore, proposed that during the next nine years the whole of them, with the exception of Blackburn (Whitebirk) and Rawtenstall, should be gradually closed down, and that the normal supplies for the entire district should be furnished by three capital stations, at Preston, Blackburn and Burnley. These three stations will be interconnected, and when fully extended will be capable of meeting all the anticipated requirements, though for a time several of the existing works will be retained as peak load or emergency stations.

Possible Extensions.

The plant at Whitebirk will be extended from 20 000 to 30 000 kW during the period 1926-31; the initial capacity of the new Preston station will be 20 000 kW (to be extended to 40 000 kW before 1931), and of the Burnley works 20 000 kW (to be extended to 30 000 kW). It is hoped that Preston will be able to supply electricity by January, 1924, and the main transmission line between Preston and Blackburn will also be proceeded with, but the Burnley station will not be erected until the 1926-31 period. The system of supply is the standard 3-phase, at a frequency of 50 cycles per second. The main transmission pressure will be 33 000 V, and the local secondary transmission 6 600 V, to coincide with the pressure at present in use. It is stated that it may be possible in three or four years to adopt a 66 000 V pressure between Preston and Blackpool. A group of schedules give statistics of the existing undertakings and of the cost of the projected developments. The capital cost of the first portion of the scheme is estimated at £741 875, and of the second portion at £1 290 225, or a total of £2 032 100; but if individual development be permitted, the cost will be £2 234 000. The scheme would thus effect an annual saving of £22 710 on capital charges, £47 912 on coal, and of £25 000 on wages, stores and repairs, or a total saving of £95 622 per annum.

Help for the Electrical Industry.

It is not a little significant of the trend of industrial progress that out of a total of £14 958 145 guaranteed up to March 31 by the Treasury under the Trade Facilities Act no less than £12 020 100 is for schemes that are wholly or partly electrical. The largest sum of all is £6 500 000, which is guaranteed for twenty-five years to the South-

Eastern and Chatham Railways for the electrification of their London suburban lines, and next to this comes £5 000 000 for fifty years (a very long term) to the London Underground Railways for the enlargement of the tunnels of the City and South London Railway, the improvement of stations, the provision of new rolling stock, and the extension of the London Electric Railway from Golder's Green to Edgware. Details of all these schemes have already appeared in The Electrician. In addition, £500 000 for twenty-five years, but redeemable after fifteen years, has been guaranteed to the Calcutta Electric Supply Corporation for the purchase of additional generating plant, buildings, transformers, and high and low tension mains, £15 600 for twenty years to the Kent Electric Power Company for the provision of mains, transformers, and generating plant, and £4 500 for twenty-five years to the Minehead Electric Supply Company for the provision of generators and mains.

A Necessary Restriction.

The other grants, though not apparently electrical, are not unlikely, commercial knowledge and industrial conditions being what they are, to find their way in part into the coffers of electrical manufacturing firms, and so give a much-needed stimulus to the concerns in which we are most interested. There has been some criticism of the grant to the Calcutta Electric Supply Corporation on the ground that this fund is intended to relieve British labour. This, however, is a short-sighted view, as the plant will probably be purchased in this country, and its erection will be carried out under British supervision. On the other hand, we hope it will be made a condition of all these grants that the whole of the money shall be spent within the British Empire. For though it has been shown in certain cases that such restrictions are a bar to technical progress, no such obstacle need be expected in this case. British firms, British skill, and British labour are quite capable of carrying out all the work involved in these schemes. They should be given a chance to do so, especially as the British taxpayer is providing the money.

Provincial Supply Companies.

Though the majority of provincial electricity supply companies seem to have done moderately well during the past year, a few of them, especially those supplying towns seriously affected by trade depression, suffered a temporary setback. This is clear from the report of the Urban Electric Company, which controls no less than thirteen such undertakings in various parts of the country. The year's net profit of this concern showed an increase of about £9 000, mainly owing to an increase in the charges for electricity, but the company has only been able to pay a half-year's dividend on the preference shares, leaving four years' dividend in arrear. The result would have been better but for the serious drop in the output from the Hawick and Cornwall undertakings. In the former town the depression in the tweed trade, and in Cornwall the serious position of tin mining industry, resulting in the shutting down of practically all the mines, caused a great diminution in the demand.

Onerous Conditions Still Imposed.

It may truly be said that the position of some of the provincial undertakings during the War and since the Armistice has not been an enviable one. They are tied down by rigid price agreements with local authorities, and faced with great opposition to applications for increased charges to correspond with the higher costs. Even now, five of the Urban Company's undertakings are still being operated under the hampering conditions imposed by the Statutory Undertakings (Temporary Increase of Charges) Act of 1918, and though steps are being taken to obtain relief by means of special orders, it is probable that the Electricity (Supply) Bill, which makes provision for the periodical revision of charges and has now an excellent chance of success, may render this course unnecessary.

An Unfair Handicap.

It will be seen that the Urban Company has, like some other supply undertakings, been unfairly handicapped in the conduct of its business, but with falling prices and lower costs there should be a gradual return to the conditions of 1914, when, though the majority of the undertakings only paid an exiguous dividend on the ordinary shares, they did at least pay something. If, however, the company is to earn an adequate rate of interest and is to secure permanent prosperity greater efforts will have to be made to increase the domestic load, and as the present high charges militate against progress in this direction, there must be a reduction in the prices charged as soon as possible. In many urban areas, as we have often pointed out, the domestic field has hardly been tapped, but with suitable propaganda and an attractive tariff considerable progress can and should be made.

Iniquity of the Corporation Profits Tax.

The outlook would, however, be brighter were it not for the Corporation Profits Tax and the rising rates and assessments. Though the Corporation Tax will not affect the company until the end of this year, it is a particularly vicious form of taxation, inequitable and discriminating in its incidence. As local authorities who own electricity supply or other public utilities are exempt from the tax, it is manifestly unjust to impose it upon companies. The latter are, many of them at all events, operating under a limited tenure and other restrictive conditions, and unless the tax is abolished, or a further period of exemption is granted, the result will be that the ordinary shareholder and the electricity consumer will have to bear the burden between them, and electrical and industrial progress will be checked. Where a tax is unfair in its incidence it should be abolished, and we hope that this will be the fate of this obnoxious impost.

The Law Regarding Supply Services.

The question whether electricity supply undertakings should make a charge for connecting installations to their mains is one which has been exhaustively debated from all sides. But whatever the opinion held, it is just as well to know the law on the matter, for even some undertakers do not seem to be clear on the legal position. The obligations of an undertaking to connect installations is laid down in Section 27 of the Electric Lighting (Clauses) Act, 1899. Undertakings must give a supply to all premises within 50 yds of any of their distributing mains. But the undertaker may insist on the prospective consumer paying for that part of the services which runs through the private property. In other words, the undertaker, at most, is only legally obliged to bring the supply just inside the gates, and the consumer is liable for the rest. But this is not all: if the distance from the distributing main to the gate is over 60 ft., then the undertaking can also insist on the consumer paying for all the excess. That is, the undertaking is obliged to pay for, at the most, 60 ft. of service cable along the public highway, and the consumer can be asked to pay for the remainder.

The Newspaper Press Fund.

The technical Press is, by its organisation and duties, rather a hybrid piece of mechanism. It has, as it were, to travel towards two goals at the same time; one of which is the acceleration of engineering progress, and the other the maintenance of all that is best in journalism. To its readers it turns mainly the first of these faces, but, privately, those who are responsible for its conduct are not the less associated with its other aspect. It is, therefore, without the least diffidence that we call attention in these columns to the claims of the Newspaper Press Fund, which was founded in 1864 for the relief of necessitous members of the literary departments of the Press, and for the widows and families of such persons. This fund follows tradition to the extent that each year it appeals by means of a dinner to the pockets of the widest possible public for the assistance and the recognition of a body of men whose work is not only useful, but is carried on under conditions of stress that make premature breakdown a frequent occurrence. This year the dinner is to be held on April 27, at the Hotel Victoria, London, under the chairmanship of Lord Leverhulme, and the occasion will be seized to make an attempt to meet a serious deficit in the receipts, which now amount to little more than half the amount distributed in grants and pensions. The Honorary Secretary is Mr. S. G. Smeed, 11, Garrick-street, London, W.C. 2. *Verb. sap.*

Imperial Water-Power Progress.

Notwithstanding the universal trade depression, the employment of hydro-electric power in Canada continues to develop, for it is calculated that the amount of new plant installed in the past year was 300 000 h.p., a figure which is above the average. This additional plant represents both extensions to existing stations and a fair amount of new construction work, and it is satisfactory to learn that the additional power available is due to Government, municipal, and private enterprise.

Rapid Progress in Canada.

In Ontario nearly 174 000 h.p. in new units were installed, making the total development of water power in that province about a million and a quarter horse-power; in Quebec 89 290 h.p. were added, bringing the total to over one million horse-power; and substantial increases were also recorded in Manitoba, New Brunswick, and Nova Scotia, making the aggregate developed water power in Canada at January last 2 755 980 h.p. This figure is less than a sixth of the estimated available power at ordinary minimum flow, so that there is still plenty of room for expansion even when allowance is made for the large amount of construction work in hand and projected. The recorded power available throughout the Dominion, calculated on the basis of 24-hour power at 80 per cent. efficiency, and under conditions of ordinary minimum flow, has been calculated at 18 255 000 h.p., while 32 076 000 h.p. can be depended upon for at least six months of the year.

Co-operation in Survey Work.

As regards organisation, each of the provinces appears to have its Power Commission, and very useful work is being done in completing surveys and in settling questions of general policy. The Dominion Water Power Branch is co-operating with these Provincial Commissions, and the results are reported to be most satisfactory. For the increased uniformity in methods of investigation has led to greater efficiency and economy. Excluding the Province of Quebec, and apart from special investigations of water-power sources, there are now about 570 stream measurement stations in the Dominion. This figure will give an indication of the importance attached to hydro-electric power in Canada and is a proof of the earnest desire of the Government to utilise its natural resources as far as possible in the best and most scientific way.

Large Units More Used.

There is an increasing tendency to use large units. For instance, on the Queenstown-Chippawa development the turbines will be of 55 000 h.p., and are stated to be the largest of the kind in the world, while at the Du Bonnet Falls on the Winnipeg River the Manitoba Power Co. proposes to erect six units of 28 000 h.p. each. Turbine sets of 5 000 to 16 000 h.p. are now quite common throughout the Dominion. This, though not up to the German standard, is getting on.

Another interesting feature is the fact that a large amount of power is being taken by paper and pulp, lumber, and saw mills, mining and other industries. In fact, new work is mainly undertaken in order to meet industrial requirements. Another development is the increase in the number of rural transmission lines and the extended use which is being made of electricity in farmhouses and in agricultural operations. In the Province of Ontario legislation has been passed to allow a bonus of 50 per cent. for rural power distribution, and as this enabled the Hydro Electric Commission, which supplies a large number of municipalities and rural areas, to quote special rates for rural services, there has recently been a great demand for a supply from farmers. In fact, at the end of the financial year, 1920, the Commission had 1 120 farm services, and it is reported that as a result of special propaganda about 3 500 rural contracts were signed in the latter half of 1921.

Some Financial Details.

Naturally, it would be interesting to have figures of the financial results of all this activity, but so far only the accounts of the Hydro Electric Power Commission for 1920 are available. The annual report states that the results of the year's operations were the most successful in the history of the Commission, though business depression affected adversely the Eugenia and Severn systems. On the large Niagara system the drop in the industrial load was more than compensated for by the increased demand from the municipalities, and towards the end of the year the general growth in business was such that there was not sufficient power to meet the demand, and new customers could not be connected. The total revenue of the Commission was $4 513 404, and after deducting the cost of power, interest, depreciation, and maintenance there was a balance of $714 735 for renewals and contingencies, but when all expenditure was met and the statutory reserves were provided there was a deficit of $147 464, the cost of service to all municipalities exceeding the year's estimate by only 3·16 per cent.

By means of connecting links between the various systems operated by the Commission the surplus power of any one of them is supplied to make up the deficiency of the others, and in this way a more normal and reliable service is maintained.

State versus Municipal Enterprise.

It is generally claimed that electricity supply is cheaper in the area served by the Hydro-Electric Commission of Ontario than elsewhere, but in a long and elaborate

report of over 225 pages to the National Electric Light Association Mr. W. S. Murray, the American expert, asserts that it is not so cheap or so reliable as that given by privately-owned companies in Canada and the United States. The report, which deals with the history and development of the Commission, was prepared in order to obtain economic data of Government and private enterprise in Canada for the guidance of those entrusted with the control and development of water power in America. As the system of the Hydro-Electric Power Commission of Ontario is the largest Government-owned electricity undertaking in existence it naturally came in for close examination, but Mr. Murray's conclusion is that no such system should be employed in the United States, his grounds being that it is subversive of American policy and custom, and, moreover, it is inefficient, expensive and wasteful. Pretty definite this! There is a natural predilection in favour of private enterprise in the United States, though we think that Mr. Murray has proved his case.

Government Service More Costly than Private.

In Ontario, of the total utility income in 1920, two-thirds was derived from those owned by the Government, but in Quebec, where the income from the same class of utilities was only five per cent., the cost of power is 32 per cent. lower, while the productivity of salaries and wages is 32·5 per cent. higher. In capital cost the Commission also compares unfavourably with private undertakings. Formerly it purchased 100 000 H.P. from the Ontario Power Company at about $9 per H.P.-year, and in 1920 the municipalities were supplied with power at $17·65 per H.P.-year, but from the new Queenstown-Chippawa development the cost will be $28·05 per H.P.-year. In consequence of these higher charges and for other reasons the Provincial Legislature has now decided to appoint a Royal Commission to investigate the administration and working of the Hydro-Electric Commission.

General Principles.

Mr. Murray concludes by affirming certain principles, which, though invoked in support of American policy, apply equally well to this country. He states that "accomplishment by individuals in control of private enterprise is under keener observation than is the case when those in charge are Governmental or municipal officers. Governmental ownership eliminates all incentive for gain and throttles initiative. The Hydro-Electric Power Commission is judge of its own acts, and a commission cannot fairly be the judge of its own (and others') rights in disputes. The Commissions of the States fully realise that protection to the people lies in protection to the electric utilities from which they are receiving power. The authority delegated to them to regulate rates, and the constitutionality of the law standing behind any action on their part or on the part of the electric utilities, provides a structure constructively balanced to do justice to all parties."

Principles Not Applicable to Canada.

There will be few who will challenge the main conclusions of Mr. Murray, though the situation in Canada is not analogous to that of the United States. The use of water power and industrial development have reached a more advanced stage in the latter country than in Canada, where many large falls occur in remote and uncultivated districts. In remote areas, where there is little or no demand for power, private enterprise cannot be induced to commence operations. Consequently, Government or municipal aid may be necessary for developing the natural resources of Canada, when it would not be required in the United States where the public utility commissions seem to be giving satisfaction to all parties.

The Situation in India.

Turning to India, where extensive hydro-electrical development is also being undertaken, though in actual construction work it cannot compare with Canada, yet we are pleased to see that progress is being made with the hydro-electric survey, under the superintendence of Mr. J. W. Meares. In India, as we have recently pointed out, there is really greater need of water-power and industrial development than in other parts of the Empire, for it has been acutely affected by trade depression, and no small part of the present unrest is attributable to unemployment. For economic reasons it has been decided that outlay on water storage and water power shall in future be a provincial charge, and we are therefore afraid that the good work which has been done by Mr. Meares may suffer a set back. The third triennial report has recently been published and is divided into two main sections. The first gives technical information and data on development for the guidance of engineers engaged on the actual work of survey, and in the second part 118 pages are devoted to a forecast of the water-power possibilities of the provinces.

Results of Survey.

In the preliminary forecast of the water power at present investigated it is stated that the total power, based on figures of the minimum continuous power available, amounts to 5 582 000 kW, or 7 400 000 E.H.P. Of this total only 213 140 kW has been developed, but four plants of 55 640 kW are under construction. Only in Bombay, Jammu and Kashmir, and in Mysore has there been any serious attempt to utilise water power, though Bihar and Orissa, with an estimated output of over one million horse-power, the North-West Frontier Province, with about a million horse-power, Burma, with nearly a million, and the Punjab, with about 800 000 H.P., are richer in waterfalls. Bengal and Bombay are respectively credited with 670 000 and 644 000 H.P., and there are also substantial amounts to be developed in Assam, the United Provinces, Jammu and Kashmir, and the Central Provinces. Of 1 125 sites and projects listed only 52 have been investigated, and it is probable that the estimate given will be greatly exceeded. In fact, it is stated that the probable ordinary minimum power will amount to over 7 500 000 kW, and the maximum power is put at 12 680 000 kW. If a substantial portion of this large amount of power were developed it would have a most beneficial effect upon the industrial and social position in India, and it would also provide a useful market for British hydro-electric plant and apparatus.

Fresh Legislation Required.

Progress cannot, however, be made until the legislation relating to water-power concessions has been amended so as to attract capital to the industry, and, in addition, Government support and sympathy will be needed for some time in order to encourage the establishment of subsidiary industries. Many of the estimates given in the present report are not final because the survey has not yet been completed on account of the magnitude and difficulty of the work. It must be remembered that, excluding Russia, India is equal in area to the rest of Europe, and as the transport facilities in certain places are very poor we think that the work accomplished by Mr. Meares and those under him is highly creditable, and in due course it will prove of great value to the Indian Empire and the electrical industry.

The Electrostatic Wattmeter.

By G. L. ADDENBROOKE.

The author gives an historical review of the application of the quadrant electrometer to the measurement of alternating currents and dielectric losses and details improvements which he has recently introduced into a new set of instruments. After studying the theory and action of the instrument at some length, he points out that it is mathematical rather than electrical in character, and shows how it may be applied to modern precision measurements.

Historical.

It is difficult to say exactly what the sensitiveness of the Kelvin electrometer was, but in 1882 Hopkinson read a Paper before the Physical Society, from which it may be gathered that working under normal conditions, the constant of his instrument was about 0·33—that is, with 100 V on the needle and 1 V between the quadrants, the deflection would be of the order of 33 mm. on a mm. scale at 2 m. distance. In concluding this Paper, Hopkinson says :

> The invention of the quadrant electrometer by Sir W. Thomson may be said to have marked an epoch in electrostatics, and the instrument from time to time finds new uses. It therefore seems well worth while to make known observations made upon it in which the instrument itself has been the only subject studied.

Application to A.C. Measurements.

Although Hopkinson does not say so, I know he had in his mind in this study the question of the application of the instrument to alternating measurements. Some three years later, I built and began to study an instrument of this type myself. Consideration satisfied me that there were primarily two desirable alterations needed to adapt the instrument for alternating measurements. The first was to get rid of any uncertainty implied in charging the needle alternately through sulphuric acid, as in the Kelvin and other instruments of the time. Secondly, an increase in sensitiveness was very desirable.

It was not until several years later, viz., about 1898, that Colonel Crompton, who was working at improving the D'Arsonval galvanometer gave me some phosphor bronze strip finer than had been obtainable so far. This met the first of the above points, and at the same time the sensitiveness of the instrument could be increased about three times, that is, under the above conditions, 1 V between the quadrants with 100 V on the needle, could be made to give 100 scale deflections readily.

It was on this basis that the instruments were constructed which I described in the paper I read at the Paris Electrical Congress, a copy of which appeared in THE ELECTRICIAN in 1900*. I mention this because a certain number of these instruments are still in use.

Application to Measurement of Dielectric Losses.

About 1900 dielectric losses in cables and other insulating materials were beginning to attract attention. Having mentioned the matter to the late Dr. Muirhead, he was good enough to place at my disposal at this time a condenser of five separate microfarads as built by him for submarine cable work. I had means of generating alternating voltages of 83 ~ up to 1 200 V, and it was found that these condensers would stand this P.D. without strain. The instruments were therefore connected up in circuit with these condensers by means of a shunt with a ratio of about 10, and with a drop of about 15 V in the series resistance inserted between the quadrants. Everything seemed in order, but the wattmeter gave a minus reading.

On looking into Maxwell's formula it seemed correct that it should do so with a shunt of such multiplying power if the power factor was below a certain value, but to make sure I wrote to Dr. Russell, who came to see the experiment and some variations.

Measurements at Low Power Factors.

Dr. Russell on the data obtained then suggested the formula which I used in two articles in THE ELECTRICIAN in 1901, which covered a preliminary investigation of the working of the instrument at low and high voltages and at high and low power factors. This formula Dr. Russell describes in his book on alternating currents.

* THE ELECTRICIAN, Vol. XLV., p. 901.. Oct. 5th, 1900.

Working in America, Miles Walker, in June, 1902, in the Journal of the A.I.E.E., described experiments on somewhat similar lines, and made a number of suggestions for coupling up the instrument to circuits which are worthy of attention.

Since then not much has been published on the use of the instrument at low power factors, until Mr. Parry's Physical Society Paper last year, though I have continued to use it in my work on dielectrics.

In 1902 I was asked to experiment on high tension paper cables for Henley's Telegraph Company, as uneasiness on the subject had arisen owing to a Paper by Mr. Mordey at the Institution of Electrical Engineers, which provoked a long discussion. These experiments, which were very complete for the date, showed power factors a little under 1·75 per cent., though to get them, working with 100 V on the needle and a shunt of about 60 ratio, we used as much as 20 V drop across the quadrants.

The instruments were not arranged to the best advantage; it was a case of doing the best at short notice. Subsequent experiments showed, however, that the results were closely correct, and therefore gave confidence in the method.

Need of Greater Sensitiveness.

Consideration, however, showed that better results and greater accuracy would be secured by making the instrument more sensitive. This would also adapt it for obtaining results on lower capacities. I will not detail the steps by which this was gradually accomplished, but at the end of 1909 I had constructed a workable instrument with a constant of from ten to twelve, or, say, ten times as sensitive as the one already mentioned and about thirty times that of the Kelvin instrument. With 100 V on the needle, one could get now a deflection of 100 to 120 mm. under the above conditions, with 1/10 V drop between the quadrants at unity power factor. At the same time good coincidence of the electrical and mechanical zeros was attainable. As this instrument was sufficiently sensitive for the work on dielectrics I was contemplating, I left the matter, effecting detail improvements from time to time, until the war put an end to experimental work.

Recent Results.

Within the last year I have had a new set of instruments built embodying a number of further desirable points and taking advantage of some improvements in drawing fine metal strips. The result is that I have now for some months been using a workable instrument with good control of the electrical and mechanical zeros which has a constant of over 40, or with 100 V on the needle and 1/10 V between the quadrants gives a deflection of over 400 mm. at 2 meters at unity power factor. This is on a par with the sensitiveness of the Dolzalek instrument using a quartz fibre suspension and with a fixed charge on the needle. The period under these circumstances is rather long, but the instrument is nearly dead beat, and easily workable for experimental purposes. Such sensitiveness is, however, seldom necessary, and therefore I shall only assume a constant of about half this.

Theory of the Instruments.

The simple form of Maxwell's equation,

$$\theta = VV_1 - \frac{V_1^2}{2}$$

which is used in practice is readily turned into :

$$W = \frac{1}{R}\left(\frac{\theta}{L} - \frac{C^2R}{2}\right)$$

Where W = watts expended in circuit, θ deflection. L inst.

constant, R = ohms in series non-inductive resistance and $\frac{C^2R}{2}$ = loss in half series resistance. This is for an instrument directly coupled across the circuit.

The position for very low power factors can be seen by taking the limiting case that W, or the watts expended in the condenser, = O which can be very nearly attained practically with the highest class of air condensers kept in a dry atmosphere.

For simplicity take R as 1 O, we then get :

$$\theta = \frac{1}{1}\left(\frac{\theta}{L} - \frac{C^2R}{2}\right)$$

From which

$$\frac{\theta}{L} = \frac{C^2R}{2}$$

Or there is still a plus deflection, but it is due to the equivalent of the loss in half the series resistance being included in the measurement under all circumstances.

Let us consider what this means from a practical point of view with an instrument with a constant of 20, an alternating circuit P.D. of 100 V on the object on which the measurement is to be made, and assuming the current through R is 1 A and its resistance 1 O, or there is 1 V drop between the quadrants, the instrument being directly coupled across the circuit.

At unity power factor the loss in such a circuit with 1 A flowing and 100 O across the circuit measured would be 100 W plus 0·5 W for the loss in half the series R, and the instrument would give a deflection of $100 \times 20 \times 1 = 2\,000$ mm. plus 10 mm. for the loss in half the series resistance.

Action with Perfect Condenser.

But if a condenser *without loss* instead of the resistance is now substituted across the circuit, still taking the same current, the charge will equal the discharge, and the two opposite forces impressed on the needle owing to the capacity effect balance. The only deflection which results is now due to the loss in half the series resistance, which is 10°, and this deflection evidently is equivalent to the loss due to 0·5 of 1 per cent. power factor.

Suppose we now assume our condenser itself has a power factor of only 0·1 of 1 per cent. or a loss of 1 part in 1 000. The deflection of the instrument will be due to 0·5 per cent. plus 0·1 per cent. or 0·6 per cent. power factor, and will be increased by $\frac{10}{5} = 2°$ or to 12 mm. This means that out of the total deflection obtained 5 parts are due to the loss in half the series resistance, and 1 to the loss in the condenser itself.

Assuming that we can read to $\frac{1}{4}$ mm. on the scale, we should be able to read the power factor of 0·1 per cent. to about 10 per cent. accuracy, everything else being taken as equal, but there is the difficulty that under these conditions the current flowing must be measured separately ; we are therefore on the verge of what we can do with such a power factor.

Effect of Varying Condenser Losses.

Suppose, however, the loss in the condenser is 0·2 per cent. instead of 0·1 per cent., we should get now 4 mm. deflection for this, while the loss in the series resistance would remain the same, we have therefore doubled the deflection for the condenser loss, and at the same time reduced the ratio of the condenser loss to that in half the series resistance to one half. We might now with a little care measure such an actual condenser loss of 0·2 of 1 per cent. and take the power factor found as, say, between 0·215 per cent. and 0·185 per cent.

Every increment of 0·1 per cent. in the condenser loss makes the position correspondingly better. At 0·5 per cent. power factor the loss in the condenser becomes equal to the loss in half the series resistance, and the deflection is 10 mm. for each of these factors, or 20° actually. Now, outside a very narrow range of conditions, in practice 0·5 per cent. is a very low power factor indeed. I have dealt with the above conditions at some length because they also cover the conditions under which zero methods must work. In these we balance out the deflections and read the results in terms of resistances.

Improved Working Conditions.

We will now consider what possibilities are open for improving the working conditions. The most obvious is to increase the drop across the series resistance. This is what Mr. Parry did in describing his zero method ; he increased the drop to about 2·5 V. This increases all the deflections proportionately. It still, however, leaves the ratio of the loss in half the series resistance to the loss in the condenser the same.

There is, however, another alteration we can make. We can raise the P.D. on the needle to 200 V. The instrument mentioned above will stand this for approximately the same constant—200 V is a very convenient voltage for this class of work.

This, if everything else is left the same, doubles the current and increases the condenser and series resistance losses four times, and consequently the deflection. We can, however, reduce the series resistance to half, which will still leave us with double the deflection we had before for the loss in the condenser, but the deflection for the loss in the series resistance alone will now be the same, so that we have reduced the ratio of the two to one half.

Assuming that under these conditions, viz., with 200 V on the needle and 2 V between the quadrants, we now examine the figures, it will be seen that at 0·1 per cent. power factor, while we shall get 20° deflection for the loss in half the series resistance, we shall now get 8° deflection for the loss in the condenser. We should now with care be able to get results for a power factor of 0·1 per cent. within something of the order of 5 per cent. accuracy.

Higher Voltage and Constants.

It is also possible to go further in the direction of raising the voltage on the needle without proportionately reducing the constant, the quadrants being set further apart. Again, I have mentioned that it is possible to get a higher constant on the instrument than has been assumed above, which enables the proportionate drop across the series resistance to be still further reduced.

I think, therefore, it is not going too far to say that with a sufficiently sensitive electrostatic wattmeter, directly coupled across the circuit, under conditions which can be reproduced practically, it is possible to measure power factors of 0·1 per cent. to an accuracy of less than 10 per cent., and that for each 1/10th of 0·1 per cent above this, the accuracy and facility of making measurements increases almost as the square of the power factor.

Having gone so far, it is desirable to turn to other sides of the question, but before doing so I would add that it is assumed that a fairly good wave form is used. Also, if the capacities are very small and high series non-induction resistances must be used, the loss in the leads connecting and operating switches, mostly surface leakages, become a factor to be reckoned with, particularly in damp weather.

Measurable Capacities.

I have been able to get results of value on capacities down to 1/1000 m.f. working on a 100 V circuit at 50 periods and down to power factors of the order of 0·1 per cent., but the ease and certainty with which one works rapidly increase as both the circuit P.D. and the capacity are increased.

The capacities met with in testing 6 in. sheets of thin dielectrics are much in excess of this, while outside a very small range of dielectrics, power factors under 1·5 to 2 per cent. are rarely met with. Many materials are used for insulation and other purposes for physical apparatus, and in engineering, the power factors of which range from the above to 5, 10, 20 or even 80 per cent. For instance, high pressure paper oil cables have usually power factors not much under 2 per cent. The condensers used for correcting power factors in motors are guaranteed as having power factors something under 0·5 per cent., but outside these and air and standard mica condensers one seldom meets with these very low power factors in practice. The real question is to have

a relatively simple reliable method of reasonable accuracy to attack all the problems met with in these materials under the different conditions under which they are employed in science and in practice.

Low P.F. Measurements with Shunt of Two Ratio.

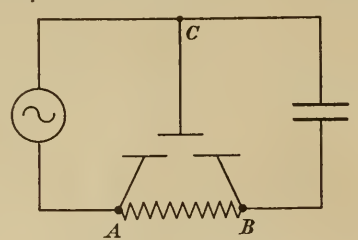
Returning, however, to our subject, for very low power factor measurement there is a second method of proceeding, viz., to employ a shunt across the circuit and connect the wattmeter needle to the middle point. The actions occurring then balance out the loss in half the series resistance, and the instrument readings give directly the loss in the condenser or other apparatus tested alone.

The possibility of doing this was first pointed out by Dr. Russell in the memorandum he sent me after seeing the experiments mentioned at the beginning of this Paper. I mentioned it in my ELECTRICIAN articles of 1901, and have made a practice of using it since for measurements of less than 0·5 per cent. power factor. At the same time Dr. Russell pointed out that this was an advantageous method of using a shunt, as it would be symmetrical if properly constructed. These direct readings can now, by the help of Dr. Owen's extension of Mr. Parry's suggestion, be turned into zero readings if required.

Theoretically we can also now increase the drop across the series resistance as much as we like, but in doing this to a very considerable degree another question arises which was raised in the debate on Mr. Parry's Paper, and which I am inclined to think is the really fundamental one in the working of the electrostatic wattmeter at very low power factors.

Action of Instrument.

In the view of the physical actions occurring in the instrument which I have always taken, it must, as Mr. Parry also stated in his Paper, be looked on as two separate instruments in one when used on low power factors. Take the case when



CASE OF CONDENSER WITH NO POWER FACTOR.

the condenser has no power factor. The greatest difference of potential between A and B (see Fig.) will occur when there is no E.M.F. in the generator circuit, consequently C is short circuited to A, and the instrument is connected as a voltmeter across A B with half the heterostatic constant and the maximum current flowing in A B. Now the voltage across A B on the basis $\frac{E^2}{R}$ measures the watt loss in A B if it is non-inductive or if we use the heterostatic constant of the instrument the watt loss in half A B. The deflection in the diagram above for this will be to the right, while any deflection as a wattmeter due to loss is to the left (the leads are crossed in practice).

The actual deflection of the needle is due to the resultant of these two opposite torques. That is, the deflection is proportionately less than the watts expended in the condenser and the series resistance by $\frac{V_1^2}{2}$ the physical effect of this being in the negative direction.

Effect of Doubled Voltage.

Taking the action with a shunt of 2. Doubling the voltage under these circumstances does not increase the potential on the needle, but doubles the current through the series resistance. This increases the wattmeter plus deflection corresponding to the actual loss in the resistance to double, but it increases the minus deflection due to the $\frac{V_1^2}{2}$ component four times. The result is that in this case the positive deflection for the loss in the series resistance is exactly balanced by the negative deflection due to the voltmeter action and the actual needle deflection is due to the loss in the condenser alone.

With higher values than 2 of the shunt, if the loss in the condenser is nothing or very small, we now begin to get negative readings, increasing as the multiplying power of the shunt is increased until finally in the limit the deflection is due to the voltmeter action alone and is in the minus direction.

Take the formula I have found most convenient for such readings :—

$$W=\frac{N}{R}\left\{\frac{\theta}{L}+A^2\left(\frac{1}{2}-\frac{1}{N}\right)\right\}$$

Where W = watts expended in condensers. N = value of shunt. θ = deflection. L = heterostatic constant. A^2 = square of volts drop across series resistance.

We can write :—

$$\frac{WR}{N}=\left\{\frac{\theta}{L}+A^2\left(\frac{1}{2}-\frac{1}{N}\right)\right\}$$

Assume that $W=O$ then $\frac{WR}{N}=O$.

Consequently $$\frac{\theta}{L}=-A^2\left(\frac{1}{2}-\frac{1}{N}\right)$$

Take for example $L=20$, $A=3$ or $A^2=9$, $N=20$

$$\frac{\theta}{20}=-\frac{9}{2}+\frac{9}{20}$$

$$\theta=-81.$$

The full minus deflection apart from the component of the loss in the series resistance included would be $\frac{9\times 20}{2}=-90$.

Useful Preliminary Calculations.

I find this method of looking at the actions occurring physically convenient, as it enables one to calculate beforehand the approximate deflections which will be obtained under any given set of conditions. For this purpose I first assume what the loss in the circuit would be at unity power factor with a given convenient series resistance and current. For low power factors the loss will be directly proportional to the power factor; say, for 1 per cent. power factor we divide the loss at unity power factor by 100 and take the result as our watts in the above equation. Knowing the constant of the instrument, we can then take different values of the drop in the series resistance and find what drop will give, on the whole, the best result with any given sensitiveness of the instrument.

Basis of the Instrument's Action.

Assuming that this view of the actions is sound, the ultimate correctness of the instrument seems to depend on whether the torque due to an E.M.F. generated by the current alone can under all conditions which may practicably arise be correctly balanced against a torque dependent on the same current, but multiplied into the pressure across the circuit.

As regards this it is clear that we have not to do with instantaneous effects, but to the integrated effects over a whole cycle in each case ; as far as I can see, the two will always be directly proportional, and can therefore be correctly balanced against each other, so long as the conditions of symmetry are not too far departed from and the deflections are moderate.

A Zero Method.

Assuming that this is so, it will be seen that when shunts of a value higher than 2 are employed we are really balancing the loss in half the series resistance multiplied by N against the loss in the condenser as far as it will go, and by suitably adjusting the series resistance a complete balance can be obtained resulting in a zero reading.

Practically this can be done under good working conditions for power factors of, say, 0·5 of 1 per cent. to about 3 per cent., which it happens are the power factors met with in cables and over a wide range of the higher class of dielectrics.

It will be seen that under these circumstances a balance can be secured under very perfect conditions; we balance the loss in the condenser against the loss in a non-inductive resistance in series with it, the same current acting on both. The value of this resistance will be accurately known, and the current flowing in it can be measured to less than half of 1 per cent. accuracy. No extra apparatus is needed and the same arrangement permits results being got either on the basis of actual deflections or by balancing out to zero. The constant of the instrument as a wattmeter is easily and quickly obtained under working conditions and remains substantially the same for long periods, but obviously when using the zero method this is eliminated.

The Instrument as an Ammeter.

Again, as regards measuring the current, with a constant of 20, the wattmeter with the needle short circuited to one of the quadrants becomes a voltmeter with a constant of 10, the deflection increasing as the square of the voltage. Consequently a drop of 2 V will give a reading for the current in the series resistance of 40 mm. and 3 V drop a reading of 90 mm., these deflections altering as the squares are easily read to less than 1 per cent. The wattmeter may, therefore, be also thus used as an ammeter, without alteration of the arrangements, for measuring the circuit current, and therefore the single instrument will give all the necessary data for calculating power factors and measuring capacities as well as actual losses. For careful measurements of capacities I have, however, found it better to supplement this arrangement by putting a throw over switch in the testing leads, and balancing the capacity current into the dielectric tested against the same current into a set of standard variable condensers. This gets rid of the difficulty of wave form, and the capacity to a close degree of accuracy can be read off the variable capacity directly and without correction up to power factors of say 8 per cent.

The Electrometer To-day.

The instrument is now really what used to be called a mathematical instrument rather than an ordinary electrical instrument. The principles in its modern construction have much affinity to those needed in the chemical balance. In fact, it is a very delicate and accurate torsion balance for weighing the difference of two electrical pulls in place of two gravitational pulls.

To measure a power factor of 0·1 per cent. we are measuring 1/1 000th of the forces operating in the circuit. Suppose we can measure this 0·1 per cent. power factor to 5 per cent. accuracy, we are measuring the difference in these forces to 1 part in 20 000, and this while these forces are alternating at say, 50 ~, or there are 200 charges and discharges per second. Looking at the matter from a thermodynamic point of view, we have in the charge and discharge of a high class condenser probably the most perfect reversible action in nature.

Applications of the Instrument.

In what I have said above I have dealt with the most difficult work to which the instrument can be put, viz., the losses in high class condensers. But it is equally applicable to the measurement of induction. For instance, suppose we take an air core transformer wound on the best principles, the lowest loss which can be got in such a case, owing to the resistance of the copper, is about 2 per cent. at ordinary frequencies. If we put in iron we can reduce the copper loss to very small proportions, but instead we have the iron losses, and it is very difficult to keep the losses even in large transformers below 2 per cent. on open circuit. Consequently working on circuits having inductance no power factors less than about 2 per cent. are met with under ordinary circumstances, and what has been said above regarding condensers of 2 per cent. power factors applies here also.

Reviews.

Experimental Wireless Stations. By Philip E. Edelman, E.E. (London: Henry Froude and Hodder & Stoughton). Pp. 392. 16s. net.

It may be a little harsh to say that this volume is superfluous, but nevertheless, there is nothing in the book which has not been said before, and said a great deal better, The author, though no doubt widely-read, betrays every now and again an imperfect grasp of his subject and an ignorance of relative values which is thrown into relief by his occasional attitude of authority and almost patronage.

The result of an attempt to cover nearly all branches of wireless is that many sections are very briefly described and often consist of three lines and a diagram. Chapter I. gives an account of the nature of wireless transmission. This account is weak in parts and hopeless in others, as when discussing the "condenser theory of propagation," and the Heaviside layer theory. On p. 18 we are told that the condenser formed by the two aerials becomes leaky when it rains, and that this is why signals are worst in wet weather (a questionable fact).

The second chapter brings us to aerials. Local telephone or light companies are given a very good character, for not only do they allow you to use their poles but some "will even give aid if properly approached." The touching spectacle of a Post Office lineman "giving aid" would soften the hardest heart.

Chapter XII. contains descriptions of arcs, high-frequency alternators, &c. Chapter XIV. deals with valves. The Fig. 74 circuit for obtaining curves shows the milliammeter A measuring not only the anode current but also the current through the anode voltmeter. Fig. 84 shows a collection of miscellaneous valve circuits. Circuits VII. should show the telephones in the anode circuit of the last valve in place of R. Grid leaks are omitted in all circuits. Fig. 90 omits a connection between B and the line beneath it.

The author states: "A crystal will even detect signals from arc and undamped wave sets under favourable conditions. The author has heard such signals when using a detector in a receiving circuit containing a variometer coupler, which caused the necessary reaction in the circuits." Comment would be superfluous.

Chapter XV. brings us to radio-telephones. Fig. 101 shows a valve transmitter in which the power is taken from the grid oscillatory circuit instead of from the anode circuit.

The U.S. Army set of Fig. 108 is reproduced incorrectly. The battery in the grid circuit of the oscillator is in an ineffectual position. The anode battery is shorted and a condenser should appear between the anode of the oscillating tube and the aerial inductance.

Chapter XIX. shows a number of crystal circuits. Fig. 131 will not work as the potentials across L and C will neutralise each other. The other circuits show the telephones directly across the crystal. In Figs. 133 and 134 the telephones should be across C. Fig. 136 is impossible. The detector is directly shorted. Fig. 137 is worse if anything, the detector being shorted and the telephone circuit being open.

While there is much matter in the book, there is little which is deserving of praise, and the recurrent fault, apart from multitudinous inaccuracies, is that everything is so sketchily described as to render it almost valueless.

John Scott-Taggart.

Lexique Technique Anglais-Francais. By G. Malgorn. (Paris: Gauthier Villars et Cie.) Pp. xxi. + 216. 10 francs.

This book, the publishers' announcement tells us, fulfils a real want as the best English and French dictionaries do not translate sufficiently well technical words and expressions. This, of course, is the case, but there are now on the market a large number of technical dictionaries which do fulfil this want as far as it ever can be fulfilled. Every technical dictionary is at best but a guide, and the translator's experience must be the final court of appeal. Within these limits the book may be recommended and seems to contain exceedingly few mistakes or weaknesses. We notice that no translation is given of the terms gasfilled, zigzag transformer, nor phase advancer, but perhaps we are asking too much for ten francs.

Auxiliary Features in Automatic Telephone Systems.*

By W. AITKEN, M.I.E.E.

Branch Offices Calling Locally without Utilising a Trunk to the Main Office.

The method of operating branch, satellite, and other small offices in connection with a multi-office system is an interesting problem. It is not considered expedient to place a first selector at a small office with another first selector at the main office, as this would mean an extra digit as a prefix for the numbers appertaining to the small office. Usually the trunks are connected to the second selectors at the main office, but this necessitates, when the calling and the called parties are in the same small office, that two trunks are used between the small and the main office. This may mean that the equipment is expensive.

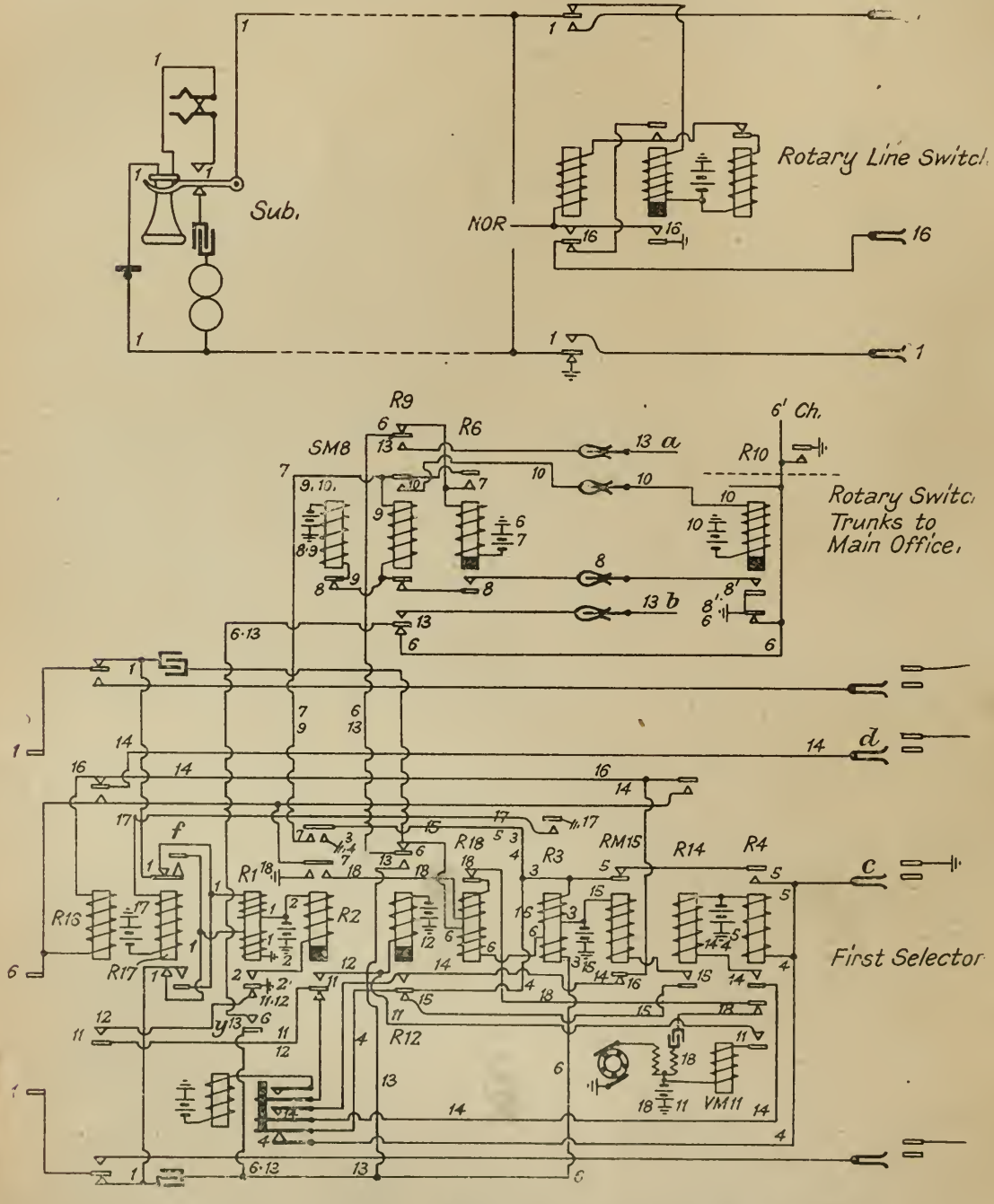
Several devices have been suggested to render the use of main office trunk in a local call unnecessary, and the diagram shows one of the Automatic Telephone Manufacturing Company's methods of achieving this end.

A rotary switch is used in combination with a selector at the branch office. The operation of the rotary line switch shown in the diagram is assumed to be known.

On lifting the receiver the calling line is extended to the selector and the rotary switch selects an idle trunk to the main office. The impulses of the first digit operate the selector shown and also a first selector at the main office. In the latter case, if the level to which the wipers are raised corresponds to a branch office number the terminals will be "dead," and the trunk is at once released and succeeding impulses are received on a selector and connector in the branch office over a local circuit.

If the level first selected corresponds to a main office number the selector shown takes a single rotary step only and subsequently acts as a repeater to repeat the remaining impulses Busy tone is given if all the trunks to the main office are busy.

The rotary switch has no normal position, and is arranged to take a step forward when released so that, should a caller have been connected with a faulty line he can, by replacing the receiver momentarily, immediately connect with another idle trunk.



PBx Calling Locally without using Trunks through Central. A. T. M. Co.

The circuits on a local call are as follows :—

1. When the receiver is lifted the caller is extended to a selector in known manner and R1 energises.
2. R2 (guard) energises.
3. Polarising circuit of R3 (this is neutralised by circuit 6).
4. R4 energises.
5. R4 locking circuit.
6. R6 energises (line relay of rotary switch).
7. R6 locking circuit.
8. Rotary switch stepping magnet SMS connected to test wiper. The rotary switch advances until it finds an unearthed test terminal of an idle trunk. R9 has been short-circuited over circuit 8.
9. R9 energises, opens circuit 6 and R6 slowly de-energises.
10. R10 of an idle trunk energises and engages the trunk over a circuit 8 to earth. Earth is cut off the starting wire 6 of the group of rotary switches. Earth remains connected at some other point while a trunk to the main office is idle.
11. The vertical magnet VM11 is energised on the 1st series of impulses.
12. R12 energises in parallel with VM11.

The windings of R3 and R18 in circuit 6 are short-circuited to give the impulses a clear path to trunk over *a* and *b*.

13. Impulse circuit to trunk referred to above.

After the impulses R12 de-energises. The rotary relay R14 and rotary magnet RM15 co-operate in known manner to rotate the wipers.

14. If the first trunk is busy R14 energises.

15. RM15 energises and the wipers take one step. Circuit 14 is open and R14 de-energises.

Circuit 15 is open and RM15 de-energises, and so on. At the first energisation of RM15, circuit 5 is opened, but R4 remains energised over the wiper *c*. All the terminals are earthed on the levels serving the second selectors of the branch office.

16. When the test wiper *d* reaches the unearthed terminal of an idle trunk the switching relay R16 energises (maintained in series with R14 which does not energise), and opens circuit 1 so that R1 de-energises, then R2, R6, R9 and R10 de-energise. In the interval between the de-energisation of the last three relays, earth, over circuit 8, is connected to M8 to step the wipers to the next trunk.

A Call to the Main Office.

The operations are similar to those described up to the point where the selector shown takes its first rotary step. R4 then de-energises because all the terminals corresponding to main office connections are blank. R14 circuit is open at R4. R16 circuit is also open and the rotary movement is brought to a stop at once. Relay R1 is in circuit so that succeeding impulses are repeated at contact *y* (circuit 13) over the trunk *a*, *b*.

17. When the call is completed and answered the reversal of current in the trunk *a*, *b*, causes the polarised relay R3 to energise, because the currents in the two circuits now assist each other instead of neutralising. R17 then energises and reverses the current to the calling station.

Busy Signal when all Trunks are Busy.

If all trunks to the main office are busy no earth is connected to the wire *Ch* and no circuit 6 completed when R1 is energised. The switch is not set in motion.

18. When R4 de-energises busy tone is through R18, which vibrates and induces a tone in the lower winding.

An Electrically Controlled Bascule Bridge.

An interesting example of the application of the electric drive to such heavy and intermittent work as bridge operation, is to be found in the bascule bridge which has recently been installed at the King George V. Dock, North Woolwich, by the Port of London Authority. A good deal could be written about the advantages of electrical operation for this class of work, but we may confine ourselves to a description of the control gear, which contains some unusual details owing to the fact that the bridge is designed for automatic working.

The contractors for the bridge, which is shown in Fig. 1, were Sir Wm. Arrol Company, Ltd. All the control gear for opening and closing the locking bolts, the main leaves of the bridge, and for operating all the auxiliary motors, was supplied by Electric Control Ltd. All these operations are carried out from one position by means of master controllers in the control tower built beside the bridge.

The two leaves of the bridge are driven independently, two motors being employed in each case. These operate through dog clutches and suitable reduction gearing. The motors are mounted two on each side of the waterway, and one contactor controller on each side operates the two motors and also controls the electrically operated brakes for holding the bridge in any definite position. The locking bolts are operated by reversible motors mounted adjacent to the bolts in the bridge leaves, each motor being controlled separately by the master controller in the control tower, which operates contactor controllers installed in the motor room below the bridge. The motors which drive the pumps for supplying oil to the main bearings and the sump pumps for the bridge, are also operated from switches on the main supply panel in the control tower.

The electricity supply is taken from the mains through a meter and fuses to the main supply panel. This panel has mounted on it distribution switches and fuses for the various power and lighting circuits, and overload protection relays and regulators for the sump motors. A set of indicating meters for current and volts and water levels are fixed in a convenient position on this board.

The Master Controller.

The master controller (Fig. 2) is fixed so that the operator can control all the operations from one position, in which position he has full view of the whole bridge and waterway. He can also, from the same position, follow the operations from the indicating board.

Describing the operations in the usual sequence in which they occur, the operator after energising the main distributing panel by closing the supply switch starts up the motors driving the oil pumps. By operating the master controller for the bolt motors he switches them on to the line, one after the other, through a buffer resistance. The motors, it may be added, are stopped automatically by the withdrawal of the bolt (see Fig. 3). This latter action is accomplished by a tappet switch which is fixed alongside the motor and operates a tappet on the bolt (see Fig. 4). The tappet switches at the same time reverse the connections for the armatures of the motor, so that they are ready for starting up in the reverse direction by the master controller, when it is operated again. When the last bolt is withdrawn, and not before, the operator can operate the controllers for the main motors, as they are electrically interlocked with the controller for the bolt motors, and cannot be energised before they are all in position for the safe operation of the bridge. By operating the contactor controllers by means of the

Fig 1.—General View of Bascule Bridge, King George V. Dock.

master controllers the main motor is started through a diverter resistance, which allows the motor to run at a very slow speed only. On the succeeding steps the speed is gradually increased, but the connections of the main controller are such that on each step of the

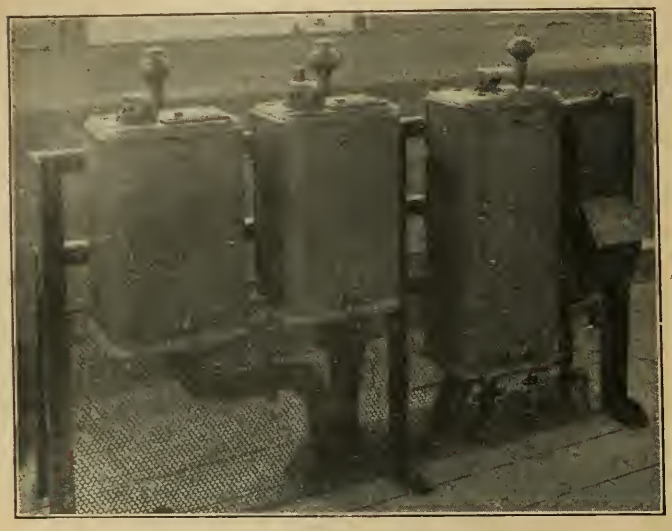


Fig. 2.—Master Controllers in Operating Cabin. Each of the small master controllers operates one of the contactor panels controlling two of the main motors. The larger master controller operates the contactor panel controlling the bolt motors.

master controller the motor will run at a fixed pre-determined speed, which is practically unaffected by the wind pressure on the bridge or other variations in the load.

Operations on Closing.

When the bridge approaches its final open position, the control is automatically taken out of the operator's hands, the bridge being

Fig. 3.—Contactor Panel controlling the Bolt Motors, which are series wound reversible.

then controlled by tappet switches operated by the bridge leaves. These tappet switches automatically slow down the bridge to a very slow speed before it reaches the final position, and finally stop it, the brakes being applied independently of the operator. The operator can, however, perform the same operations and thus stop the bridge before it reaches its extreme position, but he has no means of delaying this operation beyond the pre-determined safe limit. When it is necessary to close the bridge again, the operator has full control over the motors and can accelerate them up to full speed independently of the position of the leaves. As soon as they approach the closed position the control is again taken out of the operator's hands and is effected automatically by the operation of other tappet switches, which first slow down the motion of the bridge to a pre-determined slow speed and then finally stop the motors and apply the brakes.

Having closed the bridge, the operator can then, but not before, operate the bolt motors and close the locking bolts. The bolt motors, as in the opening operation, stop automatically as soon as the bolts are closed, quite independently of the position of the master

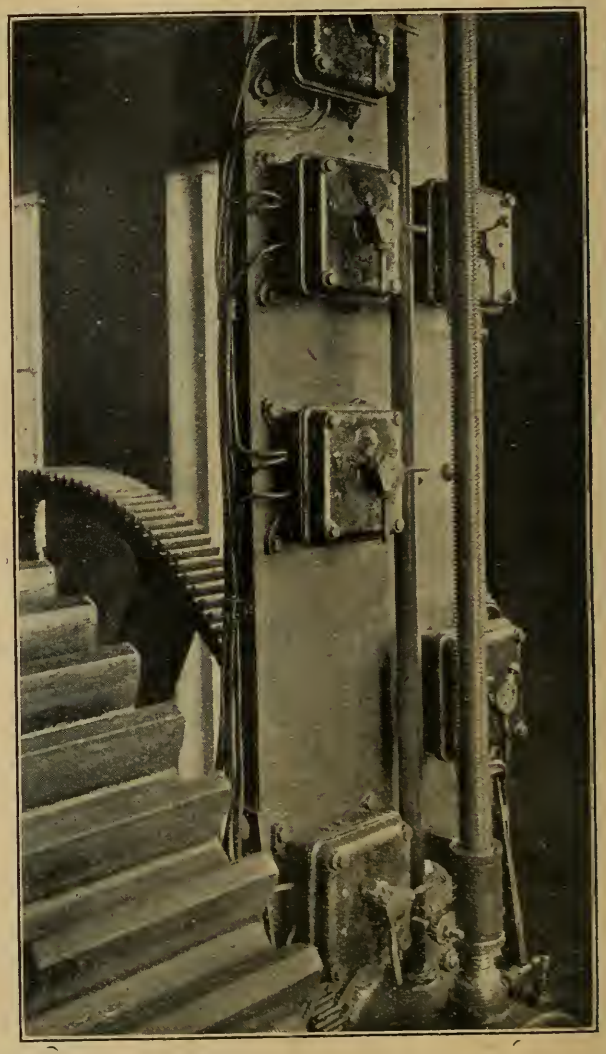


Fig. 4.—Limit Switches, showing operation by travelling screw tappet, which operates the switches in correct sequence according to position of bridge.

controller in the control room. The electrical interlocking is, therefore, so arranged that the operator cannot start the main motors before all the bolts are actually withdrawn, neither can he start closing the bolts before the bridge is completely closed and the main motors stopped.

Conditions at Night.

During the opening and closing of the bridge, the tappet switches also control indicating lamps on the indicating board in the control room, thereby enabling the operator to see the position of the bridge even in the dark. A special depth indicator is used in the control room for showing the water level in the recesses for receiving the counterweights and the tail ends of the leaves in their open position. This indicator is operated by a float and counterweight, which, through a chain, operates contacts for a voltmeter connected as in a potentiometer across a variable portion of a resistance which is permanently connected to the line. This meter is graduated directly in feet so that the operator can see at a glance the depth of the water and when he is required to start the sump pumps.

The Electrical Equipment of the D. R. Cotton Mills.

Modern Methods in Tyre Manufacture.

In an article by Mr. J. T. Randles, which appeared in the 1921 Textile Issue of THE ELECTRICIAN, a reference was made to the electrical equipment which was being installed in the D. R. Cotton Mills, Rochdale, of the Dunlop Rubber Company. Through the kindness of the ENGLISH ELECTRIC COMPANY we are now able to give some further illustrated particulars of this modern electro-textile installation.

These mills, which consist of both spinning and weaving sections, were built in 1914 to produce the fabric, &c., used in the manufacture

FIG. 1.—250 H.P. MOTOR DRIVING DOUBLING FRAMES.

of Dunlop tyres, and during the last two and a half years extensions considerably larger than the original mills have been added to meet the growing requirements of the company. Power is obtained from the Rochdale Corporation, the transmission pressure being 10 000 V (three-phase, 50 periods), and two transformer sub-stations, 10 000/400 V, are provided in suitable positions, one with an ultimate capacity of some 10 000 kVA, for supplying the spinning section and the other of rather smaller capacity for the weaving section. From the low-tension switchboards in these sub-stations three-phase feeder cables run to low-tension distributing switchboards of the ironclad industrial type.

The new spinning mill is a ring spinning and doubling mill of seven storeys, square in form, covering about three-and-a-quarter acres. The first flat or basement is arranged partly as a store and partly as a blowing room, the second flat as a doubling room, the third, fourth, fifth, and sixth flats as carding and spinning rooms and the seventh flat as a finishing room.

The Cable System.

Owing to the large power involved (some 9 000 H.P.), the satisfactory installation of the cables would have been a very difficult matter unless proper provision was made while the mill was being built; the cable system was, therefore, planned in detail, all fixings, conduits through walls, &c., being built in as the building proceeded. The final running of the cables was thus greatly facilitated, and masons' attendance, cutting away and making good, was reduced to a minimum.

For the main power feeders and distributors it was found convenient to use only three sizes of cable—0·3 sq. in., 0·2 sq. in., and 0·1 sq. in., all three-core; in the case of the feeders three or four 0·3 sq. in. cables were run in parallel in preference to using larger sizes, as above this size the permissible current density per sq. in. of area is considerably reduced and the cable becomes very unwieldy from the point of view of installation. Further, this arrangement permits any feeder to be conveniently duplicated in future if required. The cables are all paper-insulated, lead-covered and single-wire armoured, and the armouring is galvanized (left bright) and provided with a spiral binder wire to keep it in place during installation. This type of cable, it is claimed, is very suitable for use in cotton mills, as it is more easily kept clean and free from fluff than a served or braided cable, and it is unaffected by the fairly high temperature sometimes found in textile mills. The cable was manufactured and installed by Siemens Brothers & Company.

Sub-Stations.

The larger of the two sub-stations referred to above abuts on one of the staircase towers of the mill, and switchrooms for accommodating the distribution switchgear are incorporated in this tower, one switchroom being provided for each flat. One of the walls of the tower is utilised for carrying the main feeder cables from the sub-station to the various switchrooms. As these cables weigh nearly 30 lb. per yd. run each, it was necessary to provide secure means for supporting them in the vertical position, the vertical run in the case of the seventh flat being approximately 30 yds. To effect this a horizontal row of cast-iron bricks provided with T slots was built into the wall at suitable intervals, to which the cables were fixed by cast-iron clips. This construction has proved very satisfactory.

Distribution Methods.

The distributor cables which connect the various motors or groups of motors in the flats with the distribution switchgear in the switchrooms are carried on "Rigifix" fittings, to which the cable cleats are bolted. These were incorporated as required in the reinforced concrete floors of the switchrooms and under the staircases to the flats, while cast-iron conduits were provided for the passage of the cables through the mill walls where necessary. In the mill itself the cables are run on the ceilings of the flats, light beams bridging the lower flanges of the floor girders being provided to carry the cable cleats. Fig. 3 illustrates this method of supporting cable runs, which has obviously many advantages over the ordinary method of cutting holes and grouting in fixing bolts when the installation is a large one. A separate circuit is provided for every motor of 70 B.H.P. and upwards, corresponding to a line current of approximately 100 A or more. In the case of the 50 H.P. motors referred to below, a group of three motors is supplied from one distributor, the motors being connected to the cable through link boxes. Distribution boxes fitted with fuses are only used for supplying groups of the smallest motors, 20 H.P. and less.

Motor Design.

The motors installed in all the rooms except the basement are of the pipe-ventilated slip-ring type, fitted with brush lifting and short-circuiting gear, the drives being arranged on the group system. Broadly speaking, there are two systems which may be adopted when installing motors for group driving in a cotton mill: that of placing

FIG. 2.—A VIEW SHOWING ARRANGEMENT OF VENTILATING DUCTS.

the motors in a separate motor tower or corridor, and that of placing the motors on suitable elevated platforms inside the mill rooms. In the case of the D. R. Mills, owing to the size of the mill and consequently the number of shafts to be driven in each room, the former system was not suitable. It was found possible in adopting the latter system, however, to place all the motors adjacent to the walls of the mill, thus allowing the use of pipe-ventilated motors provided with ducts to draw cooling air from outside; this arrangement effectively avoids the disadvantages which follow

from placing open or protected-type motors in an atmosphere containing cotton fibre or fluff.

The Card Room Installation.

For the card rooms three standard sizes of motor were adopted, 50 H.P. for driving cards, 70 H.P. for driving roving frame shafts, and 150 H.P. for driving ring frame shafts ; in each card room there are six 50 H.P., four 70 H.P., and four 150 H.P. motors.

In the case of the roving frame and ring frame shafts, the motors are direct-coupled through flexible couplings and run at 485 revs. per min., but the card shafts are driven by laminated leather belts, the motors being of the three-bearing-bedplate type, running at 585 revs. per min.

Particular attention was given to the design of the motor supports to ensure satisfactory alignment between motor shafts and line shafting and also to enable any motor to be replaced as quickly as possible if necessary.

The motors were manufactured at the Bradford Works of the English Electric Company to their standard designs and are fitted with ball and roller bearings ; the flexible couplings, which are of the " pin " type, were also made by the same firm. The performance of these machines up to the present has more than justified the adoption of the type of motor and drive decided upon.

The control gear for each motor is mounted on the motor staging alongside its motor and consists of a triple-pole oil switch, interlocked with an oil-immersed metallic type rotor starter, the oil switch in every case being fitted with no-volt and three overload releases and ammeter. Push buttons for readily stopping any motor in case of emergency are provided at suitable points in the rooms.

The Doubling Room.

The equipment in the doubling room is similar to that described above, but the motors are each 250 H.P. and are fitted with ring oiling sleeve bearings.

Amongst the illustrations which show typical views of the installation, special mention may be made of Fig. 4, showing the individual drive system applied to a doubling frame, one of a number

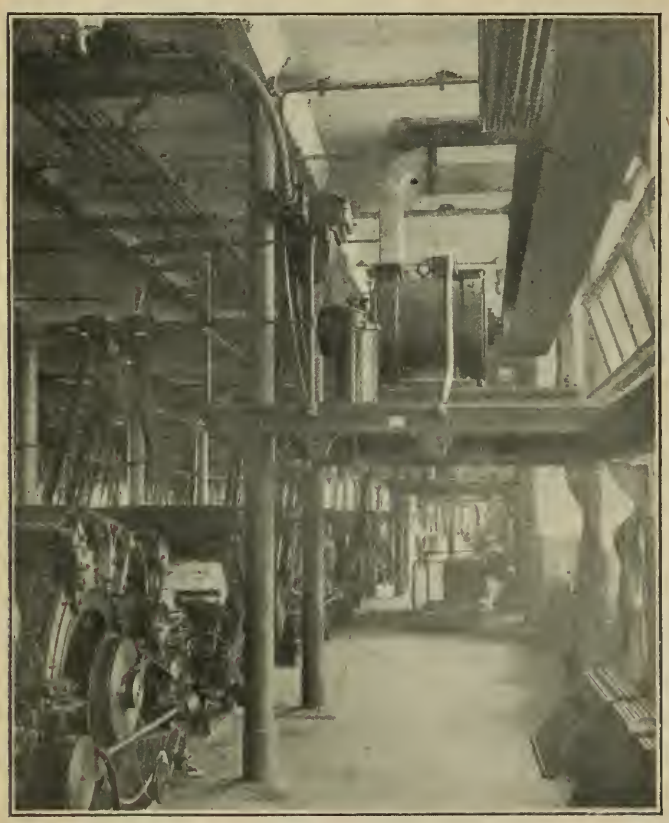


FIG. 3.—50 H.P. 3-BEARING TYPE MOTOR DRIVING CARDING ENGINES. ONE OF 24.

so equipped in one of the weaving sections. These motors are of the squirrel-cage type, specially designed for large pull-out torque, and drive the frames through clutch couplings.

The photographs of motors in the spinning mill were taken very shortly after erection was completed, and in the case of the 250 B.H.P. motor, Fig. 1, ventilating ducts had not been fitted, and the hand-railing, &c., on some of the motor stagings was not quite completed. Fig. 2 and Fig. 3, however, clearly show the arrangement of the ventilating ducts, the 50 H.P. motors being arranged to discharge their cooling air into the room and the larger motors being provided with an outlet duct in which suitable provision is made for discharging into the room when required, so that the warm air from the motors may be utilised in the cold weather to assist in the heating of the mill.

In conclusion, it may be said that the design of this mill would have been impracticable but for the electric drive. The mill shows

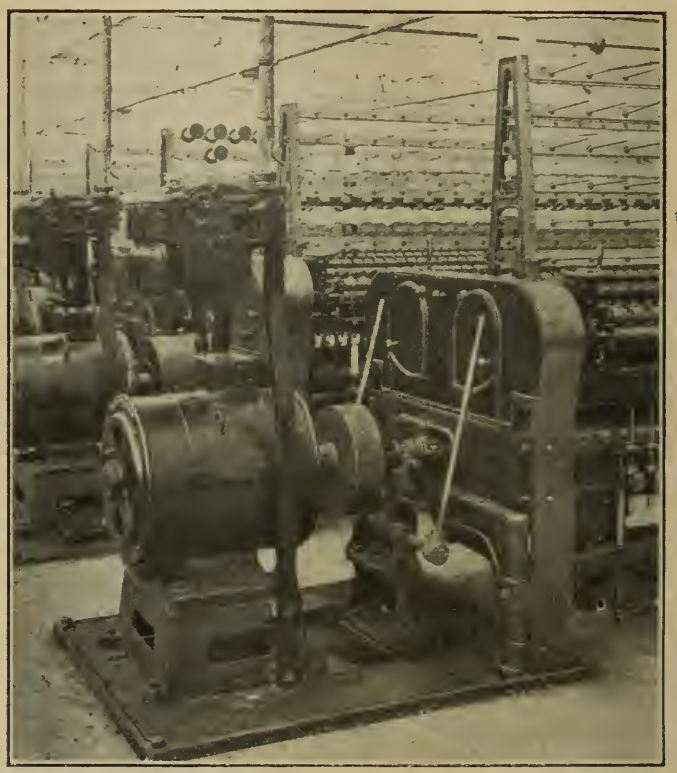


FIG. 4.—10 H.P. MOTOR DRIVING DOUBLING FRAME THROUGH CLUTCH COUPLING.

very decided advances upon the usual design of mill for ring spinning, and by incorporating electrical driving in the original design it has been possible to take full advantage of the facilities obtained by the use of electricity in a manner which can rarely be achieved when converting to electrical drive a mill originally built for mechanical drive.

Electric Traction in Italy.

To mark the holding of the ninth Congress of the INTERNATIONAL RAILWAY ASSOCIATION at Rome this week, the " Railway Gazette " has issued a special Italian Railway number, printed in English and Italian in parallel columns and forming a complete account of the history, development, and technical progress of the railway system in that country. The issue is excellently illustrated with a number of typical views on Italian railways, among which we are glad to see several of electrical interest.

One of the main articles is devoted to the electrification of the Italian railways, it being recalled that attempts to use electric traction date back to 1899, when experiments in the haulage of trains fitted with accumulators were made on the Bologna-San Felice and Milan-Monza lines, with direct current on the third-rail system on the Milan-Varese line, and with overhead wire on the Valtellina lines. As is well known, the overhead system has been generally adopted, and there are now 683 km of State railway electric lines, mainly double track.

Electric Traction and Coal Economy.

It is estimated that during and since the war the use of electric railways has saved a million tons of coal, and it is therefore not surprising to find that an extensive electrification programme is foreshadowed, and that about 5 116 km will be so worked by 1926. The lines selected for electrification are those with the heaviest traffic, though the necessity for an organic and continuous system has been borne in mind. Taking the existing figures for coal consumption, it is estimated by the electrification of less than one-third of the State lines it will be possible to effect a saving of two-thirds of the coal necessary for steam locomotion. This, of course, is due to the fact that the electrical energy is practically entirely obtained from water-power stations.

It is noted that there are difficulties in obtaining electrical equipment, which cannot be produced in sufficient quantities by Italian manufacturers, and the Government does not allow the railways to place contracts abroad.

The Automatic Control of D.C. Motors.

For certain classes of electric drive the advantages of automatic in place of hand control, need very little emphasis. For instance a pump may be started and stopped according to the level of water in a tank entirely without supervision and without the possibility of the motor running a moment longer than is necessary. For other applications, as for example the control of machine tools, a certain amount of personal attention—limited to the pressing of one or more push buttons—becomes necessary. The benefits derived from automatic control are, however, no less important. In the first place, the automatic system is mistake-proof; that is, it is impossible, owing to carelessness on the part of the operator, for either he starter or the motor to become damaged. The corollary of this is that the operator is freed from any responsibility for operating in a specified manner an apparatus which he does not understand, and is thus able to devote himself more completely to the task in hand, with beneficial effects upon the output. Moreover, the operations of starting and stopping are so easy that, although the possibility remains, he is seldom tempted to leave the motor running unnecessarily and so to waste current. Then, again, automatic control allows the use of push buttons at the working position, *i.e.*, all waste movement is avoided. The actual control panel, on the other hand, may be placed in any out of the way corner with increased safety to itself and a saving of valuable space round the machines.

So much for general features; in the present article is described a novel form of automatic starter made up with circuit breaker and isolator in an ironclad panel as illustrated in Fig. 1. The general form of the panel is that employed with the hand-operated control gear manufactured by Brook Hirst & Co., the only difference being in the starter. But the design of the latter constitutes, it is claimed, a marked departure from existing practice both in the movement and the timing.

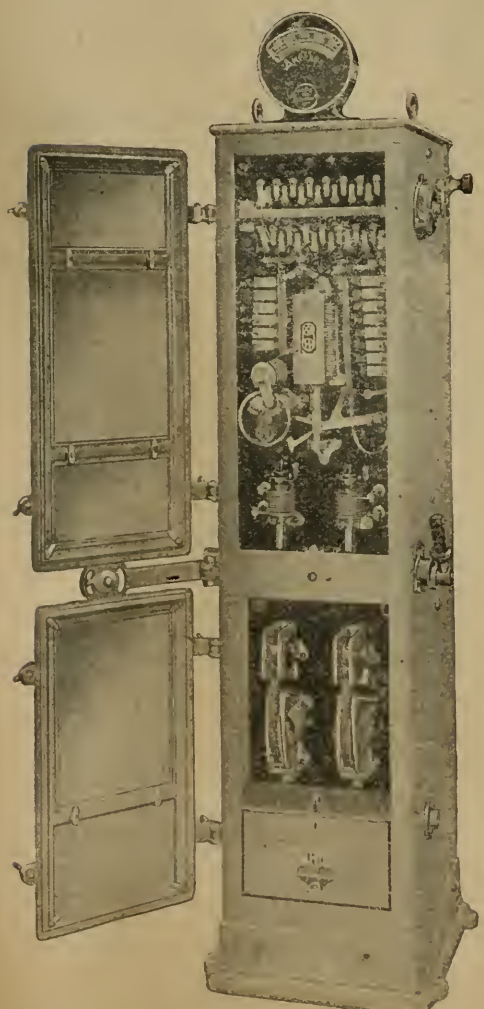


Fig. 1.—Solenoid Type Variable Speed Panel (Automatic Acceleration), with Ammeter, in Pillar Type Case.

Design of the Movement.

To appreciate the value of the first of these features it is necessary to have in mind existing automatic starter movements. These fall broadly into two classes, the sliding contact type and the contactor type. The first of these comprises the face plate, cross head and other forms of starter in which a single solenoid causes a moving bar or its equivalent to slide over the surface of a number of fixed contacts. This design has the advantage of providing a large number of starting steps in a comparatively simple and inexpensive form. On the other hand, owing to the sliding movement, there is a tendency for the contacts to become pitted. With the contactor type of starter, the provision of a separate electrically operated contactor for each step tends to limit the number of steps and may possibly involve unduly high current peaks. The butt contact whose employment is possible with this design is, in most respects, ideal, and when the initial contact is followed, as it usually is, by a sliding and self-cleaning movement, the pitting of the contacts is negligible.

The Solenoid Type Starter.

In the Brook Hirst solenoid type starter, which it is claimed combines the advantages of both types without their disadvantages, the fixed contacts are of carbon mounted in stamped holders. Behind each carbon is a spring which ensures the requisite pressure between the fixed and moving contacts. The moving contacts consist of a bar actuated by a single solenoid, but in such a way that it approaches each carbon with a direct butt movement, so that contact is established instantaneously over the whole area of the

Fig. 2.—The Contacts and Movements in the New Brook Hirst Starter.

carbon (see Fig. 2). In the course of its further movement the bar presses the carbon home into the holder, and subsequently there is a slight sliding movement which tends to clean the contact surfaces. This action is repeated on each step and, there being one solenoid only, it is possible to provide economically an ample number of steps.

The advantages claimed for this movement are several. With designs employing a sliding contact, there is a noticeable tendency when starting up for the starter arm to stick owing to the contacts becoming pitted. Such a tendency is said to be impossible with the design under consideration, and the necessity for constant supervision and adjustments is thus avoided. The number of starting steps being always adequate to the output, the acceleration of the motor is gradual and it benefits by the elimination of excessive current peaks. The absence of arcing on the contacts means that they require renewing at rare intervals only.

The Timing of the Movement.

The timing of the starter movement is effected by an eddy current retarder. The solenoid plunger acting through a rack and train of gears causes an aluminium disc to revolve between the poles of an electro magnet which is excited by the main armature current. The eddy currents generated in the disc exercise a braking effect upon it and upon the plunger. As this effect varies in direct proportion to the starting current, the retarder provides the vital characteristic of quick starting with light loads, and slow starting with heavy loads. Unlike the oil dashpot the retarder is unaffected by dirt or temperature changes, nor does it continue to exercise a braking effect when the starter arm is returning to "off." Since the contact springs also tend to force the arm to the "off" position, there is, the makers claim, a positive return and no possibility of the arm sticking on the backward movement. Apart from the automatic variation of the braking effect with the load, it can also be adjusted for normal starting conditions by regulating the distance between the poles of the electro magnet.

Reliable Governing Obtainable.

The possibility of governing the movement of the starter electromagnetically in this way, instead of by a dashpot, means a great increase in reliability. A heavy overload during starting may result in a complete interruption, temporarily, of the starting operation, thus avoiding an excessive rush of current such as might damage the motor. And finally the lack of necessity for constant attention and adjustment effects a by no means negligible saving of time on the part of maintenance staff.

The starter is not normally arranged for "inching," though this may be carried out by the use of the "starter" and "stop" buttons in sequence. Where, however, the operation is to be an important function of the starter, a special "inching" device can be employed. This enables "inching" to be effected without the starter arm

coming into action. The "inching current" can be varied within prescribed limits by means of the links and terminals provided.

Operation on Overload.

It will be seen, then, that the starter is designed to prevent damage to the motor during starting, since it slows down or interrupts the starting operation on an overload. Under any given conditions of load the time in which it will start up the motor can be predicted, the element of unreliability being thus eliminated. Finally its movement permits an adequate number of starting steps to be employed while retaining a butt contact, and the consequent absence of sparking and incidental difficulties. As has been previously indicated, this starter constitutes the central feature of an ironclad panel which comprises in addition a double-pole circuit breaker and a double pole isolating switch. The former, consisting of two magnetic blowout contactors and two solenoid type overload trips, provides, it is claimed, complete protection for the motor both during starting and running. The overload trips may be adjusted to trip at any given overload, and they may also, if desired, be arranged with an adjustable timelag, so as to avoid the circuit being opened by reason of a momentary excess of current. The isolating switch, which is fitted in a sealed compartment with external operating handle, is interlocked with the doors in such a way that the latter cannot be opened or left open unless the isolator is "off" and the panel "dead"

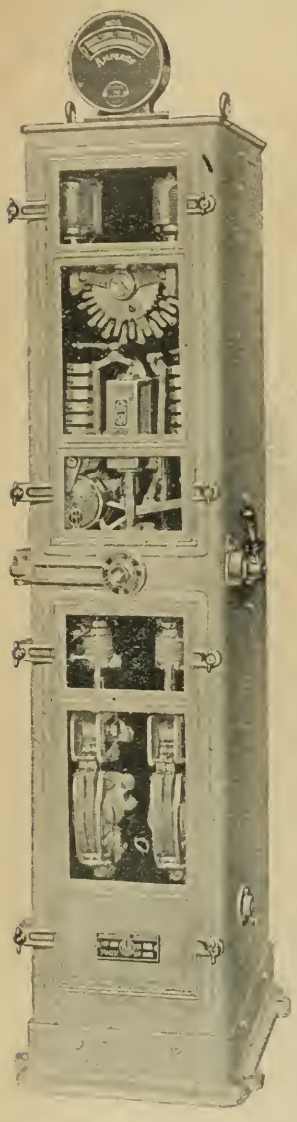


Fig 3. — Solenoid Type Variable Speed Panel (Automatic Regulation), with Ammeter, in Pillar Type Case.

Application to Printing Presses.

For certain applications (*e.g.* to printing presses) it is not, as a rule, necessary to effect speed changes at the work itself, but the speed having once been set it must be possible to start, stop, and "inch" the motor frequently, the speed at each restart always reaching and finally remaining at the set speed. In such a case a regulator of the automatic acceleration type provides the desired facilities. In this case the regulator is adjusted by hand to the required speed, if necessary while the work is in progress. On restarting, after normal speed has been reached, the motor automatically accelerates to the speed which has been set. The accelerator bar and contacts which achieve this object also cut out the whole of the shunt resistance on stopping, so that on restarting or "inching" it is not necessary previously to bring the regulator handle to the "all resistance out" position.

Complete Control of Speed.

While for a wide variety of services the speed regulating facilities outlined above are ideal, there are some conditions where it is desirable to have complete control of the speed by push buttons at the working position. For these applications a panel such as that illustrated in Fig. 3 is employed. The regulator in this case, is of the automatic type, operated by two solenoids, and it is possible from a convenient push button station to start, stop, "inch," accelerate or retard the motor.

It is also possible to employ a third system of speed regulation, using a constant speed panel as shown in Fig. 1 The regulator can then be arranged either with a pedestal, as shown, or for wall mounting, and can thus be placed in close proximity to the work.

This arrangement is intended for applications where it is necessary to effect speed adjustments at the work itself, but not to start and stop frequently. Each time the motor is started or "inched," the regulator must be brought to the "all resistance out" position, and when normal speed is again attained the regulator must be readjusted to give the required speed.

Rotary Converters.

We give below an account of the discussion which took place at Birmingham on Mr. F. P. Whitaker's Paper on "Rotary Converters, with Special Reference to Railway Electrification." An abstract of the Paper appeared on p. 258 of our issue of March 3.

Mr. R. A. Chattock said that Mr. Whitaker apparently put efficiency before reliability. To supply station engineers, however, reliability was of the first importance and railway engineers would probably think the same. With reliability was wrapped up simplicity and he was convinced that it would be better to sacrifice 1 or 1½ per cent. efficiency if greater reliability and simplicity of operation could thereby be obtained. Mr. Whitaker had pointed out how the maximum direct current voltage obtainable increased with the reduction of the frequency. This was an important point in favour of 25 periods, as the number of substations required would be reduced. To run two rotary converters in series meant complication, especially for automatic operation. He considered that high speed circuit breakers would cause surges and insulation breakdowns, unless special steps were taken to prevent voltage rises. Mr. Whitaker had rather hinted that something was to be gained by using 50 periods, and he would like to know what that was, as although the initial cost of low frequency plant might be heavier, it would not really affect the working results and in other ways it had distinct advantages. He considered that automatic operation would be a necessity for railway work, and the initial cost of the automatic rotary equipment was about double the cost of the ordinary equipment. This might seriously militate against its adoption when compared with the mercury arc rectifier.

Short Circuit Phenomena Explained.

Dr. M. Kahn said that short circuits were the principal point to consider in the design of traction rotary converters. When a short circuit occurred on the direct current side of a rotary protected by ordinary circuit breakers, the current increased from five to twenty times normal full load current in about 1/2 000ths of a second. This overload caused a deceleration of the armature, so that a considerable part of the energy given out was supplied by the moving mass, and not from the alternating current side. This meant that the alternating current did not increase so rapidly as the direct current, and thus caused a large increase in the armature reaction, and the putting out of action of the commutating poles, unless special precautions were taken. Thus violent sparking occurred. When the direct current circuit breaker opened the heavy current on the direct current side was interrupted. The voltage between the brush arms rose and a flash over was caused, partly owing to the unbalancing of alternating current and direct current in the armature in the opposite direction from that just described. At the same time there was a rush of alternating current, and this caused a considerable increase in the armature reaction and violent sparking. The phenomena was akin to hunting, and flash overs might occur in rapid succession until the machine was cleared on the alternating current side.

Ill-Fitted for A.-C. Traction.

Prof. W. Cramp said that the Paper demonstrated that compared with the motor converter, the rotary converter was ill fitted for traction work. The author had omitted all mention of transformers and connections, and he was not sure whether they were included in the efficiency and power factor curves in the Paper. The author gave too few technical data to make it possible to criticise his oscillation limits, but it was difficult to see how distinctions could be drawn between flux pulsation and flux swinging, and what was meant by saying that reactance tended to keep the tooth oscillation up so that the tooth ripple need not exceed ½ per cent. of the voltage ripple.

The 12-Phase Rotary.

Mr. F. W. Carter asked whether Mr. Whitaker had considered the 12-phase rotary, which gave an armature loss of 21 per cent. of that due to direct current alone, while the 6-phase rotary gave 27 per cent. The loss in the coils next to the taps was 18 per cent. greater than the mean in the 12-phase rotary, against 57 per cent. in the 6-phase machine. Reactance voltage was more uniform, so that the conditions for commutation would be better, though against this must be set the disadvantage of having twelve slip rings instead of six.

A Word for the Rectifier.

Mr. F. Forrest considered that the mercury vapour rectifier was a much more desirable unit for high voltage traction than the rotary converter. It was more efficient, cheaper in first cost, and perfectly reliable for a period of years. The modern rotary converter was the product of twenty years' experience, while the mercury vapour rectifier had only been on the market for a comparatively few years. The maintenance of the proper vacuum was undoubtedly a problem, but that was certain to be overcome. The cost of a fully automatic rotary converter substation was twice as great as the manual controlling, and it was difficult to see how this cost could be justified.

Correspondence.

TRANSMUTATION OF ELEMENTS AND ATOMIC ENERGY.

To the Editor of THE ELECTRICIAN.

Sir,—Notices have recently appeared in both the lay and technical press referring to the recent experiment of Dr. G. Wendt and Mr. C. E. Irons of the University of Chicago, in which a temperature of 50 000°F. is stated to have been obtained and a transmutation of the tungsten atom into helium to have been effected.

It would appear that some of the great heat and very intense light generated should be due, theoretically, not only to the original energy of the large highly-charged condenser used, but also to the atomic energy set free in the transformation from tungsten to helium.

One wishes to suggest that the method which is described as being employed by these experimenters may also be used to hasten the disruption of the radium atom.

By using a small tube of tungsten having a very fine bore as the conductor to be disrupted by a sudden large condenser discharge, and by enclosing in this bore a small quantity of radium salt, this material should be caused, one believes, to evolve all its stored energy in a short time, possibly leaving helium alone or together with lead as its sole survivor.

The experiment may be one of very great danger and some form of remote control gear operated from a distance might be used to cause the discharge of the condenser, the whole apparatus being located in a somewhat remote spot to ensure safety to the surrounding district. Also the possibility of the spreading of an atomic disruption, when once started to other masses of matter in the vicinity should be kept in mind.—Yours, &c.,

Brixton, April 18th. W. J. RICKETS.

Metropolitan-Vickers' New Zealand Contract.

We are able to give further particulars of the announcement in our last issue of the contract secured by the Metropolitan-Vickers Company from the New Zealand Government for generators and switchgear for the new MANGAHAO POWER STATION. This station forms the first of a series dotted throughout the whole of the North Island, which will finally be linked up by transmission lines at 110 000 V and roughly form a ring round the southern portion of the island. The order includes the supply of three 6 000 kVA and two 3 000 kVA water-wheel generators working at 11 000 V, three-phase, 50 cycles, 0·8 power factor, and driven by overhung water-wheels with horizontal shaft running at 375 revs. per min. Each generator will have its own direct-driven exciter, and in addition provision is being made for a stand-by motor-driven exciter, set so that when necessary the excitation of one or more generators can be transferred to an auxiliary exciter bus. Cooling air for the generators will be drawn through a separate ventilation tunnel, circulation being maintained partly by a separate blower and partly by the usual fans on the rotor, the blower being designed to keep 2 in. pressure. The generators are designed for an overspeed of 80 per cent. and will have a regulation of 27 per cent. at 0·8 power factor. Provision will be made for sliding the stators so as to facilitate access to the rotor when necessary for inspection and cleaning work.

Switch Details.

The current from the generators will be taken through automatic oil switches of the Metropolitan-Vickers "H.F. 2" type, through selector switches to duplicate 11 000 V bus-bars. Both bus-bars will be sectionalised in the middle, and this sectionalising is carried out correspondingly on the 110 000 V bus, so that the whole system can, if necessary, be split into two entirely independent portions. From the generating voltage bus-bars supply will be taken through two 12 000 kVA transformer banks to the 110 000 V bus-bars, and thence to the four outgoing 110 kV feeders. There will be four local feeders at 11 000 V. The 11 000 V equipment will be located in a conventional moulded stone cubicle structure. The e.h.t. switches for controlling the transformer sides will be indoors, while the isolating switches, oil circuit breakers, and lightning arresters for the feeder circuits will be accommodated on the roof of the power station In this way the total ground space occupied is kept down to the minimum. Each generator and transformer unit will be protected by the usual circulating current system, while on the 110 000 V feeders there will be fitted the new Metropolitan-Vickers' compensated overload relay, which is designed to give an inverse operating time characteristic with a definite adjustable minimum. In addition the pairs of feeders will be protected by balanced biased relays, which will operate in the event of the failure or short-circuiting of either feeder.

This order marks a definite period in the history of switchgear development in this country, in that it is, it is claimed, the first placed for British-built material for so high a voltage. We have already referred in our columns to the developments which the Metropolitan-Vickers Company are making in this direction, and at a later date hope to publish more complete details of the scheme now referred to.

Mr. Robert McDougall has intimated his desire to defray the cost, £5 000, of equipping a RADIOLOGICAL DEPARTMENT at Manchester Royal Infirmary as a memorial to his father, the late Mr. Arthur McDougall

Lancashire Electricity District.

The Electricity Commissioners notify that, having considered the evidence given at the inquiry held in January last into the scheme for the establishment of a SOUTH-EAST LANCASHIRE ELECTRICITY BOARD and the representations made by various bodies for the inclusion in, or exclusion from, the district of their respective areas, they have come to the following conclusions :

The Commissioners entertain some doubt as to whether the provisions by which the Advisory Board will make representations to constituent authorities, with a right of appeal to the Commissioners, whose decision (within strictly defined limits) will be binding on the constituent authorities, will enable sufficiently comprehensive works to be undertaken. They apprehend that there may be a tendency to proceed by piecemeal extensions of stations and interconnecting lines at an ultimate increased cost to the constituent authorities and the consumers concerned. An Advisory Board may also experience difficulty in securing supplies in unoccupied areas, more especially in those contained in the enlarged district south of the Manchester Ship Canal, for which a Joint Electricity Authority would be empowered to make provision. In view, however, of the unanimous support given to the scheme by the authorised undertakers, and of their strongly expressed opinion that this voluntary arrangement is the best in the particular circumstances of the district, the Commissioners are prepared to make an Order embodying the arrangements which the constituent authorities have agreed to carry out.

Area and Administrative Scheme.

The Commissioners confirm the area provisionally determined, subject to the exclusion of the urban districts of Lymm (Cheshire) and Haydock (Lancs), both of which are now included in the Mersey and W. Lancashire district, and the inclusion of the urban district of Adlington (inadvertently omitted) and of the municipal boroughs of Buxton and Macclesfield, the urban districts of Bollington, New Mills and Yeardsley-cum-Whaley, the rural districts of Macclesfield, Hayfield and Disley, and the parishes of Chapel-en-le-Frith, Chinley, Bugsworth and Brownside, Fernilee, Green-Fairfield, Hartington-upper-Quarter, Kingsterdale, Peakforest and Wormhill.

The title "South-East Lancashire Electricity Board" is inappropriate and is liable to be misinterpreted, having regard to Sec. 8 of the Electric Lighting Act, 1909, and the more appropriate title would be "South-East Lancashire Electricity Advisory Board." The number of representatives on the Board is unnecessarily large. If the authorities in the district are unwilling to reduce the size of the Board, the Commissioners will be prepared to include in their Order the proposal submitted in the second schedule to the amended scheme, subject to certain modifications consequent upon the agreed representation of the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board, and upon the increased area of the district. Having regard to the representation to be given to local authorities who are not authorised undertakers, as provided in the scheme, the Commissioners consider it unnecessary that county councils should be represented on the Advisory Board. The engineer of the Stalybridge, &c., Electricity Board should be a member of the Engineering Advisory Committee, but, having regard to the non-standard frequency of the Stalybridge system, he should be entitled only to attend the meetings of the Committee when electrical developments and proposals are to be considered which may affect the area of the Stalybridge Board and the areas contiguous thereto. The Yorkshire Electric Power Company will not be required to furnish plans of new works to the Board, but only to furnish such statistics as may refer to supplies given by the company within the urban districts of Saddlesworth and Springhead.

Technical Scheme.

The Commissioners approve generally the technical scheme submitted to them, subject to a provision that modifications thereof may hereafter be made with the approval of the Commissioners. The scheme includes provision for the giving of advice and assistance to the Board by the Engineering Advisory Committee on (*inter alia*) the adjustment of running hours of the generating stations in the district in such manner as to secure maximum economy of production, and on the principles which should govern the charges to be made by, or between, constituent authorities for reciprocal, stand-by and bulk supplies. In the event of disagreement between the Board and any constituent authority there is a right of appeal to the Commissioners, whose decision, subject to specified reservations, is to be binding on the parties.

Notwithstanding these provisions, the Commissioners are of opinion that the actual direction of the times and method of working of inter-connected stations so as to produce the most economical results will be best effected by an officer of the Board appointed for that purpose, who would carry out the programme of working laid down by the Engineering Advisory Committee and approved by the Board; a scheme of control of generating stations following the above-mentioned lines should be submitted for the approval of the Commissioners. The Commissioners will include in the Order a provision requiring the Board, within two years from the date of its establishment, to submit proposals for securing a supply in areas within the district which are not at that date within the areas of supply of authorised distributors and in which there is a reasonable prospect of such supply being remunerative.

Political Finance.

Its Devastating Effects on Trade.

The interest for the business man in THE GENOA CONFERENCE is not in the way in which the various delegates are manœuvring for position or in the extraordinary rapidity with which the political kaleidoscope revolves and changes, but rather in the emergence of the long-delayed hope that an economic sense, a return to financial sanity, seems at last to be in prospect.

It will indeed be a strange, if a fitting, conclusion to the mixture of drama and comedy which goes to make up the history of Europe in the last few years if the Bolsheviks should for a time occupy the centre of the stage and complete their mission, giving to the world one brief, great, and awful demonstration of the utter futility of what may be described as "political finance." These madmen, at the frightful cost of millions of their own people, have already given to humanity an object lesson of the result of infringements of economic law, from which the world of the future must derive untold benefit, and if now they add to their ruthless exposure of the idiocy of communism a practical demonstration of the impossibility of the economic war, they may be recognised in centuries to come as important constructive factors in the development of civilisation.

The Object of the Genoa Conference.

The Genoa Conference is assembled to discuss economic questions and to debate once again how much money certain countries shall pay and how much other shall receive, a discussion, the absurdity and impracticability of which I have never ceased to argue. Trade, industry and commerce cannot again resume the full measure of their service to mankind until the politicians cease meddling with the medium of exchange. So long as political conferences continue to discuss the allocation of large sums of money between different nations and different parties, so long will money fail to exercise its proper functions, and so long will trade and commerce remain almost an impossibility.

The difficulty is that politicians, like, indeed, most human beings, have the flimsiest conception of the character of this thing called money, about which they talk so glibly and decide so lightly. If the Prime Ministers of Europe were to collect all the violins in existence and distribute them among professors of mathematics, they would be acting with about as much sense as when they attempt to settle political problems through the medium of exchange. Money is a medium of exchange which was created and perfected by commercial men for the purposes of commerce; it has no real use except in connection with the exchange of commodities; it ceases to be money when it fails to represent realities. The trouble is that the machinery of exchange has been brought to such a pitch of scientific perfection that it is possible for people for whose use it was never intended, like gamblers or politicians, to get hold of it and use it for purposes for which it is utterly unsuitable; and the worst of it is that in so using it the politicians or gamblers cannot avoid the exercise of a very damaging influence upon all those who are concerned in the use of money for its proper and legitimate purposes. We are gradually learning our lesson; the next generation will accept as an article of faith the unalterable truth which this generation is not yet quite able to see—that the divorce of money from exchange is a crime, and the worst form of crime, inasmuch as it damages not only those immediately concerned in its perpetration, but every human being in existence at the time that it is done. There is no difference between some of the decisions of the Allied Conference and the realm of finance and Kruger's historic demand for moral and intellectual damage.

The true import of Kruger's innovation was not realised at the time because he was dealing in very small figures; but when the Bolsheviks put forward a claim for £1 500 000 000, the essential fallacy of the whole business becomes apparent. The error is at bottom exactly the same as that contained in such proposals as the capital levy, or work, or maintenance, and is seen in a slightly different form in the iniquity of the printing press.

An Impossible Situation.

The business man, who as a business man is not in the least concerned with the political manœuvres at Genoa, can see these things a little more clearly than the general public. For instance, if it is right and proper that Czecho-Slovakia, which may, without offence, be described as the Ireland of Austria, should receive financial consideration in respect of the part which it played in the war, there can surely be no objection to interpreting in terms of money the service rendered in the same cause by the Russian steamroller. The truth is, of course, that neither case can be settled on a cash basis. The absurd results which have already accrued from this attempt to assess war claims in the medium of exchange are demonstrated for the benefit of all who care to study the matter of the present price of money in Central Europe.

I journeyed through six countries a few weeks ago, and changed sovereigns for 48 francs in France, 55 francs in Belgium, and 350 marks in Germany, but the gross stupidity of it all is illustrated still better by the position of the old Austrian crown. The same crown which a few years ago was worth, roughly, 1s., stood in Austria proper at 32 000, in Hungary at 3 500, and in Czecho-Slovakia at 320. The difference between 32 000 and 320 was not even a difference of form, the same piece of paper serves for both crowns, the mere addition of a red ink stamping impressed to the order of the politicians makes one paper chit worth 320 and the other worth 32 000.

If the traveller will board the Ostend-Constantinople express, which now runs daily, he can drink a cup of coffee out of the same pot, or eat a slice of meat off the same joint, without even changing his seat, and pay nine or ten different prices for the same article, the price being regulated by the country into which the train happens to have wandered. I know of no illustration which more graphically exposes the impossibility of the situation.

The Germans and the Bolsheviks may have been guilty of treachery, they may be devoid of all sense of honour in negotiation, they may be unworthy to sit at the same conference table with more orthodox diplomats. These are questions of which I am no judge; but in deciding, as they appear to have done, to wipe out between themselves all indemnities, all reparations, and all sums of money which do not represent exchange for value given, they have set an example which, sooner or later, the rest of us, although we may not yet have reached a state of mind in which we are prepared to realise it, will be bound to follow.

We are now nearer than ever to the happy day when money and finance will be understood as the special province of the business man; when the world will understand that war has nothing to do with business, and that the machinery of business cannot be made to clear up the messes of war; the two things are as wide apart as the poles. When we have learnt that lesson, and it seems as if we are now beginning to do so, trade, commerce, industry, and all that makes for civilisation, will once more resume their beneficent service to mankind.

E. J. P. B.

Grampians Electricity Supply Scheme.

Some progress has been made by the GRAMPIANS ELECTRICITY BILL, which has now passed its second reading in the House of Commons, and it will probably come before a Select Committee in the first week in May. The promoters (The Hydro-Electric Development Company) have made arrangements with some of the petitioners against the Bill, and negotiations are being conducted with other opponents.

For some time informal discussions have been proceeding between the promoters and representatives of Dundee Corporation in regard to the proposals submitted by the Company. These included an offer by the Company to pay the Corporation £25 000 per annum to cover annual charges for sinking fund and interest on the capital expended on the power station, and to supply electricity at £3 7s. 6d per annum per kW of maximum demand up to a maximum of 25 000 kW, plus 0·2d. per unit delivered, all demands above the maximum to be supplied at £3 5s. per annum per kW, plus 0·2d. per unit. The agreement would be for a period of twenty years, each party to have a right to call for the revision of charges at the end of five years. The Corporation should grant a lease to the Company of Carolina Port Station at a rent of £25 000 per annum, and the Company would supply the whole of the electrical requirements of the Corporation in bulk from the station, or partly from the station and partly from certain sub-stations, the Corporation guaranteeing a maximum demand of at least 12 000 kW.

The suggested agreement contained other conditions, but at a special meeting of Dundee Town Council last week it was decided, on the motion of Mr. R. F. Sturrock, convener of the Electricity Committee, to reject the Company's offer as the inducements offered were not sufficiently favourable to the Corporation.

Oswestry's Electricity Charges.

The application of the OSWESTRY ELECTRIC LIGHT & POWER CO. for power to increase their maximum charges for electricity from 8d. to 1s. 3d. per unit was the subject of an inquiry last week by Colonel T. C. Ekin, a commissioner appointed by the Electricity Commissioners. Opposition was offered by the Corporation and Oswestry Traders' Association. For the Corporation, the TOWN CLERK protested that the company had already increased its charges to the maximum amount now asked for without sanction having been given, and that for the past three years consumers had had to pay more than the statutory price authorised by the company's Provisional Order. The maximum price now asked for was in excess of the charge for electricity in other towns in the district. It was important that the period for any increase, if granted, should not exceed three years. Firstly, because it was reasonable to suppose that the cable from Dolgarog, North Wales, would be laid in Oswestry before the end of next year, when the price for current in the town would be 2d. per unit or less. Secondly, because the Corporation had the power to acquire the undertaking in 1929, at the then fair market value, subject to a payment in addition to the value of the works of a sum equal to the net profits of the undertaking for the then preceding three years. If this increased maximum charge was sanctioned, enabling the company to charge this maximum during the last three years, it might cause the price to be paid by the Corporation to be a sum considerably in excess of the actual value of the work and plant.

Mr. W. K. MINSHALL, for the company, said there had been no profiteering, and the increase already made in the charges was not in any way in proportion to the increased cost. The charges (net) in 1914-15 for light was 6¾d. per unit, raised in 1921 to a net charge of 1s. 2¼d., an increase of 111 per cent. On the other hand, the costs had increased 244 per cent. He hoped the Commissioners would grant the application, and make it retrospective to 1918.

The Commissioner: That is quite impossible. No order can be made retrospective.

Alderman E. BREMER SMITH, engineer to the company, said he was sorry to hear that. If they had to reimburse what they had overcharged the last three years it would come to over £8 000. Their capital was only £8 000, and it would mean that the company must go into liquidation.

The Société des Ingenieurs-Civils de France.

In his presidential address to the British Section of the Société des Ingenieurs-Civils de France last week, at the Institution of Mechanical Engineers, London, Mr. W. Noble Twelvetrees said that the essential objects of the British Section were to provide for the establishment of closer relations between members resident in different parts of Great Britain and the British Empire, and to encourage professional and friendly intercourse between French and British engineers generally. The first President of the British Section was Mr. C. H. Wordingham (Past-President of the Institution of Electrical Engineers). The Section was formed soon after the war, and at its first meeting it was pointed out that it might help towards the attainment of intercourse between French and British engineers by drawing into the ranks of the French Society as many members as possible of the engineering institutions in this country, and, at the same time, by working for the recruiting of French engineers as members of British engineering institutions. The first of these suggestions had met with a most promising response, for the membership of the Section was now approximately three times that existing at the date when the Section was formed. Further, the membership was thoroughly representative of all classes of engineers, and included, in addition to Mr. Wordingham, Mr. Roger T. Smith and others on the electrical side. The suggestion that French engineers should be invited to offer themselves for membership of British institutions was one that the Section would gladly attempt if the idea were approved by the institutions concerned. One difficulty which had in the past prevented many young French engineers from joining British institutions was that the qualifications for associate membership usually included the passing of examinations or the possession of an approved diploma or certificate exempting candidates from examination. It was desirable, therefore, that the equivalence of French and British engineering diplomas and certificates should be determined, with the object of preparing a list of French qualifications which would be accepted by British engineering institutions, in every case with due regard to special requirements, as exempting candidates wholly or in part from the examinations prescribed.

The Work of the Section.

Dealing with the work of the Section, Mr. Twelvetrees said the President of the Section had represented the parent Society at various meetings and functions of engineering institutions and societies in London and the provinces, and arrangements had been made with engineering firms in Lorraine to accept a few British engineering students for periods of three months during the summer, so that some experience might be gained of French engineering practice.

After dealing with the interchanges between French and British engineers, and suggesting that they might be more frequent, the President said it appeared to him that if the engineering institutions on both sides of the Channel were once effectively organised, the next step should be the formation of a Franco-British committee, whose special business it would be to consider all possible means of bringing into closer touch the engineers of the two nations. Such a scheme could well be spread to other countries, and he mentioned that an American Section of the Société des Ingenieurs-Civils de France had been formed.

In response to an invitation from the President to express their views on this question of co-operation and federation, a number of engineers took the opportunity to do so.

Difficulties of Co-operation.

Mr. C. H. Wordingham said there were serious difficulties in the way of producing a workable scheme for the federation of engineering institutions in this country, mainly due to the jealousies and opposition of the smaller societies, who felt they should not be left out. Whilst he agreed that they should not be left out, it was not practicable that all of them could be represented on a central body directly. Therefore he suggested the grouping together of these smaller societies so far as they dealt with a particular branch of engineering, and then federating the groups representing that branch under a main institution. The main institutions could then be federated together in the Grand Council of the whole engineering body of this country. During the war a Committee of the Conjoint Board of Scientific Societies was formed, under the chairmanship of Sir Robert Hadfield, which made great efforts to acquire the site of the old Stationery Office for the purpose of erecting a central building for the engineering institutions of the country. He (Mr. Wordingham) was a member of that committee. The site in question was the only one that would have enabled a joint building to be erected in conjunction with the existing buildings of the Institutions of Civil and Mechanical Engineers, which it was felt were too recently erected to think of abandoning, and also it was felt that such a joint building should be in Westminster, the office home of engineers. The Government, however, would not part with the site.

A Central Library.

Not the least of the many advantages of such a scheme would be a central library, to which could easily be attached a bureau of technical information, because at the present time there was a lamentable waste of effort in connection with the abstracting of articles of an engineering and technical nature. As to co-operation with other countries, he advocated a start with the Allied nations. Also, it was important that British firms should take French pupils, and that the qualifying examinations of British and French institutions should be rearranged, so that a British engineer, having passed the qualifying examination for an institution in this country would be accepted at once as a member of a similar French institution and *vice versa*.

Captain H. Riall Sankey (Past-President, Institution of Mechanical Engineers) said that progress had been made at the conference between the Institutions of Civil, Mechanical, and Electrical Engineers and Naval Architects, and that details of a scheme of co-operation would be published before long.

Mr. W. H. Patchell referred to the intention of the Institution of Mechanical Engineers to hold its summer meeting in Paris this year, and said that the latest information made him rather doubt whether the Institution would be able to carry out its intention, because the prices charged by hotel-keepers in Paris were rising so enormously. Whilst he upheld the principle of federation, he did not think that we in this country could get anything approaching the federation that existed in America, which would be altogether too unwieldy for us, and he believed it would soon be too unwieldy for America. He believed the tendency in all countries in future would be for the engineering institutions to pay more attention to men than materials. He agreed with Mr. Wordingham as to the amount of money misspent in abstracting, notwithstanding which it was impossible to get decent abstracts.

The next meeting of the British Section will be held in June, when the projected lateral canal to the Rhine will be discussed.

On Mr. Matthews' Farm?

"Oh, Sir, something has gone wrong with the electric milker, and one of the cows has got charged with electricity."

(By kind permission of the proprietors of "Punch.")

The Stylolectric Pen.

The Stylolectric Pen, which has recently been on view at Selfridges, is a most attractive and useful device. It is no larger than a fountain pen, and is so insulated that neither the user nor the material can be harmed. Only the point of the pen is heated, the holder never even gets warm. For use, it simply has to be attached to any ordinary electric light socket. It operates equally well on any voltage—a.c. or d.c. circuit—and its heat can be regulated to any degree. For marking wooden packing cases, leather goods, tennis balls, &c., it is invaluable, and is becoming recognised in the jewellery and electrical trades as the smallest, efficient, self-heating soldering iron. As a cauterising instrument it is also finding favour with doctors. With the aid of coloured transfer papers, which are supplied by the makers, the Post Electric Company, New York, artistic patterns in colour can be burnt into materials of every kind, including hard rubber, bakelite, paper, celluloid, &c.

An electrophone has been installed in Sefton Park Presbyterian Church, Liverpool, to assist deaf members of the congregation to hear the sermons. A receiver has been placed in the pulpit, and from this wires are laid along the aisles and into certain pews.

Mr. Gillott and Domestic Electricity.

We understand that, owing to reorganisation, Mr. W. A. Gillott is relinquishing his position as sales manager and engineer with the Jackson Electric Stove Company.

Mr. Gillott is well known throughout the electrical industry as a champion of the cause of electric cooking and heating, but it is only those who have his intimate acquaintance who are aware of the enormous amount of work he has put in in enlightening engineers and consumers alike as to the advantages of using electricity for these purposes. A few more engineers of his experience and energy on the domestic side of our industry are necessary, and we hope that Mr. Gillott at least will not be lost to that field.

Mr. Gillott, after serving his apprenticeship with the Electrical Company, in 1906 joined the staff of the Newcastle-on-Tyne Electric Supply Company as assistant engineer for the design, erection, and maintenance of high-tension transmission lines, low-tension net works, and sub-station equipment. In 1910 he entered the consumers' and development department of the company and concentrated his attention on propaganda work for the extended use of electricity. So successful were his activities that it was necessary in three months to erect a new sub-station in what had been an unprofitable residential area in order to handle the increasing demand. In 1912 he was given a free hand to establish and work a department, with showrooms, to test the possibilities of developing the heating and cooking load over the whole area of the company, some 1 500 sq. miles.

Nothing more need be said on this point except that at the time of his leaving the company in 1920 its heating and cooking load was 15 000 kW, and was an entire financial success. It will be remembered that Mr. Gillott was invited by the late Lord Rhondda to take control of the electrical work for the National Kitchens and Restaurants of the Ministry of Food, and held the position until the Department closed shortly after the Armistice. Since his connection with the Jackson Electric Stove Company in 1920 Mr. Gillott has given close attention to the design of electrical and heating apparatus of all descriptions, a particularly interesting piece of work for which he was responsible being the equipment which is installed in the Great Northern Railway dining cars. Mr. Gillott has been closely connected with the Electrical Development Association since its formation, and is at present a member of the Council and of the Executive, Domestic, and Publicity Committees.

Mr. Gillott's present address is "Dunsinane," Hadley-road, New Barnet, Herts.

Guarantees Under the Trade Facilities Act.

A White Paper was issued last week containing a statement of the guarantees which the Treasury stated its willingness to give up to March 31 last. The total is £14 958 145, and includes :—

South-Eastern and Chatham Railway Company, £6 500 000 (25 years). Electrification of suburban lines.

Underground Railway, £5 000 000 (50 years). Enlargement of tunnel of the City and South London Railway, improvement of stations and provision of new rolling stock, and extension of London Electric Railway from Golder's Green to Edgware.

Calcutta Electric Supply Corporation, £500 000 (25 years; redeemable after 15 years). Purchase and installation of additional generating plant and buildings, additional high-tension cables and transformers, and additional direct-current mains.

Kent Electric Power Company, £15 600 (20 years). Provision of mains, transforming apparatus, and station plant.

Minehead Electric Supply Company, £4 500 (25 years). Provision of generator and overhead mains.

Wireless on Fishing Vessels.

The Fishery Board for Scotland draw attention to an article on the use of wireless on board French fishing vessels which appeared in the Bulletin of the Oceanographical Society of France dated Jan. 15 last. Despite the interruption due to the war, considerable progress appears to have been made in the extension of this means of communication to the French fishing fleet, as in the space of ten years wireless apparatus has been installed on some 200 vessels. In order to have the messages from the fishing vessels transmitted as rapidly as possible, the French postal authorities have them telephoned direct from the coast wireless station to the owners. La Rochelle is the only fishing port of importance which is not yet provided with a wireless station, although almost forty trawlers of that port are equipped with wireless. At St. Pierre and Miquelon there is not yet a sufficiently powerful coast station, but an up-to-date apparatus with a radius of 600 miles is expected to be put in commission during next season.

British Electrical Orders from Calcutta.

Orders for electrical plant, amounting in value to £500 000, are being placed with British engineers by the Calcutta Electricity Corporation under a Trade Facilities Act guarantee. Contracts in connection with this scheme, totalling about £250 000, have already been placed. Among firms to secure orders are, states the "Industrial Daily News," the English Electric Company, for a 15 000-kW turbo-generator; Stirling Boiler Company, Glasgow, for 60 000 lb. boilers; the British Thomson-Houston Company, for transformers; Hicks, Hargreaves & Company, of Bolton, for condensing plant; and Henley's Telegraph Works, for cables.

"Caeg" Miners' Electric Lamps.

Owing to pressure on our space we were unable last week to give more than a few particulars regarding the visit, on the 8th inst., of members of the Midland Institute of Mining, Civil and Mechanical Engineers to the works of the Caeg Miners' Lamps and Supply Company at Barnsley. The party were shown all over the works, which occupy about three acres and employ some 300 workpeople, and saw the lamps in their various stages of manufacture.

The lamp consists of three main component parts, the accumulator, accumulator holder or body, and lamp-holder. The holder and body of the lamp are, in the main, made of a high-grade steel, the cylindrical portion being made from solid drawn tubes cut into correct lengths and slotted at the top. The base of the body and shoulder and top of the lamp-holder are stamped from sheets and pressed to shape in 60-ton presses, as are the brass contacts and brass locking arrangement. The base of the case is then spot-welded to the cylindrical portion of the body; at the same time the shoulder and top of the lamp-holder are assembled, using the four guards protecting the glass globe as rivets. The assembled body and lamp-holders are then pickled and tinned. To the body the brass guide ring is riveted, all brass parts being machine made to gauge.

The accumulator portion of the lamp is assembled at Barnsley, but the plates are made by the company at their Lancashire works. The plates are of cylindrical form for the hand lamps and flat for the cap lamps, in which case the accumulator is carried strapped to the miner's back.

The positive plates are die cast in cylindrical form and are then pasted. The negative plates are produced by rolling, being bent to shape and burnt to form a cylindrical plate. After placing the plate in the celluloid containers and fitting the top, the whole is placed in a small lathe and the top chamfered to ensure as flat a joint as possible when the cementing strip of celluloid is placed in position. This also facilitates dismantling the cell. On completion of the cell it is filled with standard battery acid and given three forming charges, the acid removed and Jellac substituted, and two further forming charges given. It is claimed that Jellac only reduces charging effect by 1 per cent.

All bulbs are tested for c.p. before assembly, 5 per cent. by grease spot photometer and standard, the remainder by comparison with a sub-standard, visually. One per cent. of all bulbs purchased are run continuously until burnt out under artificial working conditions (*i.e.*, in periods of 8 hours, with intervals of 8 mins.), hence the life of a lamp is approximately found. This is claimed to be 500-600 hours. The glass of all lamp bulbs is tested for stresses by a polariscope. Any showing stress of any kind are rejected. The life of cells is also tested by repeated charge and discharge through a lamp. Contacts in the lamp are tested for wearing by clamping the lamp to a bench and the lamp-holder to an oscillating arm, the oscillations per hour of which is known.

Charging stands are made by the company, also charging contacts, racks, and resistances for charging boards. All drilling of component parts is done by jig, thus ensuring interchangeability. In addition to the standard type of lamp made of tinned steel, this type is also made up in brass, copper, and, for presentation purposes, in silver. Smaller types of lamps are made for official use, having cells running for 7 hours. These are, however, of a special pattern. All lamps are fitted with either magnetic locks or the old type of lead rivet, whichever is preferred.

Ban on Non-union Labour.

We regret to notice that the question of connecting consumers' premises which have been wired by non-union labour has been raised once more. On this occasion Chelmsford has been selected by the Electrical Trades Union as the place for putting a ban on work not executed by union men, for they claim to bar any of its members from connecting up to the mains of the local supply company (the Electric Supply Corporation) premises which have been wired by non-union workers.

The dispute raises points of great importance to the industry, and it has now been referred to the National Joint Industrial Council for the Electricity Supply Industry. When the E.T.U. delegates placed a ban on the connection of the premises the matter was referred to the District Industrial Council, but as the trade union representatives were unable to remove the veto, the employers' representatives on the Council withdrew in a body, and the matter is now one for the National Council.

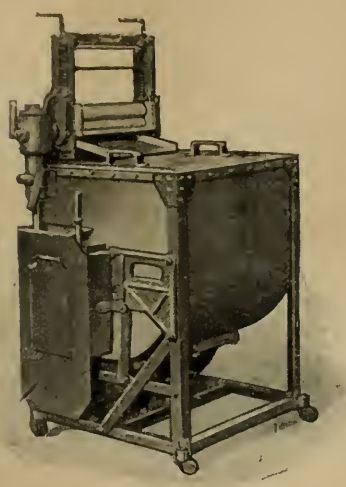
American Steam Turbine Tests.

According to the "Electrical World," recent tests made on the 60 000 kW cross-compound, triple-cylinder steam turbine installed in 1918 at the Seventy-fourth-street station of the Interborough Rapid Transit Company, show that a steam consumption of 11 lb. per kWh can be obtained under normal conditions. With the high-pressure turbine and one low-pressure turbine in service the lowest consumption was 11·25 lb. per kWh. When operating in this way the consumption is better than that for the complete set at loads below 25 000 kW. The 60 000 kW turbine is of the Westinghouse type, and consists of one high-pressure and two low-pressure elements, each element driving a separate generator. The normal steam pressure at the throttle is 220 lb. absolute, with a superheat of 150 deg. Fah., and the machine exhausts into a vacuum of 29 in. referred to a 30 in. barometer at 58·1 deg. Fah. The speed of all three elements is 1 500 revs. per min.

The "Briarton" Washer.

Arton & Walton, the manufacturers of the "Briarton" washing machine, claim that it washes, boils, rinses and wrings the clothes at a running cost of under 2d. per hour with electricity at 8d. per unit, and that a day's wash can be completed in an hour and a half. The firm have had fourteen years' experience in the design and manufacture of such machines, and the designer of the "Briarton" was closely associated with the design and manufacture of the greater part of the machinery installed by the British War Office in the huge laundry at Etaples, near Boulogne, which washed the clothes of the British Army during the War.

The "Briarton" is fitted with a special gas burner and air blast apparatus which reduces the time required for boiling the clothes to a minimum when compared with the older and less efficient form of burner with which some foreign machines are fitted.



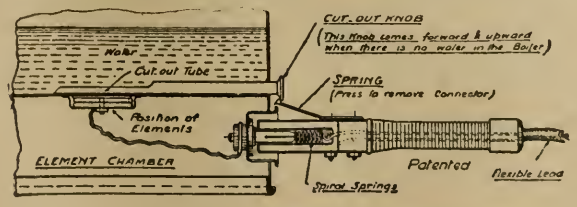
The "Briarton" Washer.

Special attention is called to the capacity of the power-driven reversible and swivelling wringer. Its 15 in. long by 2 in. diameter best quality rubber rollers are claimed to be of 50 per cent. greater capacity than many machines now on the market, and the largest household articles in the wash can be comfortably wrung.

The washing cylinder is 20 in. diameter by 20 in. long, and is built up of heavy gauge perforated zinc sheet with tinned brass ends. It has five hardwood rubbers and lifters, and is rust and verdigris proof, and runs in anti-friction bearings. The motor is totally enclosed and of ample capacity (¼ h.p.). It runs on ball bearings and drives the machine direct through the special design of friction clutch which prevents overloading. It can be arranged for any voltage, either d.c. or a.c. circuit. There are no belts to stretch and slip. The speed-reduction box contains all gears except bevel gears driving the wringer. All fast running gears are machine cut, with helical teeth, and run continuously in an oil bath. The bearings are arranged for automatic and continuous lubrication. The control is by one switch and two levers only. The washing compartment and wringer may be driven together or separately, as desired. The floor space occupied is only 2ft. 10in. by 2ft. 3in.

The "Creda" Kettle Protector.

A patent safety device to prevent the possibility of a kettle boiling dry has recently been put on the market by the Credenda Conduits Company. The device, which can be fitted to all "Creda" kettles and water boilers, automatically cuts off the current when the water



The "Creda" Kettle Protector.

is exhausted. The arrangement of the spring connector makes it a simple matter to disconnect the article from the supply, it only being necessary to press a flat spring, which releases the connector, thus preventing any damage to the flexible cord.

The device, which we illustrate, functions as follows:—A tube containing a special metal is fixed between the heating elements and the bottom of the utensil. From the end of the tube projects a small knob, which is allowed to come forward and upward as soon as the article reaches a certain temperature. The sockets of the connector are fitted with spiral springs which are compressed by the terminals on the article, and the connector is prevented from flying off by means of a flat spring, the end of which engages with the protector knob. When the kettle is boiled dry the protector knob releases the connector, and cuts off the current. Immediately the device has functioned it automatically re-sets itself and the article is again ready for use.

The war memorial tablet to the memory of employees of the Westminster Electric Supply Corporation was unveiled on Wednesday, the 12th inst., by the chairman, Capt. E. I. Bax.

A New Line of Motors.

Fig. 1 represents a new line of motors which the London Electric Firm are now manufacturing in sizes from ¼ to 10 h.p., the smaller ones being bi-polar, and the larger machines having 4 poles. The frames are of cast iron with steel poles, and the bearings are ring oiled (except where ball bearings are used). The design and construction are on the most modern lines throughout. One of these machines was coupled to a dynamo of the firm's make, to generate the current supplied to the Pilot House Searchlight, which was such a feature at the recent Shipping, Engineering and Machinery Exhibition at Olympia.

Fig. 1.

In numerous cases where the speed must be reduced for efficien y driving, the firm make worm reduction gears, as shown in Fig. 2. This is a totally enclosed gear, provided with cast-iron oil bath casing. The worm is of special high grade steel, and runs in ball journal bearings, and is also fitted with ball thrusts. The wheel is of phosphor bronze, accurately hobbed. Automatic lubrication is provided, and any reasonable ratio of gear can be given. Many sizes are made.

Fig. 2.

Fig. 3 shows the special flexible coupling made by the Company for coupling dynamos and motors together. Laminated metal links are used to connect the flanges, no perishable materia being employed. It is claimed to be specially suitable for coupling

Fig. 3.

motors, to reduction gear, pumps, blowers, hoists, etc., and is made in a comprehensive range of sizes.

Chinese Notes.

The Civil Governor of Chihli has reported to the Ministry of Agriculture and Commerce that the establishment of the Peitaiho Coastal Hydro Electric Company by Chu Chih-chien will do no harm to the place.

The original Chinese Merchants' Electric Light Company, at Chungking, has been advised by the authorities to purchase new machinery and to take immediate steps to reorganise the company on a more profitable and efficient basis. Preparations are proceeding.

Parliamentary Intelligence.

Electricity (Supply) Bill.

This Bill has now been through the House of Lords and has been read a first time in the House of Commons.

On the Report stage in the Lords, the Earl of Bessborough moved an amendment to Clause 1, providing that when the amount to be borrowed by a joint electricity authority exceeds £100 000 an order by the Electricity Commissioners should be provisional only, and should not have effect until it had been confirmed by Parliament.

Viscount Peel said that the effect of the amendment would be that joint electricity authorities could not borrow at all. They would be bound hand and foot, and so would the Electricity Commissioners, because nothing could be done without going through a course of procedure which would involve tremendous delay. Local authorities at present could borrow millions from the Electricity Commissioners, but if they joined together and wanted to borrow they could not borrow more than £100 000 without going through a most extraordinary elaborate procedure. However, he proposed the following amendment :—" A scheme constituting a joint electricity authority shall fix, with reference to the estimated capital expenditure of the authority, the maximum sum which may be borrowed by the authority, and the authority shall not have power to borrow under this section sums in excess of the amount so specified unless authorised to do so by subsequent special order."

To Clause 15 (Limitation on prices charged) an amendment was made, on the motion of Viscount Peel, providing that if there was a deficiency in revenue in any year, such deficiency should be divided among the members of the joint electricity authority who took supply, and who would pay in accordance with the number of units supplied. Those who did not take a supply of electricity would not be called upon to make good any of the deficiency.

Lord Bessborough withdrew his amendment, and Lord Peel's amendment was agreed to.

Telephone Service.

Sir H. Brittain asked the Postmaster-General (House of Commons, April 11) whether, with a view to popularising the trunk system, he was prepared to give instructions for time to begin to run when communication had been established with the individual required, and not, as at present, when the number asked for had been obtained?

Mr. Kellaway : I regret that I am unable to entertain this proposal, which would involve a considerable increase in the number of trunk lines and operators, and would virtually convert all trunk calls into what are known in the United States as " particular person " calls, where an extra charge of 25 per cent. or 50 per cent. is made for this service.

Sir H. Brittain asked whether the Postmaster-General was aware that in many instances it was impossible for a tenant to obtain a lease for a full period of twelve months; that a telephone contract must be undertaken for the minimum period of one year; and whether he could see his way to modify such a contract in the case of those desiring a telephone service, but whose tenancy did not hold good for that length of time?

Mr. Kellaway : Where service is required for a short period, it can be provided on payment of a proportionate rental plus the cost of providing and recovering the necessary wires and apparatus or at a year's rental, whichever is the less.

Replying to Lieut.-Colonel Willey, in the House of Commons on April 12, Mr. Kellaway said that he understood the system of reversal of trunk telephone charges in the United States was only in connection with " person to person " calls. It had not been practicable as yet to introduce a service of " person to person " calls in this country, but when the numerous trunk lines now in course of construction were completed further consideration would be given to the matter.

Yorkshire Electric Power Bill.

The Yorkshire Electric Power Bill, which provides for alteration in and addition to the capital of the company, passed its third reading in the House of Lords last week.

Institution of Civil Engineers Awards.

The Council of the Institution of Civil Engineers have made the following awards for papers read and discussed during the session 1921-22 :—

Telford Medals to Sir Henry Fowler (Derby), Mr. H. N. Gresley (Doncaster), and Mr. H. F. Parshall (London); a Watt Medal to Mr. William Willox (London); an Indian Premium to Mr. F. G. Royal-Dawson (London); Telford Premiums to Mr. A. W. Rendell (Bournemouth), Mr. W. F. Stanton (Chile), and Mr. A. C. Walsh (Chile).

The awards for papers printed, without discussion, in the " Proceedings " for this session will be announced in the autumn.

The Council have also made the following awards for papers printed, without discussion, in the " Proceedings " for the session 1920-21 :—

A George Stephenson Medal to Mr. J. H. Taylor (Buenos Aires); Telford Premiums to Mr. F. H. Hummel (Belfast), Mr. E. J. Finnan (Belfast), and Mr. Herbert Chatley (China); and a Trevithick Premium to Mr. G. E. Lillie (Reigate).

Legal Intelligence.

Municipal Election Sequel.

An unpaid electricity account for £2 5s. 2d. was responsible for an unusual application by Blackpool Corporation at the local County Court last week.

The Deputy Town Clerk asked that an amount of £2 5s. 2d., for electricity supplied to Mr. James Kay, be allowed to be sent in and paid by the respondent, as provided by the Municipal Elections (Corrupt and Illegal Practices) Act of 1884. Mr. Kay was a candidate at the November municipal election, and his committee room was supplied by the Corporation with electricity, in respect of which the debt was incurred. The Act provided that all expenses incurred by him had to be paid within twenty-one days, but the County Court might, on the application either of the candidate or of a creditor, allow any claim to be sent in or any expenses to be paid after the time limited by the Act. Mr. Kay had paid all his other bills and had made a return to the Town Clerk, but he had omitted to pay or obtain the account for the electricity due to the Corporation. It had, apparently, been done without any intention to evade payment, and he presumed it was forgetfulness.

The application was allowed.

A Telegraphist's War Bonus.

Last week the Court of Appeal (Lords Justices Bankes and Scrutton, Lord Justice Atkin dissenting) reversed the decision of Mr. Justice Darling in favour of a telegraphist (Mr. Sutton), who brought a test action against the Crown by way of petition of right. The suppliant, relying on a document issued by the Postmaster-General in 1914, left the Post Office for military service. The document stated that postal servants who entered the Army would be allowed " full civil pay in addition to military pay." During the absence of the suppliant bonuses were given to those of the Post Office staff who remained at home, and he claimed the amount of these bonuses. In the court below the suppliant succeeded, but the Court of Appeal reversed the decision by a majority.

American Wireless Patent Litigation.

The United States Circuit Court of Appeals for the Second Circuit has given judgment in the appeal of the De Forest Radio Telephone & Telegraph Company against the decision of Judge Mayer, of the United States District Court for the Southern District of New York, in the action brought by Major E. H. Armstrong against the De Forest Company for the alleged infringement of his patent, No. 1 113 149, for a wireless receiving system. The facts were given in our issue of August 19, 1921, and the present judgment, which affirms the earlier decision, awards to Major Armstrong the credit of having invented the Feed-back or Regenerative-valve Circuit as early as January, 1913.

Funeral of Sir John Benn.

The funeral of Sir John Benn, Bart., head of the firm of Benn Brothers, took place at Limpsfield, Surrey, last Thursday. The first portion of the service was held in Oxted Congregational Chapel, and was conducted by the Rev. Bernard J. Snell, of Brixton Independent Church, and the Rev. Wilton Rix, the pastor at Oxted. In addition to the chief mourners, who included Lady Benn, among those present were Sir Ernest Clarke, Sir Arthur and Lady Spurgeon, the Rector of Oxted, and several representatives of the editorial, publishing, and commercial departments of Benn Brothers, six of whom acted as pall-bearers. Mr. Gillespie, who was at the organ, played " O Rest in the Lord " and Schumann's " Dream " as voluntaries, and as the cortège entered the church " I know that my Redeemer Liveth," from Handel's " Messiah," while at the close he rendered " The Hallelujah Chorus."

At the memorial service at Christ Church, Westminster Bridge-road, London, a large congregation was present including :—The Marquess of Lincolnshire, Lord Riddell, Sir Godfrey Baring, Sir Stephen Collins, Sir Lulham Pound, Sir W. Lancaster, Sir Willoughby and Lady Dickinson, Sir Arthur Roberts, Sir W. Collins, Sir Clement Kinloch-Cooke, Lady Beachcroft (Sir Melvill Beachcroft was unable to be present through indisposition), Mr. and Mrs. Pickstone, Mr. C. W. Bowerman, Mr. John Burns, Mr. G. H. Hume, Mr. St. John Morrow, Mr. W. C. Copperthwaite, Mr. G. W. Humphreys, Mr. J. Rolls Hoare, Mr. and Mrs. J. Benson, Mr. Edward Rice (representing the Kennington Conservative Association), Mr. John Ames, Dr. Scott Lidgett, Captain Albert Larking (secretary of the Early Closing Association), the Rev. Stewart Headlam, Mr. Seth Howard, Mr. Frank Atkins, Mr. J. C. Knight, Mr. A. P. Comyns, Mr. H. J. Greenwood, Dr. and Mrs. Chapple, Captain Swinton, Mr. H. D. Smith, Mr. John Osborne, Mr. G. Mitchell, Mr. H. B. Knight Chorley, the Rev. R. H. Hutchinson, Mr. Arthur Warne Browne, Mr. F. R. Anderton (chairman of the London County Council), and many members of the Council.

The service, at which the Rev. J. D. Jones, the Rev. F. B. Meyer, and the Rev. W. C. Poole officiated, was choral, and included the hymns " O God, our help in ages past," " Praise, my soul, the King of Heaven," and " For all the Saints." Handel's " Hallelujah Chorus " was also rendered, and an address was given by the Rev. J. D. Jones.

The King and Queen sent the following message to Lady Benn from Windsor Castle : " The King and Queen are grieved to hear of the irreparable loss which you have sustained, and desire me to offer you their heartfelt sympathy in your sorrow.—Private Secretary."

Electricity Supply.

The cost of the administration of the Electricity Commissioners' Department for the year ending March 31 was approximately £44 000.

The National Electric Supply Company has been formally taken over by Preston Corporation, who now own every public service except the gas undertaking.

Salford Town Council have sanctioned the renewal of an agreement with the Manchester Corporation to supply a certain amount of electricity in bulk during the next two years.

The electricity supply works built by the Portrush Urban Council were opened on the 13th inst. by Mrs. Kelly, wife of Mr. Andrew Kelly, chairman of the Urban Council. About £17 000 has been expended on the scheme, and the majority of the business and private houses have their connections.

Considerable discussion took place at the last meeting of Reading Town Council on the proposed repairs to the electric lighting system at the Berks Mental Hospital, for which the Council is called upon to contribute over £1 000. The Finance Committee recommended payment of the sum, but the Council referred the matter back for further consideration and report.

Glasgow Electricity and Tramways Departments are in favour of a project to generate electricity at the proposed new refuse destructor works for the south side of the city, and recommend that, if the plan is carried out, their departments take the supply at not less than the then existing cost of production of electricity to these departments.

A. & R. Appleton, flour millers and corn merchants, Hull, have intimated to the Electricity Committee that owing to the high charges for electricity they are placed at a great disadvantage in competing with millers of York, Leeds, Sheffield, Middlesbrough, &c., and that unless this unsatisfactory state of affairs can be remedied they will be compelled to change over to steam or gas, or to transfer their provender plant to Leeds.

The Irish Society have refused to continue negotiations in regard to proposals put forward by the Coleraine Urban Council to rent the water power at the Cutts, on the River Bann, for the purpose of generating electricity for the lighting of the town, and also proposals to give a reasonable indemnity against damage to the fisheries. The society state that, having consulted the lessees of the fisheries, the loss so caused to the salmon fishing would be considerable.

Burnley Electricity Committee have decided to support Newport Corporation in their effort to secure an alteration in the basis upon which salaries are calculated in the E.P.E.A. schedule from that of "plant capacity" to "output," and to effect a re-grading of the basic rates with the object of obtaining a material reduction therein. The electrical engineer (Mr. J. E. Starkie) reported that a second reduction of salaries took effect from April 1, whilst workmen suffered a reduction of 1d. per hour.

At a meeting of Sheffield Electric Supply Committee the general manager of the Electricity Department (Mr. S. E. Fedden) reported that the accumulated profits realised in the installation and motor department, working under "The Sheffield Corporaion Act, 1912," after paying all charges, including interest and sinking fund and income tax, amounted to £32 010, and that year by year these trading profits had been carried to the general appropriation account of the electric supply department. It was resolved "That a sum of £30 000 of this amount be transferred to the relief of the rates."

Glasgow Electricity Committee recommend that, failing to obtain more satisfactory terms, the Corporation should take steps to oppose the resolutions in the House of Commons and the House of Lords approving the Renfrew and District Electricity Special Order, 1922, with a view to the modification of the proposed area of supply. Under one of the proposals the Corporation would be permitted to supply electricity for domestic and shop lighting and heating (but for no other purposes) in Cardonald and Hillington, including the Corporation's housing scheme at Cardonald so far as south of the Glasgow and Paisley Joint Railway, on condition that no cables or wires of a working pressure exceeding 550 V are laid in, through, or over the area described in the Order.

New Schemes and Mains Extensions.

Shrewsbury Town Council have decided to increase the plant at the electricity works by the introduction of oil engines at a cost of £15 000.

Dundalk Urban Council has asked the Irish Minister of Economics to sanction a loan of £18 000 to extend the municipal electrical works.

Application is being made by Thos. Hy. Thompson to the Electricity Commissioners for a Special Order authorising him to generate and supply electricity in Budleigh Salterton (Devon).

In reply to an inquiry from Hazel Grove and Bramhall Urban Council, Stockton Corporation have intimated their willingness to furnish a supply of electricity in bulk for distribution by the Council.

Hemel Hempstead Urban Council has accepted the terms submitted by Watford Urban Council for a supply of electricity. Watford is to apply for a Special Order, under which the Corporation will have the option of purchasing after twenty-one, twenty-eight and thirty-five years, and afterwards at the end of each ten years. The maximum charge to be inserted in the Order is 9d. per unit, but as to actual charges, consumers in the borough are to pay during the first ten years 12½ per cent. above the prices at Watford, and during the next eleven years 5 per cent. above.

Portsmouth Town Council has decided to apply for a Special Order to extend the area of supply to the Havant Urban and Rural Councils and the Warblington Rural District. The estimated cost is £15 800, and it is proposed that the charge to consumers in the new area shall be 2d. per unit above that at Portsmouth for lighting and ½d. above for power.

Alteration of Charges.

A reduction from 7d. to 6d. per unit for lighting and from 2·1d. to 1¾d. for power has been made by Battersea Council in the charges for electricity, the reduction to take effect from the March meter readings.

As from the June meter readings electricity charges at Dewsbury are to be reduced from 7¾d. to 7¼d. per unit to lighting consumers, and from 120 to 100 per cent. over pre-war rates to power consumers on the maximum demand system.

St. Helens (Lancs) Electricity Committee have reduced, as from the 1st inst., the charges for electricity to ordinary consumers for lighting, power and heating from 80 to 60 per cent. above the pre-war rates.

Worcester Electricity Department have decided to allow a discount of 10 per cent. from all electricity accounts (including the rateable charge under the Norwich system) which are paid before the last day of the month on which the accounts are rendered, except the accounts for supplies in bulk rate terms, which include coal and labour clauses, and accounts for public lighting.

Southampton Electricity Department announces considerable reductions in charges for electricity as from the 1st inst. The lighting rate has been reduced from 8d. to 6d. per unit; heating and cooking from 2d. to 1½d. per unit; power, the old sliding scale of 6½d. to 1¾d., reduced to 2½d. sliding scale to 1¾d. Premises supplied with current at the heating and cooking rate of 1½d. per unit must have a lighting installation of not less than six independent points. No rental is charged for the extra meter required for the heating and cooking supply. With regard to power supplies, it is proposed that when the total amount, as calculated on the basis of the sliding scale, is more than would have been due had the consumption been greater per H.P. installed, the amount shall be calculated at the next lower rate.

Electric Traction.

The Minister of Transport has made the Doncaster Corporation Light Railways (Extensions) Order, 1922.

It is stated that the Birmingham Corporation Tramways Committee is losing £800 per week on the 1d. short-stage fares.

St. Helens Tramways Committee proposes to make application for a loan of £40 000 for tramway purposes. In percentage of working costs to revenue, St. Helens works out, with one exception, the lowest in the country.

Wolverhampton Town Council have adopted the recommendation of the Tramways Committee to reduce the minimum ordinary tram fare from 2d. to 1½d. It is estimated that this reduction will result in a deficit of £3 562, but it is hoped that reductions in costs may balance the account.

The Minister of Transport has extended the period allowed by the Western Valleys (Mon.) Railless Electric Traction Act, Oct., 1913, for the completion of trolley vehicle equipment for one year from Feb. 15, 1922; and the period allowed by the Western Valleys (Mon.) Railless Electric Traction (Extension) Order, 1914, for similar work, for one year from July 8, 1922.

Manchester Tramways Committee have received thirty-eight applications for the position of general manager to the tramways, which has become vacant through the resignation of Mr. J. M. McElroy. The applicants have now been reduced to three: Mr. E. S. Rayner, general manager of the Hull Tramways; Mr. J. S. D. Moffet, general manager of Belfast Tramways; and Mr. H. Mattinson, the chief civil engineer to the Manchester Corporation Tramways. These three are to attend the committee meeting on April 25, when the final selection will be made.

In a recent letter to the "Scotsman," "D. R. P." gives some particulars of the official trial trip last month by an electric express train of ten carriages, or 300 tons, from Genoa to Turin and Modane (Mount Cenis route). Over the section from Genoa to Turin, 104 miles, electric trains have been regularly run for more than a year, but it is only recently that the electrification and the supply of hydro-electric power have been extended to the Turin and Modane section (64 miles). Owing to the heavy gradients, up to 1 in 70, on some of the sections of both lines, steam-propelled trains have often necessitated the use of two engines, but the electric trip was accomplished by a single locomotive at the high mean speed of 60 miles an hour over the whole distance of 170 miles. This is, so far, the longest electric main line in Europe. With the regular running of electric trains, the Mount Cenis route will, at least on the Italian side, beat its Simplon rival by something like an hour, and the saving of time will be further extended to the line from Genoa to Spezia and Pisa (for Florence and Rome) when, six months hence, the electrification of that section will also be completed.

Personal and Appointments.

Dr. F. Johnson has been elected chairman of the Birmingham section of the Institute of Metals for the ensuing year.

The Earl of Crawford has been appointed Minister of Transport, without salary, as well as First Commissioner of Works.

Mr. Charles Collinge, permanent way superintendent of Coventry Corporation Tramways, who is leaving for Rochdale, has been presented by the staff with a suit case.

Swindon Town Council has referred back to the Finance Committee for reconsideration a recommendation to reduce the salary of the electrical engineer, Mr. A. Nicklin, from £500 to £475 per year, and that of Mr. T. Medcalf, manager and secretary of the tramways, from £520 to £494.

Business Items, &c.

Gillespie & Beales announce a considerable reduction in the price of the models A, B, C, and D of the "Nilfisk" electric suction cleaner.

The Solidite Manufacturing Company has been formed to take over the business of the Improved Solidite Company, Ltd., of Wandsworth. Large, up-to-date premises have been acquired at Mitcham, which will enable the company to cope more easily with the orders. All correspondence should be sent to the head office of the company, 28, John-street, Bedford-row, London, W.C. 1.

Mr. H. E. Barringer has been appointed manager of the Cardiff office of Simplex Conduits, Ltd., in succession to Mr. J. Entwistle, who was recently appointed manager of the Newcastle and District branch of the company. Mr. Barranger has been connected with the company's Bristol depot for a considerable time, after twenty-one years' previous experience at the head office and works.

Institution Notes.

The annual general meeting of the Electrical Trades Benevolent Institution will be held at the offices of the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, on Monday, April 24, at 2.30 p.m.

The Paper to be given before the East Midland Sub-Centre of the Institution of Electrical Engineers by Mr. R. J. Mitchell, on "Electric Vehicles," has been postponed from the 18th to the 25th inst., when it will take place at Loughborough College at 6.45 p.m.

The Institute of Physics, of which Sir J. J. Thomson is president, is arranging a course of public lectures with a view to indicating the growing importance and place which physics now hold in industry and manufacture. The first of the lectures, "Physics and Engineering Science," will be delivered by Prof. A. Barr, of Glasgow, on Wednesday, April 26, at 8 p.m., in the Hall of the Institution of Civil Engineers, Westminster, London.

The eighth meeting of the 1921-2 session of the South Midland Centre of the Institution of Electrical Engineers was held at the University, Edmund-street, Birmingham, on the 5th inst., when Dr. C. C. Garrard gave a lecture and showed cinematograph films of the effect of very large currents and heavy short circuits on oil switches, current transformers, potential transformer fuses, &c. Mr. F. Gill showed three reels on "Telephone Inventors" and two on "The Audion." The meeting was very successful, some 250 members and friends being present.

Trade Inquiries.

A loan of Gld.2 400 000 (divided into 2 400 7 per cent. bonds of Gld.1 000 each) is being raised by the Oost-Java Stoomtram Maatschappij (Dutch East Indies) for the purpose of completing the electrification of their lines at Sourabaya. A double track will be laid down with a total length of about 21 kilometres. (Reference, Department of Overseas Trade 771/15/F.G./P.N.)

A firm of manufacturers' agents in Winnipeg desire to obtain the representation of United Kingdom manufacturers of electrical household appliances, automobile accessories, &c., on a commission basis, for Western Canada (Fort William, Ontario, to Victoria, British Columbia). Particulars may be obtained from the Department of Overseas Trade. (Ref. No. 100.)

A consulting mechanical and electrical engineer in Vancouver, British Columbia, who for some years acted as chief engineer to a large colliery company, and has a fairly extensive connection with the coal mining industry in British Columbia, desires to obtain catalogues and prices, particulars and literature on the latest practice in the utilisation of the latest type of coal mining machinery and equipment, coal cutters, electrical switchgear, pumps and small motors, with a view to representing suitable United Kingdom manufacturers, on a commission basis. Particulars from the Department of Overseas Trade. (Ref. No. 405.)

Palmers' Shipbuilding and Iron Company recently accepted the tender of Sir John Jackson, Ltd., for the construction of a dry dock at Swansea in connection with the large ship repairing and engineering works they are establishing. This is the first of two parallel docks which the company intend to construct on the south side of the King's Dock at Swansea, and powerful electrically-driven centrifugal pumps are to be installed for emptying the dock.

Telegraph and Telephone Notes.

A new telephone exchange was opened in the Liverpool district last week. This exchange will be known as Willaston (Birkenhead), and will serve a portion of the existing Bromborough, Hooton, and Neston exchange areas.

In view of the complaints of delays in the transmission of Conference news from Genoa, the Italian Telegraph Administration states that the Genoa telegraph offices despatched on April 10 telegrams containing 210 000 words. On the same day the outgoing telephone calls from Genoa to other Italian towns showed a total of 108 hours, and to towns abroad a total of 22 hours, equivalent to 2 600 conversations of three minutes each.

The London Telephone Advisory Committee passed a resolution last week commending the report of the Select Committee, and urging that prompt effect be given to the report as a whole, and especially to the portions relating to the reduction in charges, the separation of the administration of telephones and telegraphs from mails, the division of the country into separately administered districts, and the securing of better co-ordination throughout the department.

Wireless Notes.

The International Wireless Conference, which opened at Cannes last month, has been transferred to Paris.

A new high-speed commercial wireless service between Berne (Switzerland) and England was inaugurated last week.

It is reported that the German Wireless Transatlantic Company is increasing its capital by 30 000 000 marks, which are to be used for the extension of the stations at Nauen and Eilvese.

The Vancouver correspondent of the "Times Trade Supplement" states that the three daily newspapers of that city have each installed a high-power wireless sending apparatus, by means of which every isolated camp and farm is being brought into touch with the happenings of the outside world. Statistics recently published in the United States show that, whereas five months ago there were less than 50 000 receiving outfits in the whole of that country, and 40 000 of these within 100 miles of New York, to-day there are at least 700 000 of them, and the demand continues to be so great that the factories cannot cope with it. There are thirty-five broadcasting stations in eighteen different States in the Union.

At a conference last week of airway managers and pilots to draw up rules to prevent a recurrence of such an air collision as that which took place over Northern France on April 7, the following, among other, resolutions were passed :—That every commercial aeroplane must be equipped with wireless telephones; that additional ground wireless and weather reporting stations should be established at Poix and Noailles on the French section of the London-Paris airway; that the terminal air stations of Croydon and Le Bourget should now be in constant communication with each other by wireless telephone as well as by ordinary wireless; that the question of "interfering" with wireless telephony by the powerful Eiffel Tower wireless station should now be investigated; that the ground wireless station at St. Inglevert, on the French coast, which was destroyed by fire recently, should now be replaced.

Exhibition Notes.

A sample fair will be opened in Padua next June. At last year's fair 2 000 Italian firms exhibited and 500 foreign, the greater number of the foreign firms being German. This year the fair will occupy an area of 1 700 000 sq. ft., and there will be a special exhibition of scientific instruments, particularly of electrical instruments, electro-magnets, electro-meters, electric ovens, and wireless telegraphic and wireless telephonic equipment.

Under the auspices of the British World Trade Expedition, the 9 000-ton steamship "British Trade" will sail in June from the Port of London on a cruise round the world with an exhibition of representative British manufactures and industries. It was originally intended that this ship should leave London on May 1; but the engineering dispute caused a postponement of the date of sailing, and it has not yet been definitely fixed. The cruise will occupy 267 days, of which 119 will be exhibition days at various ports, including Rio de Janeiro, Montevideo, Buenos Aires, and the chief ports in South Africa, Australia, Tasmania, the South Sea Islands, Japan, the Straits Settlements, India, Egypt, and the Mediterranean. It is hoped that upwards of 150 British firms will be represented in the ship, which will contain every convenience for carrying on business. Cinematograph films depicting exhibitors' works and specialities will be shown at every port of call.

The accounts of King's Lynn Electricity Department for the year ending March 31, 1921, show a gross profit of £3 700. After allowing for interest on loans (£1 227), repayment of capital (£2 017), income tax (£555), and bad debts (£7), a deficit of £106 remains. Capital expended during the year amounted to £23 703, bringing the total capital expenditure to £84 202. The units sold numbered 882 314, against 786 201 in 1920; maximum demand, 736 kW (586 kW); load factor, 13·68 per cent. (15·32 per cent.); private connections, 1 144 (1 087). The total inclusive cost per B.T. unit was 4·55d. (3·84d.), and the average price obtained 4·06d. (3·89d.).

Foreign Notes.

Calcutta Corporation have approved of the proposed expenditure of R300 000 (£200 000) for eight electric lorries.

The Niagara Falls Power Company has been allowed by the Federal Power Commission to amend its plans so as to enable it to erect three hydro-electric units of 70 000 h.p. each and one forebay, instead of five units of 37 500 h.p. each and two forebays as originally proposed.

The volume of German trade with China continues to increase, and the value of machinery imports into Shanghai alone in 1921 compares favourably with imports into the whole of China in 1913 and 1914, while aniline dyes represented a higher value than the whole of Germany's trade in pre-war days.

For the purpose of scientific research and medical uses, the Czecho-Slovakian Government proposes to reserve to itself the sole right of exploiting the radio-active resources of the Republic. Since 1919 the mines at Jachymov have produced 6·5 grammes of radium, which is said to be the purest in the world.

According to a correspondent there is a growing demand for machinery and electrical supplies in Manchuria. The horse tramways in Mukden are to be converted to electric traction, Messrs. Okura & Company furnishing the capital. Orders have been placed in Germany for electrical machinery for the Patahao Mines, near Hulutao Harbour, and a telephone service between Mukden and Tientsin is being contemplated.

President Harding is stated to be one of the most enthusiastic of the American wireless enthusiasts. The Navy Department has recently installed a receiving set for him which can use a wavelength of 25 000 metres. Under ordinary conditions the President can hear not only all the stations in the United States, but also those in Hawaii and Panama, although these overseas stations do not send in voice, but in the Morse code.

The Hidroeléctrica Española, the second most important company in Spain, has, the "Engineer" states, nearly completed the construction of its station at Dos Aguas, the junction of the Rivers Jucar and Gabriel, to the south-west of Valencia. This station will give some 100 000 h.p. when completed, and will help to improve the inadequate power and light service of Madrid, where the existing stations are quite insufficient to meet the increased requirements.

The second Annual Electric Vehicle Show, organised by the New York Edison Company, was held from April 3 to 15 inclusive, and is reported to have been highly successful. A number of new cars as well as the oldest "electric" in existence were exhibited. The first week was devoted to road trucks and pleasure vehicles, and during the second industrial trucks and trailers were on view. The storage battery and accessory sections were strongly represented.

A resolution has been introduced into the American House of Representatives calling for an investigation into the charge that the General Electric, the Westinghouse, the American Telephone and Telegraph, and the United Fruit Companies have combined with the Radio Corporation of America for controlling the manufacture and sale of radio equipment. The cross-licensing of patent rights and the combination of the various interests are considered to be a conspiracy in restraint of trade.

Under the Customs Union, which has recently been instituted between the Free City of Danzig and Poland, the former has the right to allow the import of certain quantities of specified goods at rates lower than those prescribed in the Polish Customs Tariff, on condition that goods imported under this provision are imported before Sept. 30. The list includes installation material for electric plant, telegraph, telephone, &c., apparatus, on which the duty is reduced 25 per cent., the maximum quantity to be imported at reduced rates being 40 tons (metric).

The estimated cost of the new steam station, the trunk lines, and feeders required for the National Electric Supply Scheme of Czecho-Slovakia is put at 1 500 000 000 crowns. As already announced, it is proposed to erect capital stations near the coalfields, and later to construct hydro-electric works. The first part of the scheme will take twenty years to carry out, but it is not expected that the water-power development proposals will be completed for fifty years. All the supply undertakings will be linked up, and the trunk lines will transmit three-phase energy at 100 000 V, 50 cycles.

Tramway Rails and Fishplates.

A revised edition of British Standard Specification and Sections for Tramway Rails and Fishplates has been published by the British Engineering Standards Association. The following are some of the more important modifications which have been made:—(1) Separate analyses are given for the manufacture of rails by the Bessemer and open-hearth processes, both acid and basic, a higher minimum carbon content being specified, and in the case of basic rails added silicon has been provided for; (2) the position in the head of the rail from which the drillings and test pieces for the chemical analyses and tensile tests are to be taken is now defined; (3) the minimum tensile strength of the rails has been increased to 45 tons per sq. in.; (4) the falling weight test is required to be made from each cast, the use of crop ends of rails being permitted, and is to be carried out on the British Standard falling weight testing machine, the specification for which is inserted as an appendix; (5) the testing procedure before rejection, both for rails and fishplates, has been set out in detail; and (6) a standard series of short lengths is given. The brand or mark of the Association now indicates only that the rail is of British Standard section.

Miscellaneous.

The death has occurred of Mr. P. A. E. Dowling, Registrar of the College of Science, Dublin.

The late Mr. J. T. Allingham, of the British Mannesman Tube Company, has left estate valued at £6 170.

The late Mr. Hugh Bramwell, chairman of the Treforest Electrical Consumers' Company, has left estate valued at £21 465.

The late Sir Francis Barker, a director of Vickers, Ltd., Canadian Vickers, Ltd., Metropolitan-Vickers Electrical Company, Electric Holdings, Ltd., British Lighting and Ignition Company, Compagnie Electro Mécanique, &c., has left estate valued at £118 801.

At Burnley Quarter Sessions last week, Edwin Growden Langsford, an electrician, was remanded until the next sessions on charges of obtaining money by false pretences. The Recorder said this would give him an opportunity of repaying the money as he had promised and to test his sincerity.

An interesting feature of the special Lauder Performance at the Princes Theatre on April 26 will be the presence of prominent leaders of both organised capital and organised labour. The performance is to be under the personal patronage of H.R.H. the Duke of York, and the proceeds will go to the Industrial Welfare Society, of which he is president.

Thirteen men were injured, seven seriously, by an explosion which occurred in one of the mines of the Viewpark Colliery, Uddingston, near Glasgow, last week. At first the cause was thought to be due to firedamp, but later the belief was current that one of the electric cables of the coal-cutting plant fused and ignited an accumulation of gas.

The Metropolitan Asylums Board, states the "City Press," provides a remarkable instance of the vagaries of tendering. For so straightforward and simple a job as the installation of the electric light at a certain hospital, the prices submitted by contractors ranged, it states, between £943 and £5 600. The latter figure was £3 600 above the one next to it!

The librarian of the R. Istituto Lombardo di Scienze e Lettere of Milan is anxious to find the letters of Alessandro Volta to De Luc, and of any other letters and MSS. of Volta, for the national edition of Volta's works, which is being prepared under the auspices of the Italian Government by a commission attached to the Istituto Lombardo. Information on the subject should be sent to Mr. Paget Toynbee, Fiveways, Burnham, Bucks.

It has been decided to reduce the grade of the Commercial Diplomatic posts at Rome from Commercial Counsellor and Commercial Secretary (Grade II.) to Commercial Secretary (Grade I.) and Commercial Secretary (Grade III.) respectively. The senior post, which was vacant owing to the resignation, which we announced last week, of Sir E. Capel Cure, has been filled by the promotion of Mr. J. H. Henderson, the present Commercial Secretary (Grade II.) at Rome; and the junior post by the transfer of Mr. H. C. A. Carpenter, Commerical Secretary (Grade III.) at Washington.

A case at the Dudley Police Court last week is a good illustration of the damage that can be caused by small boys when tools are left lying about. Two boys, named Aston and Hicks (thirteen years of age), were charged with causing damage at Messrs. Goodyear & Sons' works. The works are connected with the G.W. Railway by a private electric tramway, and a tramcar, which was left on the line, was set in motion by one of the two boys using a loose spanner for switching on the electric current from a switch-box. The tramcar, having been started down an incline, dashed into an embankment and was smashed. The damage was estimated at £1 000. One of the boys was ordered to receive six strokes with a birch-rod and the other was discharged.

The 1922 Year Book and Export Register of the Federation of British Industries has been divided, for easy reference, into four sections. Section I. gives a general survey of the scope and activities of the Federation, the qualification and specific services gained by membership, &c. In Section II. the manufactures and products of F.B.I. firms and Associations are arranged in alphabetical order. Under each heading is given a list of the firms manufacturing the article indicated in the heading. In Section III. all members, whether firms or Associations, are listed together in alphabetical order. After each name is given, in the case of firms (*a*) a brief description of their business, (*b*) head office, works, and cable addresses, and (*c*) names and addresses of agents overseas. In the case of an Association the name and address of the secretary is given, a brief statement of its objects, and, in many cases, a list of members. Section IV. contains 340 pages of members' advertisements. In addition to the advertisements the book contains 454 pages, and is on sale at 25*s.* net.

Owing to the high cost of the Queenstown-Chippawa hydro-electric development and of the consequent higher charges for power by the Ontario Hydro-Electric Commission, the Ontario Legislature have decided to appoint a Royal Commission to conduct a full and impartial investigation into the expenditure and estimates of the Commission, of which Sir Adam Beck has been chairman for many years. About a month ago Colonel Carmichael, Minister without portfolio in the Ontario Cabinet, resigned from the Commission because last year's estimates had been exceeded by over £3 000 000.

Tenders Invited and Accepted.

UNITED KINGDOM.

FALKIRK PARISH COUNCIL. May 1.—Six months' supply of electric lamps, ironmongery, &c., to Blinkbonny Home. Schedules, &c., from the Governor.

GLASGOW ELECTRICITY DEPARTMENT. May 1.—Supply of (1) cables (including small IR cables and flexibles); (2) meters; (3) carbons, for a period of twelve months. Particulars from R. B. Mitchell, Engineer, 75, Waterloo-street, Glasgow.

DOUGLAS (ISLE OF MAN) CORPORATION. May 8.—Ten-ton travelling crane, two oil engines, with oil storage tank, cooler and piping, two 210 kW d.c. generators and balancer-booster set, main switchboard and storage battery. Specifications from Messrs. Handcock & Dykes, 11, Victoria-street, London, S.W. 1.

H.M. COMMISSIONERS OF WORKS.—Erection of a telephone repeater station at Taplow, Bucks

ASIA.

DEPARTMENT OF POSTS AND TELEGRAPHS, BANGKOK. June 5.—Telegraph and telephone materials to the value of £10 000. Tender forms can be obtained from the Chief Electrical Engineer, Telephone Exchange, Bangkok.

MANCHESTER Corporation have accepted the tender of Walter Scott, Ltd., for steel girder tramway rails.

KETTERING Corporation have accepted the tender of the Union Cable Company for two feeder cables.

HALIFAX Corporation have accepted the tender of Crompton & Company for a d.c. switchboard, £1 665.

LEEDS Corporation have accepted the tender of W. T. Henley's Telegraph Works Company for cable, £1 187.

CANNOCK Urban Council has accepted the tender of Raybould & Ancott, Darlaston, for wiring the Council offices at £98.

MANCHESTER Corporation have accepted the tender of Ferguson, Pailin, Ltd., for a 200 A 6 000 V oil switch for Stuart-street station.

PORTSMOUTH Town Council has accepted the tender of Babcock & Wilcox for a Green's economiser for the electricity works, at £3 726.

BIRKENHEAD Corporation have accepted the tender of Holden & Brooke for electrically-driven turbo pumps at Flaybrick Hill and Tranmere reservoirs, £1 896.

DUBLIN Corporation have accepted the tender of the British Electric Transformer Company for twelve months' supply of transformers, estimated at £7 000.

GLASGOW Coporation have accepted the tenders of the British Thomson-Houston Company for converting plant, £11 012, and switchgear, £1 414; and Johnston, Park & Company for electrical work in the municipal buildings extension.

MARYLEBONE (London) Council have accepted the following tenders: British Electric Transformer Company, transformers, £3 537: Ferguson, Pailin, Ltd., switchgear, £2 688.

BRADFORD Corporation have accepted the tenders of Thompson & Company for 500 5-A s.p. meters, and Jessop & Baydell for wiring and fitting the Electricity Department's new offices and showrooms.

EDINBURGH Corporation have accepted the tender of Dorman, Long & Company for tramway rails and fishplates, £1 527 10s., and Craven's Railway Carriage & Wagon Company for tramcar top covers, £4 300.

BARROW Corporation have accepted the tenders of the Metropolitan-Vickers Electrical Company for insulating tape, &c.; British Insulated & Helsby Cables, Ltd., insulating compound; A. P. Lundberg & Sons, pin-plugs; General Electric Company, lampholders, switches, &c.; Edison Swan Electric Company, fuse wire and half-watt and carbon filament lamps; Chamberlain & Harkham, meters; Downes & Davies, casing and capping.

SUNDERLAND Electricity Department have accepted the following tenders:—British Insulated and Helsby Cables Company, 600 yards 0·154 cables; Callender's Cable and Construction Company, 12 service boxes and 5 link boxes; Armstrong, Addison & Company, creosoted redwood capping; Ferguson, Pailin, Ltd., two l.t. switch panels; Cambridge Scientific Instrument Company, temperature and flue-gas recorders; Consolidated Pneumatic Tool Company, electric drilling machine.

The WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburg, Pa., have received contracts, amounting to approximately $250 000, from the Commonwealth Edison Company, of Chicago, and from the Consolidated Gas, Electric Light and Power Company, of Baltimore, for five large booster converters, with transformer and equipment. This company have also been awarded the contract for electrical equipment for a new power-house, to be constructed by the Southern California Edison Company, and to be known as Big Creek, No. 3. The contract gives to the company all switching equipment, both h.t. and l.t., for this station and all h.t. switching equipment at three sub-stations—Magunden, Eagle Rock and Vestal.

EDINBURGH Town Council recently decided, by 30 votes to 19, to accept the tender of Dorman, Long & Company for steel tramway railways and fishplates at £1 527 10s., in preference to the offer of the Equipment & Engineering Company, Ltd., London, at £1 425, the rails to be of German manufacture. A recommendation by the Tramway Committee to accept the tender of Mannesmanrohen Works, Dusseldorf, amounting to £5 436, for one-piece tramway poles was defeated, an amendment by Mr. Gorman to accept the lowest tender for three-piece poles—*viz.*, that of Stewart & Lloyds (Ltd.), Glasgow, being adopted by a majority.

Islington (London) Council have accepted the following tenders:—Chamberlain & Hookham and British Insulated & Helsby Cables, Ltd., meters; British Electric Transformer Company, transformers; Johnson & Phillips, steel transformer tanks; Hackbidge Construction Company, c.i. tanks; General Electric Company, carbons; the British Central Electrical Company, arc lamp globes; British Insulated & Helsby Cables, Ltd., h.t. insulated cables; Enfield Ediswan Cable Works, Ltd., l.t. paper-insulated cables and h.t. and l.t. rubber-insulated cables; Callenders Cable & Construction Company, joint and cable boxes, h.t. fuse and l.t. service boxes and dividing boxes; British Insulated & Helsby Cables, dividing boxes; Lucy & Company and Johnson & Phillips, fuse boxes; W. Lucy & Company and H. Hughes & Son, l.t. service boxes; Dussek Bitumen Company; W. T. Henley's Telegraph Works Company and India Rubber Gutta Percha & Telegraph Works Company, compounds, tapes, &c.; British Insulated & Helsby Cables, carbon and m.f. lamps; Edison Swan Electric Company and L. Andrews & Company, wiring accessories.

MANCHESTER Corporation have accepted the following tenders: Dyer & Young, commutator segments, &c.; Metropolitan-Vickers Electrical Company, commutator segments, coils, spindles, brushes, brake shoes, motor and controller parts, &c.; Manchester Armature Repair Company, coils; P. R. Jackson & Company, coils; British Thomson-Houston Company, pressure-arms and tension-springs, motor and controller parts, &c.; L. Andrew & Company, fuller board mica bushings, tapes, &c.; Fairless Engineering & Supplies Company, controller fingers, &c.; S. Gratrix, Jun., & Brother, connectors, cells, shades, muranese glass, &c.; General Electric Company, lamps, switches, &c.; Drake & Gorham (Wholesale), lamps and filaments; Commercial Electric Company, lamps; Edison Swan Electric Company, cells; A. Wiseman, Ltd., overhead equipment and insulating material; Tramway Supplies, Ltd., trolley-wheel bushes; R. W. Reeves, Ltd., electro-mechanical brake parts; W. T. Glover & Company, power and lighting cables; F. Smith & Company, Inc., copper cable, string and wire; F. Smith & Company, Ltd., steel tinned wire; Edgar Allen & Company, points and tongues, &c.; Quasi Arc Company & Alloy Welding Processes, electrodes; Chamberlain & Haskham, car meters; English Electric Company, controller parts.

Openings for Trade in the Netherlands.

The following extracts from the Dutch Press of recent dates may lead to openings for British trade:—

Plans have been drawn up by J. Vrijman, Parkstraat 16, The Hague, for the building of a new laboratory for scientific instruments at Groningen. Work will begin next year.

The Town Council of Deventer have decided to lay an electric cable along the left bank of the Ijssel.

The managing board of the starch factory, "De Beijenkorf," formerly M. K. Honig, of Koog aan de Zaan, intend adding to their works a new water pump station with electric motors. Work will commence in a few months' time.

The municipal electric power station at Haarlem (address, Harmen Jansweg 131) is to be extended. Estimate Gld.248 000. Work will be begun as soon as possible.

A proposal has been laid before the Town Council of Nijmegen to take the transport of house, street, and factory refuse under their own management, starting with 1923. For this purpose several motor vehicles would have to be purchased.

A loan of Gld.2 400 000 (divided into 2 400 7 per cent. bonds of Gld. 1 000 each) is being raised by the Oost-Java Stoomtram Maatschappij for the purpose of completing the electrification of their lines at Soerabaja. A double track will be laid down, with a total length of about 21 kilometres.

Forty Years Ago.

ELECTRIC LIGHT IN BELFAST.—The Town Council have accepted the offer of Mr. J. H. Greenhill, of Belfast, to light a portion of Castle and Mill Streets with the electric light, free of charge.

ELECTRIC LIGHT IN SHEFFIELD.—We believe that Messrs. Tasker, Sons & Company, of Sheffield, and well known in connection with telephonic work, are about to form a local company for the introduction of the electric light into that town.

CITY AND GUILDS INSTITUTE.—We are glad to find that Mr. J. Perry, M.E., has been elected to the Chair of Mechanical Engineering at the City and Guilds of London Technical College Finsbury, this week. We know of no one more fitted for the position.

ACTION OF ELECTRIC-MAGNETS ON MINERALS.—Experimenting with electro-magnets on various minerals, Professor Doelter has made the interesting observation that the absolute amount of iron present does not determine the degree to which the minerals are attracted, for sulphides and sulphates, containing much iron, are very little attracted, while the attraction of oxides, carbonates, and silicates is strong. This varying amount of attraction, it is pointed out, may be of service in mechanical separation of natural mixtures of ores, purifying ores, &c.—"Nature."

Companies' Meetings, Reports, &c.

The Direct United States Cable Company has declared a final dividend of 4s. per share, less tax, making 4 per cent. for the year ended March 31, 1922.

The Indo-European Telegraph announce a final dividend for the year ended December of £1 2s. 6d. per share (making with interim dividend already paid 7 per cent. for year), free of tax.

Letters of allotment and regret have been posted in respect of the Metropolitan Railway Company issue of £600 000 5 per cent. preference stock, which was enormously over-subscribed, applications having been received for more than £8 000 000.

An extra-ordinary meeting of the Hydro-Electric Power & Metallurgical Company is to be held in Melbourne after the ordinary meeting on April 21, to consider a resolution that the name of the company be changed to Carbide & Electro Products, Ltd.

The report for 1921 of Brolt, Ltd., states that the year's trading has resulted in a loss of £23 808, after providing for depreciation of buildings, plant, and machinery, and making due provision for all bad and doubtful debts. Deducting the surplus of £1 758 brought forward from last year, there is a net deficiency of £22 049 to be carried forward.

The report of the City of Santos Improvements Company for 1921 shows net revenue of £86 958, plus £13 431 brought forward, making £100 389, compared with £120 301 in 1920. The directors have transferred £5 000 to reserve, and, having set aside £6 000 to tramways renewal account, they recommend a final dividend of 3 per cent. on the ordinary shares, making 5 per cent., less tax, for the year, carrying forward £11 519.

The following companies will be struck off the Register of Joint Stock Companies unless cause to the contrary is shown before July 11 next :—Denton Electrical Construction Company, Denton's Foreign Patents, Derby Lamp Works, Electric Timekeepers, Electro Galvanisers, Holmquist Electric Company (1911), Londonderry-Moville Electric Railway Syndicate, Sandbanks Railless Electric Car Company, Swanage Electricity Supply Company, United States Railless Electric Traction Company.

The report of the Shawinigan Water and Power Company for 1921 shows gross earnings of $4 224 046, against $3 943 359 for the previous year, and net revenue of $1 590 813, against $1 609 043. After making usual appropriations and paying a dividend on the common shares of 7 per cent., there is carried forward $155 406. Owing to the depressed industrial conditions of last year the new power development at Shawinigan Falls will not be completed until September.

The Stock Exchange Committee have granted or ordered the following securities to be quoted in the Official List : £823 300 7 per cent. 50-year prior lien A bonds of the Barcelona Traction, Light & Power Company ; 755 780 £1, fully paid, ordinary shares and 650 000 £1, fully paid, 6 per cent. cumulative preference shares of the County of London Electric Supply Company ; and £350 000 6 per cent. guaranteed debentures of the Thames Valley (N.Z.) Electric Power Board.

The report of the Western Union Telegraph Company for 1921 shows gross operating revenues $104 155 112. After deducting operating expenses, including repairs, reserve for depreciation, rent for lease of plants, taxes, &c., $93 959 083, the sum of $10 196 029 remains, plus income from dividends and interest $1 072 962. Interest on bonds absorbs $1 635 183, leaving balance transferred to the surplus account of $9 633 808, which, with $40 685 211 brought in, makes $50 319 019. Dividends paid and declared took $6 982 622, and adjustments of surplus (net) $272 703, leaving surplus at Dec. 31, 1921, $43 063 692.

In accordance with the terms of the trust deed of the Submarine Cables Trust, tenders are invited from the certificate-holders of certificates to be redeemed out of surplus income, accrued to the 15th inst., at a price not to exceed £120 per certificate, the certificate-holder retaining the coupon of reversion attached to any certificate which may thus be redeemed. Certificate-holders desirous of surrendering their certificates on the above-mentioned terms should communicate with the secretary, Mr. Sidney Collett, Electra House, Moorgate, London, E.C. 2, stating the lowest price they are willing to accept.

The Rangoon Electric Tramway and Supply Company recommend a dividend of Rs. 1 per share, tax free, to shareholders in India or Burma on the ordinary shares, making Rs. 1½ for the year. The sum of £30 000 has been placed to reserve for renewals ; £2 927 for depreciation on sundry assets in Rangoon : £7 333 for Indian Income-tax ; £3 359 for Corporation Tax ; £3 641 for employees' provident fund and bonus ; £2 927 for depreciation of sundry assets : £3 224 for loss on exchange and expenses of new issue ; £26 305 for repairs, renewals, and maintenance, leaving £12 969 to be carried forward. It is proposed to increase capital to £800 000.

The total receipts of Rothesay Tramways Company for 1921 amounted to £22 335. After providing for all expenses chargeable to revenue, including £1 920 for debenture and other interest, payment to local authorities amounting to £270, and providing £2 310 for the renewals fund, there is, with £1 609 brought forward, a balance of £7 301, which the directors propose to dispose of as follows : reserve, £2 000 ; dividend of 5 per cent. on the preference shares, £500 ; dividend of 4 per cent. on the ordinary shares for the year, £3 270 ; leaving £1 530 to be carried forward. The dividend on the ordinary shares for the preceding year was 3 per cent.

The accounts of the City Electric Light Company, Ltd., of Brisbane, for the year ended Jan. 31 last show, after making addition to the sinking fund and renewal and contingencies account, and an amount to the employees' provident fund, a credit balance £77 359, which, with the balance brought forward, makes £77 541. Out of this year's profits the directors paid an interim dividend with dividend duty in September last amounting to £34 506, and a further dividend on March 15 of 3 per cent. on the 6 per cent. preference shares, 3½ per cent. on the 7 per cent. preference shares, and 5 per cent. on the ordinary shares, in proportion to the amount paid thereon, free of tax, leaving a balance of £109 10s. to be carried forward, against £181 last year.

The accounts of Wycombe (Borough) Electric Light and Power Company for the year ended Dec. 31 last show, including balance from contracting business, a gross profit of £17 004, compared with £16 993 in 1920, and after paying interest on debentures, loan, and outstanding accounts, and adding the amount brought forward from last year, there remains a balance of £14 276 to be dealt with. The directors recommend that a dividend of 10 per cent. be paid for the year, which will absorb £5 000, that £5 000 be placed to the renewal reserve fund and £4 000 to general reserve fund, leaving a balance of £276 to be carried forward. To meet the increasing demand for electricity, additional generating plant is now being installed at a cost of about £15 000. To provide the necessary capital for this extension it is proposed to issue 3 000 £5 cumulative 10 per cent. preference shares. The connections during the year show an increase of 142 kW.

New Companies.

J. B. Bower & Company.

J. B. Bower & Company, Ltd. (180 937). Private company. Registered April 5. Capital, £10 000 in £1 shares. Manufacturers of and dealers in electrical apparatus, machines, accessories, &c., at Wimbledon or elsewhere, and to acquire the business carried on by the Wimbledon Electrical Company, Ltd. First directors : J. P. Wallis Trevone, J. B. Bower (both directors of Wimbledon Electrical Company, Ltd.), and O. O. Dale. Registered office : 15, Kingston-road, Wimbledon, S.W. 19.

Electric House Cafes.

Electric House Cafés, Ltd. (181 072). Private company. Reg. April 11. Capital, £3 000 in £1 shares. To carry on in the United Kingdom shops, cafés, &c. Subscribers : H. Wintle, A. C. MacWhirter, W. A. Chamen, J. H. P. Herthow, T. E. Alger, C. T. Allen, and H. T. Ellis. Solicitor : R. W. Nicholas, 31, Queen-street, Cardiff.

Electricity Concessions (Ireland).

Electricity Concessions (Ireland), Ltd. Private company. Registered in Dublin, April 8. Capital, £1 919 in 380 shares of £5 each and 380 shares of 1s. To acquire the business of electrical engineers and contractors carried on by A. D. Brown, at Municipal Buildings, Blackrock, as the "Irish Overseas Direct Trading & Engineers Association." First directors : A. Brown and D. J. Byrne. Secretary : G. J. Crowe. Registered office : Municipal Buildings, Blackrock, co. Dublin.

Haywards Heath & District Electrie Supply.

Haywards Heath & District Electric Supply Company, Ltd. (181 143). Registered April 13. Capital, £30 000 in £1 shares. To acquire from E. A. Bridge, H. Dearden, H. Finch, T. White and E. Prior, with the consent of and on such terms and conditions as may be approved by the Electricity Commissioners, the undertaking authorised by the Haywards Heath & District Electricity Special Order, 1922, and to carry on the business of suppliers of electricity in all its branches. First directors : E. A. Bridge, H. Dearden, H. Finch, T. White and E. Prior. Registered office : Hornbeam, Perrymount-road, Haywards Heath, Sussex.

Lighting & Power Finance Corporation.

Lighting & Power Finance Corporation, Ltd. (181 031). Private company. Registered April 8. Capital, £2 000 in 1 800 preference shares of £1 each and 4 000 ordinary shares of 1s. each. To carry on any trade connected with electric lighting, electrical distribution for light, heat and power electrical and general engineering, building and contracting, for the supply and construction of electrical and engineering works, &c. Subscribers : R. E. Lenon and W. C. Green. Registered office : 20, Abchurch-lane, E.C.

Plant and Supplies.

Plant and Supplies, Ltd. (181 109). Private company. Reg. April 12. Capital, £4 000 in £1 shares. Electrical and mechanical engineers, dealers in electrical and mechanical plant and engineering supplies, &c. Subscribers : A. P. Pope and J. P. Southwell. Registered office : 12 and 13, Henrietta-street, W.C. 2.

Tele-Photography.

According to "The Times," M. Edouard Belin has communicated to the French Academy of Sciences a description of the modifications he has recently made in his process of transmitting photographs by electrical means. The account states that the photograph to be transmitted is printed on gelatine impregnated with bichromate, the film being mounted on a revolving metal cylinder. A stylus, which is connected to a special microphone, records the variations in the thickness of the gelatine print and causes corresponding variations in the resistance of the electrical circuit. At the receiving end a minute spot of light from the special arc lamp is focussed on to the mirror of a Blondel oscillograph. Variations in intensity are produced by using a glass screen with a scale ranging from complete opacity to complete transparency, and the variations are focussed on to a sensitive film, which moves in complete harmony with the gelatine print in the transmitter.

COMMERCIAL INTELLIGENCE.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

ELLARD-STYLES & COMPANY, LTD., 287, Upper-street, Islington, electrical engineers. £21 15s. 5d. and £10 12s. 6d. Feb. 16.

GILL & WHITE, 26, Hardwick-street, Buxton, electricians. £11 9s. 4d. Feb. 21.

KIRBY, Mr. R. J., 62, Oxford-street, W., electrical engineer. £23 11s. 10d. Feb. 17.

SOUTH WALES ELECTRIC WELDING COMPANY, King's Dock, Swansea, electric welders. £30 0s. 6d. Feb. 4.

WENMAN, Harry Orlando, Electrical Works, Ludlow, electrical engineer. £31 17s. 9d. Feb. 7.

Deeds of Arrangement.

TUCKER, Spencer John (trading as TUCKER & BATESON), 55, Berners-street, Oxford-street, electrical engineer. Filed, April 13. Trustee, T. L. Summers, 64, Victoria-street, A.A. Secured creditors, £135; liabilities unsecured, £1 157; assets, less secured claims, £253.

WEBSTER, Ernest Walter, and WEBSTER, Walter George Frederick, trading at 48-50, Rendezvous-street, and the Harbour, Folkestone, as WEBSTER & SON, automobile and electrical engineers. Filed, April 7. Trustee, W. J. Bennett, 173, Fleet-street, E.C. Liabilities unsecured, £4 610; assets, less secured claims, £3 971.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Company Winding-up.

BISHOPS CASTLE ELECTRIC LIGHT & POWER COMPANY, LTD. A petition for winding-up has been presented by the Premier Accumulator Company (1921), Ltd., of Cattle Market-road, Northampton, and is to be heard at the County Court, Leominster, Hereford, on May 8 at 10 a.m.

Companies Winding-up Voluntarily.

B E. COMPANY (OF LONDON AND BIRMINGHAM), LTD. F. Rowland, 70, Queen Victoria-street, London, appointed liquidator. Meeting of creditors at the Cannon-street Hotel, Thursday, April 20, at 3 p.m. Particulars of claims to the liquidator by April 20.

EVANS, DEWHURST & COLLEY, LTD. A. Shankland, 82, Queen-street, Cardiff, appointed liquidator. Meeting of creditors at 82, Queen-street, Cardiff, Tuesday, April 25, at 3 p.m.

HUBERT D. CARTER (BANGOR), LTD. W. Rowley-Redwood, Strand Buildings, Abergele-road, Colwyn Bay, appointed liquidator. Meeting of creditors at the offices of A. McIntyre & Company, Strand Buildings, Colywn Bay, at 12 noon, Friday, April 21. Particulars of claims to the liquidator by May 8.

NATIONAL ELECTRIC SUPPLY COMPANY, LTD. W. H. Ainsworth, 11, Winckley-street, Preston, appointed liquidator. Meeting of creditors at liquidator's office, Tuesday, April 25, at 3 p.m. Note.—This notice is given to comply with the Companies Acts. All creditors have been or will be paid in full.

PORTARLINGTON ELECTRIC LIGHT AND POWER COMPANY (THE), LTD. Michael Crowley, 16, College-green, Dublin, appointed liquidator. Meeting of creditors at liquidator's office, Saturday, April 22, at 11 a.m.

Bankruptcy Information.

COOKSON, Eugene (trading as W. TURNBULL & COMPANY), the Express Magneto Repair Works, Elizabeth-street and Charles-street, Blackpool, electrical, &c., engineer. First meeting, April 20, 10.30 a.m., 13, Winckley-street, Preston. Public examination, April 21, at 3 p.m., Court House, South King-street, Blackpool.

HOLMES, Samuel, Palatine Chambers, Halifax, under the style of HOLMES & COMPANY, electrical contractor. Receiving order, April 11. Debtor's petition. First meeting, April 28, 10.15 a.m., and public examination, May 19, 10.30 a.m., County Court House, Prescott-street, Halifax.

ORMONDE, Frank Sinclair (in co-partnership with another), under the style of the SOHO ELECTRICAL WORKS, at 125, Islington, Liverpool, electrician. Receiving order, April 8. Debtor's petition.

VIVIAN, Albert, 180, Gray's Inn-road, London, W.C., electrical engineer. Receiving order, April 10. Creditor's petition. First meeting, April 26, 12 noon, and public examination, June 20, 11 a.m., Bankruptcy Buildings, Carey-street, London, W.C. 2.

Partnerships Dissolved.

DUNSTER, Cecil George, and BACON, Vincent Edward, under the style of DUNSTER & BACON, 19, North Holmes-road, Canterbury, Kent, electricians, by mutual consent as from April 8, 1922.

FAVELL, John Edward, and MARTIN, Thomas Dawson, electrical merchants, 2, North-street, Newcastle-upon-Tyne, under the style of JOHN E. FAVELL & COMPANY, by mutual consent as from March 29, 1922. Debts received and paid by J. E. Favell, who will continue the business.

MALLIN, Matthew, MALLIN, James, and MALLIN, Luke, electro-platers and polishers, 29 and 30, Raglan-street, Wolverhampton, under the style of THE CROWN PLATING COMPANY, by mutual consent as from April 11, 1922.

WOOD, Lionel, and MEARNS, Henry, under the style of SLEIGH & WOOD, electrical and mechanical engineers, of Consett Chambers, Newcastle-upon-Tyne, as from March 27, 1922.

Edinburgh Gazette.

J. L. BROWN & COMPANY, electrical engineers, 920, Pollokshaws-road, Glasgow (J. L. BROWN, trading as). A petition for sequestration of the estates of this firm and sole partner has been presented at the instance of Johnstone & Gilmour, 606, Eglinton-street, Glasgow.

LIVINGSTONE & MALCOLM, electricians, 7, Canal-street, Coatbridge (JAMES LIVINGSTONE & FRANK MALCOLM, trading as). A petition for sequestration of the estates of this firm and partners has been presented at the instance of the Edison Swan Electric Company, Ltd., 123-125, Queen Victoria-street, London.

Bankruptcy Proceedings.

BENNETT, Charles Godolphin, engineer, 66, Mark-lane, E.C. The affairs of this debtor, who had been interested in an electric switch-holder, and against whom a receiving order was made on Dec. 13 last, came before Mr. Registrar Hope at the London Bankruptcy Court on Wednesday, April 12, on the hearing of his application to approve a composition of 7s. 6d. in the £, which had been accepted by his creditors. The Official Receiver estimated the total liabilities at £1 422, but said that since the date of the receiving order two claims for £104 and £69 had apparently been paid. The assets were estimated by the debtor at £103, and in his (the Official Receiver's) opinion, apart from court fees, a sum of £551 would be required to pay the composition and attendant expenses. In 1906 the debtor began business in partnership at the above address, but later on he carried on business by himself. Since March, 1916, he had been associated with another in experimenting and putting on the market an electric switch-holder, which he had financed to the extent of £2 000. The debtor attributed his insolvency to loss in connection with that project and to lack of capital. He admitted that he was not a professional engineer, but he claimed to have been interested in electrical subjects all his life. He estimated his loss in connection with the switch-holder at £2 847, and admitted that probably if he had not entered into that venture he would not have been insolvent. The Official Receiver reported that the debtor's assets were not of a value equal to 10s. in the £, that he had omitted to keep proper books of account, and that he had contributed to his failure by rash and hazardous speculation. With regard to the proposal, the Official Receiver considered that it was reasonable and calculated to benefit the creditors. The Official Receiver added that the application had stood over from the date it was originally before the Court to enable the debtor to lodge the rest of the money. It was largely a question of a proof of debt for £267, in which the creditor had not included the security that he held. His Honour now made an order approving the composition.

RAWCLIFFE, Frank, trading as FRANK RAWCLIFFE & COMPANY, 8, Nun-street, Newcastle-on-Tyne, electrical engineer. The statement of affairs shows liabilities of £3 866 against assets of £11. At the first meeting of creditors the Official Receiver stated that a limited company had been formed in August, 1921, to take over the liabilities. This company was now in voluntary liquidation, and there had been a suggestion of a payment of 10s. in the £ by means of debentures liquidated every three months. Debtor stated that the whole of the creditors could claim against the limited company and get 10s. in the £. The meeting was adjourned.

The INTERNATIONAL WESTERN ELECTRIC COMPANY reports that 1921 was the best year in its history, and the total sales of the company and its associates amounted to $41 000 000. The associated companies in England and Belgium were operated at full capacity, and the export business compared favourably with that of 1920. The demand for telephone equipment all over the world continues to increase.

Catalogues, Price Lists, &c.

Two illustrated loose-leaf pamphlets are to hand from MELDRUMS, LTD., describing in detail their forced draught furnaces and mechanical stokers.

In No. 7 of the series of TRANSFORMER ABSTRACTS, published by Johnson & Phillips, the question of "Switching-in Current Rushes" is dealt with in detail.

The latest stock list of motors and dynamos of the A.C.E.C. (ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI), received from the firm's London offices in Victoria-street, shows that the company hold a stock of between 1 100 and 1 200 a.c. and d.c. motors from which immediate delivery can be given. The pamphlet is well illustrated, but it would doubtless add to its value if it were printed in English as well as in French.

The ELECTRIC & ORDNANCE ACCESSORIES COMPANY, of which the proprietors are Vickers, Ltd., are circulating a new abridged catalogue of their porcelain insulators. Numerous designs of h.t. bushings, bus-bar insulators, telegraph and telephone insulators, cleats, threaded tubes, leading-in tubes, h.v. ceiling roses, &c., are illustrated, the firm's patent "fireite" heat-resisting and insulating material being employed in their manufacture.

No better way of showing the wide range of trucks manufacured by the firm of H. C. SLINGSBY could have been chosen than the sheet recently issued, which measures 2 ft. 8½ in. by 3 ft. 6 in., and every square inch of which, on both sides, shows trucks of various types for every conceivable purpose. Several types of electric trucks are illustrated, such as electric crane trucks, electric tractors, electric lifting-tiering trucks, electric lifting platform trucks.

We have received from ARCHIBALD BAIRD & SON, manufacturers of high-grade steel castings, a loose-leaf booklet of illustrations, measuring 9 in. by 11 in. After excellent photographs of the works at Hamilton, near Glasgow, including a general view of the outside, the interior of the moulding, dressing, and engineering shops, and the power house, illustrations are given of the firm's manufactures—ship castings, gear wheels and blanks, mill spindles and coupling boxes, machine-moulded spur wheels, colliery castings, &c.

The RUNBAKEN MAGNETO COMPANY have issued a leaflet describing their new Ford ignition system, which gives two distinct forms of ignition (battery and magneto), and uses the magneto system installed on the cars The system, they claim, can be installed by anyone, without special tools, in forty minutes. Instead of four coils, with their troublesome tremblers, complicated connections, &c., a small transformer coil takes their place. There is one contact breaker and one h.t. distributor, both of which are quite accessible and simple in construction.

In an illustrated booklet entitled "Steam Generation," BABCOCK & WILCOX, LTD., deal with some of the developments which have taken place in their manufactures since the outbreak of the war in 1914. Among the more important of these are those in connection with their C.T.M. and W.I.F. boilers, chain grate, and forced and balanced draught stokers, traversing coal chutes, portable boilers, special furnaces, &c. In addition to the natural and forced draught chain grate stokers mentioned above, the company have acquired the right during the last twelve months to manufacture the Riley Underfeed stoker.

Prices of Metals, Chemicals, &c.

TUESDAY, APRIL 18.

		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£63 0 0	—	—
Electro Wirebars ..	„	£66 10 0	—	—
H.C wire, basis	per lb.	0s. 10 1/16d.	—	—
Sheet	„	0s. 9 7/16d.	—	—
Phosphor Bronze Wire (Telephone)				
Phosphor-bronze wire, basis	„	1s. 2 1/16d.	—	—
Brass 60/40—				
Rod, basis	„	0s. 7⅛d.	—	—
Sheet, basis	„	0s. 9¼d.	—	—
Wire, basis.....	„	0s. 10d.	—	—
Pig Iron—				
Cleveland Warrants .	per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 SWG	„	£18 0 0	—	—
Lead Pig—				
English	„	£24 0 0	10s.	—
Foreign or Colonial ..	„	£22 15 0	7s. 6d.	—
Tin—				
Ingot	„	£151 15 0	—	15s.
Wire, basis	per lb.	2s. 1d.	—	—
Aluminium Ingots	per ton	£120 0 0	—	—
Spelter	per ton	£26 12 6	5s.	—
Mercury	per bottle	£11 0 0	—	—

Salammoniac.—Per cwt. 65s.-60s.
Sodium Chlorate.—Per lb. 3½d.
Sulphur (Flowers).—Ton £10 15s.
„ (Roll-Brimstone).—Per ton £10 15s.
Sulphuric Acid (Pyrites, 168°).—Per ton £9 10s.
Copper Sulphate.—Per ton £26 10s.
Sodium Bichromate.—Per lb. 5½d.
Boric Acid (Crystals).—Per ton £60
Rubber.—Para fine, 10½d. ; plantation 1st latex, 8⅞d

The metal prices are supplied by British Insulated & Helsby Cables, Ltd, and the rubber prices by W. T. Henley's Telegraph Works Company.

Arrangements for the Week.

FRIDAY, April 21st (to-day).

ELECTRICAL POWER ENGINEERS' ASSOCIATION.
7 p.m. At Essex Hall, Strand, London, W.C. General Meeting.

JUNIOR INSTITUTION OF ENGINEERS.
8 p.m. At Caxton Hall, London, S.W. Paper entitled "Condenser and Choke Coil Protective Apparatus," by Mr. S. A. Stignant.

MONDAY, April 24th.

INSTITUTION OF ELECTRICAL ENGINEERS.
(LIVERPOOL SUB-CENTRE.)
7 p.m. At the Laboratories of Applied Electricity, the University, Brownlow-street, Liverpool. Paper entitled "Engineering Advertising and the Work of the E.D.A.," by Mr. J. W. Beauchamp.

INSTITUTION OF MECHANICAL ENGINEERS.
7 p.m. At the Institution, Storey's Gate, London, S.W. Paper entitled "Jigs and Tools," by Mr. B. A. C. Hills.

TUESDAY, April 25th.

INSTITUTION OF CIVIL ENGINEERS.
6 p.m. At Great George-street, Westminster, London, S.W. Annual General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS.
(EAST MIDLAND SUB-CENTRE.)
6.45 p.m. At Loughborough College, Loughborough. Paper on "Electric Vehicles," by Mr. R. J. Mitchell.

INSTITUTION OF ELECTRICAL ENGINEERS.
(NORTH-WESTERN CENTRE.)
7 p.m. At the Engineers' Club, 17, Albert-square, Manchester. Annual General Meeting. Lecture on "Advertising and the Work of the British E.D.A.," by Mr. J. W. Beauchamp.

INSTITUTION OF ELECTRICAL ENGINEERS.
(SOUTH MIDLAND CENTRE.)
7.30 p.m. At the University, Edmund-street, Birmingham. Annual General Meeting.

WEDNESDAY, April 26th.

ROYAL INSTITUTION OF GREAT BRITAIN.
3 p.m. At Albemarle-street, Piccadilly, London, W. 1. A Lecture on "Industrial Relationships," by Prof. D. H. Macgregor.

ROYAL SOCIETY OF ARTS.
8 p.m. At John-street, Adelphi, London, W.C. 2. Lecture on "The Use and Advantages of Electric Power in the Factory, as Illustrated by its Application to the Jute Industry," by Mr. John Francis Crowley.

LIVERPOOL ENGINEERING SOCIETY.
8 p.m. At the Royal Institution, Colquitt-street, Liverpool. Annual General Meeting.

THURSDAY, April 27th.

ROYAL INSTITUTION OF GREAT BRITAIN.
3 p.m. At 21, Albemarle-street, London, W. 1. Lecture on "Audition and Colour Vision," by Prof. E. H. Barton.

THE NEWCOMEN SOCIETY.
5 p.m. At Caxton Hall, London, S.W. Papers on "A Note on Brunton's Walking Engine, 1813." by Mr. L. St. L. Pendred; "A Note on Heaton's Steam Carriage, 1828," by Mr. A. Titley; "Gurney's Railway Locomotives," by Mr. E. A. Forward.

INSTITUTION OF ELECTRICAL ENGINEERS.
6 p.m. At the Lecture Theatre of the Institution, Savoy-place, Victoria Embankment, W.C. 2. Lecture on "Protective Apparatus for Turbo-Alternators," by Mr. J. A. Kuyser.

LIVERPOOL ENGINEERING SOCIETY.
7.30 p.m. At the Royal Institution, Colquitt-street, Liverpool. Students' Meeting. Paper entitled "The Uniflow Steam Engine," by Mr. E. Cockshutt.

THE ILLUMINATING ENGINEERING SOCIETY.
8 p.m. At Royal Society of Arts, John-street, Adelphi, London. Discussion on "The Use of Light in Hospitals."

FRIDAY, April 28th.

ROYAL SOCIETY OF ARTS.
4.30 p.m. At Royal Society of Arts, John-street, Adelphi, London. Indian Section Meeting.

ELECTRICAL POWER ENGINEERS' ASSOCIATION.
7 p.m. At the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London. Lecture entitled "Some Notes on the Design of Generating Plant," by Mr. C. F. Hewitt.

INSTITUTION OF ELECTRICAL ENGINEERS.
(NORTH-WESTERN CENTRE.)
7.30 p.m. At the College of Technology, Manchester. Public Lecture on "Recent Developments in Atomic Research," by Prof. W. L. Bragg.

INSTITUTION OF ELECTRICAL ENGINEERS.
(SCOTTISH CENTRE.)
7.30 p.m. At Technical Institute, Dundee. Paper entitled "Single and Three-Phase Alternating Current Commutator Motors with Series and Shunt Characteristics," by Prof. S. Parker Smith.

JUNIOR INSTITUTION OF ENGINEERS.
8 p.m. At Caxton Hall, London, S.W. Lecturette. "Some Notes on the Utilisation of Water Power," by Capt. H. Whittaker.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Complete Specifications.

142 870 Nienhold, J. Apparatus for rectifying high and low-frequency alternating currents. (15/5/17.)
144 318 Hubers, G. X-ray plant. (27/3/16.)
144 738 Moses, W. B. Electricity generating and ignition apparatus for internal combustion engines. (29/6/17.)
145 018 Junger, E. W. Primary galvanic batteries and electrodes for such batteries and methods of manufacturing such electrodes. (17/6/19.)
145 042 Metallurgique Electrique. Suspension of electric traction wires. (19/2/14.)
145 422 Siemens-Schuckertwerke Ges. Arc lamps, more especially for searchlights. (20/8/17.)
146 354 Siemens & Halske Akt.-Ges. System for controlling relays by means of wave trains especially for wireless high-speed telegraphy. (27/5/19.)
146 530 Radio Corporation of America. Wireless signalling apparatus. (5/4/15.)
146 531 Radio Corporation of America. Thermionic valves for use in wireless signalling apparatus. (5/4/15.)
146 536 Radio Corporation of America. Apparatus for radio signalling. (1/2/16.)
146 538 Radio Corporation of America. Thermionic vacuum valve devices. (10/3/17.)
146 946 British Thomson-Houston Co., Ltd. Generation of electrical oscillations. (8/7/19.)
147 148 British Thomson-Houston Co. Ltd. Electron discharge devices. (29/10/13.)
147 153 Seibt, G. Telephones. (1/3/16.)
147 225 Vaile-Kimes Co. Automatic cut-out for electric motors. (16/6/15).
147 430 Ges. für Drahtlose Telegraphie. Wireless telegraph transmission. (24/12/15.)
147 439 Ges. für Drahtlose Telegraphie. Coarse and fine adjustment suitable for tuning and coupling devices for wireless telegraph apparatus. (10/11/17.)
147 445 Ges. für Drahtlose Telegraphie. Means for signalling to railway trains in motion. (4/2/19.)
147 446 Ges. für Drahtlose Telegraphie. Wireless receivers. (21/5/19.)
147 457 Ampere Ges. Process for producing ferrotungsten. (6/5/18.)
147 616 British Thomson-Houston Co. Ltd. Electron discharge apparatus. (16/10/13.)
147 627 Frankfurter Maschinen-ebau-Akt.-Ges. vorm Pokorny & Wittekind. Electro-motors. (18/3/16.
147 663 Kohler Co. Electric generating systems. (20/8/17.)
147 702 Ges. für Drahtlose Telegraphie. Production and control of high frequency currents in static transformers with auxiliary magnetisation, especially for use in wireless signalling. (26/2/14.)
147 718 Jacoviello, F. Combined resistance with hollow conductors. (21/12/17.)
147 756 Latour, M. Telephone and like systems. (23/5/19.)
147 772 Apple, V. G. Terminal bending tools for armatures. (11/12/16.)
147 773 Apple, V. G. Method of constructing armatures and stators for dynamo-electric machines. (30/12/16.)
147 775 Apple, V. G. Method of building commutators for dynamo-electric machines. (22/1/17.
147 776 Apple, V. G. Method of uniting armature terminals adapted for building commutators for dynamo-electric machines. (22/1/17.)
147 779 Apple, V. G. Starting and lighting apparatus for self-propelled vehicles. (23/4/17.)
147 780 Apple, V. G. Method of joining separated armature conductors and of making commutators from said conductors. (14/2/18.)
147 787 Apple, V. G. Dynamo-electric machines. (21/3/18.)
147 789 Apple, V. G. Methods of making armatures, and armatures produced thereby. (7/5/18.)
147 790 Apple, V. G. Method of connecting conductor bars of dynamo-machines. (20/5/18.)
147 792 Apple, V. G. Tool for bending the terminals of armature conductors. (23/12/18.)
147 802 Soc. Francaise Radio-Electrique. Electro-magnetic wave-receiving systems. (1/6/15.)
147 806 British Thomson-Houston Co. Ltd. Means for controlling electric currents and potentials by the use of electron discharge apparatus. (5/2/14.)
147 807 British Thomson-Houston Co. Ltd. Dynamo-electric machines. (16/1/17.)
147 808 British Thomson-Houston Co. Ltd. Electric motors. (14/2/18.)
147 811 British Thomson-Houston Co. Ltd. Wireless receiving systems. (15/6/18.)
147 812 British Thomson-Houston Co., Ltd. Electric starting systems for internal-combustion engines. (16/1/17.)
147 813 British Thomson-Houston Co. Ltd. High-frequency alternators. (23/9/16.)
147 814 British Thomson-Houston Co. Ltd. Means for transforming direct current. (29/12/13.)
147 816 British Thomson-Houston Co. Ltd. Wireless receiving systems. (11/10/17.)
147 819 British Thomson-Houston Co., Ltd. Electron discharge devices. (31/10/17.)
147 823 British Thomson-Houston Co. Ltd. Wireless signalling systems. (29/12/13.)
147 836 Soc. Francaise Radio Electrique. Wireless telephony systems. (24/2/17.)
147 851 Ges. für Drahtlose Telegraphie. Thermionic valve generators. (9/1/18.)
148 127 Kruh, O. Airtight metal cap connection for conducting electric current into hollow glass bodies. (6/7/17.)
148 130 British Thomson-Houston Co. Ltd. Production of metal films, particularly for use as electrodes in vacuum electric discharge apparatus. (6/6/14.)
148 131 British Thomson-Houston Co., Ltd. Generation of high frequency oscillations. (3/6/18.)
148 180 Ges. für Drahtlose Telegraphie. Transmitters of high-frequency oscillations. (6/11/18.)
148 321 Huth Ges., Dr. E. F. & Loewe, S. Wireless receiving apparatus. (20/12/15.)
148 324 Huth Ges., Dr. E. F. Electric coils for high-frequency purposes. (29/11/16.)
148 334 Schlotter, M. Process for the electrolytic production of dense and firmly adhering tin deposits. (15/3/17.)
148 522 Kruh, O. Airtight metal cap connection for conducting electric current into hollow glass bodies. (15/1/19.)
148 524 Ges. für Drahtlose Telegraphie. Electric conducting coils. (4/3/18.) (Patent of Addition not granted.)
148 786 Goldschmidt, R. Ground connections for wireless stations. (21/3/17.)
148 805 Allgemeine Electricitäts Ges. Coin-freed meter for electricity, gas, water or the like, provided with a device for making a minimum charge. (13/7/17.)
148 872 Schmidthammer, G. L. Production of electric carbons. (20/3/18.)
148 913 Gutmann, K. Holders and brackets for electric lamps. (14/2/19.)
148 978 Signal-Ges. Electro-magnetic submarine sound-signalling apparatus. (1/11/18.)
148 979 Signal-Ges. Electro-magnetic sound-transmitting and receiving apparatus with two exciting windings. (18/11/18.)
149 236 Allegemeine Electricitäts Ges. Three-arm choking-coil or transformer with inductance variable by continuous or alternating current of low frequency. (17/9/14.)
149 268 Coninck, M. R. de. Electric propulsion of ships. (15/7/19.)
149 345 Philipps Akt.-Ges. Magneto-electric lamps. (24/7/19.)
149 973 Bardeloni, C. Receiving methods of radio-telegraphic and radio-telephonic signals. (10/1/18.)
151 243 Apple, V. G. Method of constructing armatures for dynamo-electric machines. (15/9/19.)

APPLICATIONS FOR PATENTS

April 3, 1922.

9 489 R. Bosch Akt.-Ges. Electro-magnetically operated hooters. (18/4/21, Germany.)
9 519 O. L. Kleber. Printing telegraph machines.
9 521 Patent Trenhand-Ges. für Elektrische Glühlampen. Electric gas lamps with glow discharge. (4/4/21. Germany.)
9 526 Western Electric Co. Telephone repeater systems.
9 527 Western Electric Co. Telephone exchange systems.
9 529 E. W. Dorez. Electrostatic condensers.
9 532 B. T.-H. Co. (G. E. Co.). Supporting devices for pointers, needles, &c.
9 547 Aeronautical Instrument Co. Earth inductor devices. (13/8/21, U.S.)
9 560 J. S. Ross. Devices for recording telephone calls.
9 569 Soc. Anon. pour l'Exploitation des Procedes M. Leblanc-Vickers. High speed electric machines. (16/4/21. France.)
9 579 W. H. Meyrick. Anchoring conductor rails.

April 4, 1922.

9 590 J. R. C. August & E. K. Hunter. Electric control means.
9 593 G. W. Hawksley. Device for magneto testing.
9 640 Woods-Gilbert Rail Remodelling Co. Machines for dressing rails.
9 685 W. F. Topley & F. H. Robinson. Electric railway signals.
9 686 F. W. Le Tall (Westinghouse Electric Supply and Mfg. Co.) Frequency regulators for a.c. circuits.

April 5, 1922.

9 742 W. J. Newman. Cycle dynamo lamps, &c.
9 763 T. F. Wall. Means for rectifying alternating currents, &c.
9 768 A. A. King. Electric torches.
9 770 N. Clough. Systems of electric traction and suspension of overhead conductors.
9 775 S. W. Bligh & E. L. Crowe. Amplifying wireless signal currents to work recording instruments.
9 786 Cie Franc. pour l'Exploitation des Procédés Thomson-Houston. Safety devices for switch hooks of telephone instruments. (8/4/21, France.)

April 6, 1922.

9 842 F. Addie & A. G. Hartley. Electrical control gear.
9 874 W. R. Macdonald. Electric motors.
9 876 H. E. Holman. Electric mincer.
9 886 Measurement, Ltd., & F. Holden. Prepayment electricity meters.
9 902 F. C. B. Chase. Insulating device.

April 7, 1922.

9 911 A. M. Taylor. Reducing self-induction and eddy current losses in underground electric cables.
9 912 W. E. Roberts. Devices for ensuring electrical continuity in steel conduits.
9 924 L. J. Vann. Electric machines.
9 925 Fuller's United Electric Works & R. E. Beswick. Vents for storage batteries.
9 926 J. G. Thomson. Utilising tidal energy for generating power.
9 929 Townshends, Ltd., & E. Townshend. Detachable connectors for connecting flexible cables to kettles, &c.
9 931 P. G. Barden. Automatic time switch for electric light.
9 941 Parker, Winder, & Achurch, & J. F. Pennefather. Incandescent lamps.
9 947 Crompton & Co. & W. F. Jones. Automatic circuit-breakers.
9 960 F. E. Pernot & L. J. Rich. Selective reception of alternating currents.
9 968 P. Rombach. Electric pocket lamp.
9 970 O. R. C. Sherwood. Amplifiers for wireless telegraphy, &c.
9 982 B. T.-H. Co., H. C. Hastings, & C. T. Hanna. Motor control.
9 992 A. J. Church. Carbon holders for arc lamps.
9 997 Western Electric Co. Long telegraph cables. (16/8/21, U.S.)
10 002 A. E. O'Dell (Lorenz Akt.-Ges. & Scheppmann). Method of receiving in telephony and wireless telegraphy and telephony.
10 003 Schweizerische Gasapparate Fabr. Solsthurn u. Elektra Fabr. Elek Heiz u. Kochapparate. Electric regulating resistances for switches, &c. (13/4/21, Switzerland.)

April 8, 1922.

10 016 R. Bosch Akt.-Ges. Battery ignition devices. (17/5/21, Germany.)
10 028 O. Zinke. Apparatus for recording telephone conversations.
10 031 Stamping & Spinning Works, Ltd., & N. L. Penn. Dimmer Switches for motor vehicle lamps.
10 043 J. Hampson & R. Olsen. Electric switches.
10 058 F. E. Pernot & L. J. Rich. Multiplex telegraphy.
10 082 C. O. Bastian. Positively indicating completion of magnetic change in carbon steel under heat treatment.
10 084 Telegraph Condenser Co. & W. J. Cole. Electric condensers.
10 088, 10 092, 10 093, & 10 094 H. S. Conrad. Telephone systems.
10 089 H. S. Conrad. Apparatus for automatic telephone systems.
10 090 & 10 091 H. S. Conrad. Telephone switching mechanism, &c.

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CONTENTS.

Notes of the Week.

The Great Question.

Is taxation going to be reduced? That is the question of the moment to which the answer will be supplied by the Chancellor of the Exchequer on Monday. Like all questions of its kind, the answer will not depend solely on financial or industrial considerations, but will be influenced by those political undercurrents which are the evil genius of our time. Taxation cannot be reduced, say the Treasury officials, without resource to unsound methods of finance. If taxation is not reduced, say Lord Inchcape and the City of London, we shall land, "unless we act promptly and resolutely, in the ditch." How are these two expert opinions to be reconciled? Lord Inchcape supplies the best answer: By a reduction of expenditure, a simple course to which the Government are as averse as ever was Naaman the Syrian when he was told what to do.

A Bold Course the Best.

But even if expenditure be not drastically reduced, and only allowed to fall by the soft and easy methods beloved of the Government, the reduction of taxation is a course, bold it may be, but still essential for the end in view. The present high rate of income tax, the Corporation tax, the penal excise duties are not only strangling trade but are failing to produce the expected revenue. Were the income tax to be reduced, and the Corporation tax abolished, it might be that the stimulation given to trade would result in no falling off in revenue. Sir Robert Peel tried the experiment about eighty years ago, and it was successful. It would certainly be worth repeating.

The Intricacies of Armature Winding.

There are some branches of electrical activities which ever remain a mystery to those not intimately engaged in them. When questions connected with them crop up the only difference between the average electrical engineer and the rest of the world is that the former is distressed because he feels he ought to know, while the latter proceeds on his way in blissful ignorance, or the certainty which is akin thereto, but generally in still more blissful indifference. We might cite as an example of what we mean much of the modern complicated work in telephony into which Mr. Aitken periodically gives readers of The Electrician an insight, but more to the point will be the contents of the article on "Practical Armature Winding Formulæ," which Mr. L. Wollison contributes to this issue. Outside the specialists' drawing office and the designers' den the armature winding diagram is a thing of mystification to most. Little less mystifying is the armature actually being wound in the shops. It is therefore a relief to find that many of those who wind armatures do not understand the theoretical diagrams, and it is to their rescue, and incidentally to the rescue of the more general reader, that Mr. Wollison therefore comes. Equally true, of course, is it that many of those who can design armature windings cannot wind armatures, but that is another story.

A Plea for Simplicity.

Summarised, Mr. Wollison's arguments are a plea for simplicity. The winder, he says, when given an armature containing a certain number of slots and commutator segments requires only to know the pitch between the two sides of any coil in the slots, in terms of the slots, and the pitch between the two segments of the commutator, to which the two ends of any unit are connected, in terms of the segments. It is possible to express any type of series drum d.c. winding of any degree of multiplicity or re-entrancy in terms of the segments by a simple formula for which is necessary to know nothing beyond the number of segments in the commutator and the type of winding. Mr. Wollison

supports his arguments by means of numerous examples and makes out so good a case that we feel sure he will bring relief not only to those for whom he primarily writes but for electrical engineers at large.

Pure Science and its Applications.

The series of lectures on "Radioactivity," recently given at the Royal Institution by Sir Ernest Rutherford, of which we conclude our account to-day, not only bring together in readable form much information on an important subject, but indicate how our knowledge of the disintegration of substances, which were at one time thought indivisible, both into new substances and into those already known in another form, is increasing. It is a branch of investigation which has always had a fascination for scientific workers since the days of the early alchemists, though the methods employed and the fate meted out to those engaged in it are vastly different. For with investigators in radioactivity like Sir J. J. Thomson and Sir Ernest Rutherford disintegration has been an incident in a genuine search after further knowledge rather than a means to earthly riches and power. It is not unlikely, however, that these researches in the purest of pure physics may have some considerable application. Such a thing has happened before and doubtless will happen again until we are almost led to contend that there is no field of theoretical investigation from which some useful data of practical application may not be derived.

Amateur Wireless.

Progress in wireless communication assumes different forms in accordance with the different viewpoints of the observer. To the expert this progress is reflected in patent specifications, in articles in technical journals, or in Papers read before scientific societies. To the amateur, progress means an increasing facility in reading signals owing to a development in his own aural skill or in the discovery of the idiosyncracies of his apparatus. To the newspaper man, wireless progress means the more speedy and more general dissemination of news. For the amateur and for the newspaper man, therefore, improvement in wireless telephony especially opens up new vistas of enjoyment and new possibilities. Some of these are not without their drawbacks, and the newspaper man is more than a little fearful of one phase at least of this possible development.

Wireless Telephony and Civilisation.

The statement of Mr. Godfrey Isaacs that wireless telephony is destined to play a great part in every country in future has therefore had as an immediate result the publication of all sorts of special articles and opinions on this important question from the two points of view we have just mentioned. Technical opinion is naturally silent in these discussions, though without its help these developments will be quite impossible and can only progress with its continued assistance. Here, however, there should be no great difficulty. Equally easy should be the path of the amateur, and contentment should be his lot, providing he can resist the temptation to think life incomplete without a licence for transmitting, a facility which we hope will be most sparingly granted. For there are already complaints in this country that important wireless services are being interfered with by messages from privileged amateurs, and in America the confusion has been so great as to cause the Government to appoint a Committee to consider the whole question. Indiscriminate, even limited transmission, is unnecessary, and should be strictly controlled. Our streets are crowded and noisy enough to make us wish that the Heaviside layer should be kept free from similar distractions.

News, Not Comment.

This limitation however imposes this great responsibility on Government: that the information sent out by wireless telegraphy or telephony to be picked up by innumerable newspaper or amateur stations, as Mr. Isaacs envisages, should be news in the truest sense of the word uncoloured by comment and free from the suspicion of propaganda. If the wireless amateur finds it difficult to resist the temptation to transmit, much more difficult will the Government find it to resist, as they must resist, the temptation to use wireless news service for anything but pure news. If, however, that is done, not only will the propagation of information be possible with an accuracy, speed and fulness unknown to-day, but the wireless industry will enter an era of unbounded prosperity, which is, of course, the matter with which we are most concerned.

Railways and Electrical Men.

As we recently pointed out, the organisation of electrical work on our main railways is not without its injustices and its illogicalities. The "Railway Gazette" emphasises this by recalling that on the London and North Western Railway the signal department was for some time under the chief mechanical engineer, but is now under the chief engineer (on railways the officer who looks after civil engineering work). For a time the telegraph department was a separate unit, then it came under the signal superintendent, and finally under the electrical engineer when Col. Cortez Leigh was appointed to that position. Now the chief engineer once more holds sway over its destinies, as is the case on most other railways except the Great Western, where Mr. Blackhall supervises both the signals and the telegraphs. On the Midland there is a different division of duties, the telegraphs, telephones and overhead work connected with electric traction coming under Mr. Sayers, as telegraph superintendent, and the generating plant and electrically equipped rolling stock under Mr. Dalzell, of the chief mechanical engineer's department.

The Need for a Railway Electrical Engineer.

In practice probably the confusion is not so great as in theory. Nevertheless, we hold to our opinion that all electrical work on a railway should be placed under an electrical engineer, who should be a chief officer with direct access to the general manager. If the telegraph and telephone systems are so closely connected with the signalling that the signal superintendent must exercise supervision over them in practice, the whole of the electrical work should certainly be carried out in consultation with the electrical engineer. It is time the electrical department ceased to be considered as a Cinderella and be made what it is, one of the most important links in the whole machine.

The Engineers' Dispute.

The conduct of negotiations between the parties to recent industrial disputes have followed a well trodden path. Both sides have viewed with apparent indifference a movement towards a stoppage of work, and even after that stoppage has occurred, though conferences innumerable have been held, there has been an equally apparent reluctance to come to terms, until a longer or shorter period of stagnation of production has elapsed. Meanwhile, much damage is done to both sides, and in the result either side is little, if any, the better. It is not much of an advertisement of the tact and diplomatic capacity of either side or

of the much vaunted national characteristics of sanity and levelheadedness.

Qualities for Settlement.

The engineers' dispute seems about to run the same disastrous course. After days of alternate hopes and fears it looks at the time of writing as if the lock-out, far from being raised, will be extended to the members of the other forty-seven unions concerned, and that 1 000 000 workmen in the engineering and shipbuilding industries will be rendered idle. This is to take place at a time when trade is said to be reviving, and when high hopes of still further stimulation from reduced taxation are in everyone's mind. And the worst of it is it all seems about so little. For even the lengthy statements which are issued by both sides are but reiteration and embroidery of the simple fact that no formula can be found which gives employers control in their own works and at the same time safeguards the workers against apprehended injustice and oppression. We fear that the reason why such a formula cannot be found is that stubbornness is prevalent on both sides, that goodwill is lacking, and that fatalism is stultifying that moderate opinion which should be working for peace. But the present state of deadlock cannot go on indefinitely, and the sooner, therefore, that it is resolved the better for all parties. As Sir Charles Macara says: "It is high time an end was put to the folly."

Storms in Teacups.

Is there something in the electricity supply industry which makes for a highly-charged atmosphere? It certainly seems so, for quite small matters have a way of suddenly expanding out of all semblance to their initial proportions. The latest example is the Chelmsford dispute, where a jointer, in a way jointers have, refused to connect up non-union wiring to the mains. The District Council forthwith passed a resolution of the high-explosive type and transmitted it to the National Council for discharge. Now we hear rumblings which we are meant apparently to regard as the crackings of the foundations of the Whitley Council movement. But we decline to visualise the edifice rocking. For in our opinion the industrial councils are far too firmly set on their foundations to be endangered by such surface vibrations.

What is the Issue?

But, after all, what is the issue in all these cases from the trade union side. Merely an attempt to force a few small wiring contractors to observe union conditions. Often these contractors are merely "one man firms," and are not worth powder and shot. On the other hand the trade unions have everything to gain by relinquishing their present doubtful methods of refusing to connect up the work done by such people. For such a policy puts the electricity supply undertakings in a difficult legal position. The unions must realise this; and realise too that their policy must in the long run endanger that goodwill which has been so vastly augmented by the three years working of the industrial councils. As a matter of fact, it speaks volumes for the goodwill existing between both sides, that this guerilla-warfare, carried on by the unions in the territory of the undertakings, has not resulted in an open breach of the peace. The dispute is, in fact, still in the realms of friendly negotiation. We certainly hope that the trade unions will concede this point, especially in view of the fact that the mere settlement of an awkward dispute of this kind by the Council will give added prestige to the Whitley movement, and establish it more firmly than ever.

British Electric Transformer Progress.

The Reports of a manufacturing company like the British Electric Transformer Company may be taken as a good index of the steady advance of the electricity supply industry, for the company manufactures equipment and domestic apparatus to meet the demands of new consumers. It is therefore satisfactory to learn that the past year's working of the Company is a record, the net profit being £91 417, compared with £70 267 in the previous year, and £48 053 in 1919. After placing £15 000 to reserve (against £10 000 in 1920), the directors are able to pay an ordinary dividend of 10 per cent. with a bonus of 2½ per cent., as in the three previous years, while a sum of £12 700 is carried forward, or £6 500 more than in the previous year. It should be noted the growth of the net profit has kept pace with the increase in the capital, and the figures in the accounts therefore indicate that the Company's business is sound and expanding. As progress is made with the reorganisation of electricity supply, and as the charges for electrical energy are lowered there should be an increasing demand for the Company's products, and even better results may, therefore, be anticipated in future years.

South American Ideas of Justice.

The actions of the Governments and municipal authorities of South American republics are sometimes as weird and peculiar as those of the heathen Chinee. The latest performance of the Monte Video Council, therefore, only adds one more chapter to a history which is not without its purple patches. Swayed by strange influences as our local authorities sometimes are, they do not go about seizing the undertakings of the private companies. Yet this is what recently happened to the United Electric Tramways of Monte Video, and to another tramway company operating in the same city. It is obvious that if this sort of thing is going to occur often, no British company, or company of any other nationality, will rush to own and operate electricity supply, electric tramways, or other public undertakings in South American towns, and that, as the management of these undertakings does not seem to be within the capacity of the local inhabitants, the facilities for transport and lighting in these cities will suffer considerably.

How the Trouble Arose.

What makes the matter more interesting to English companies is that the trouble apparently arose over the fares question. The company's concession contains provisions fixing the fares that might be charged; but during the war, and since the Armistice, no increase to meet the great rise in the cost of materials, and of higher wages paid to employees, has been permitted, in spite of the fact that about four years ago, when the company applied for sanction to such increases, the matter was fully discussed, and a Government Committee made a favourable recommendation. To make matters worse, the Government has recently been dabbling in social reform, which, as our own experience has shown, has added heavily to the expenses of the company; while, adding insult to injury, the company's employees came out on strike recently for a still further wage increase, which the company naturally refused to grant. When the strike commenced, the Gilbertian municipality ordered the company to resume its services, or in default to pay a fine of $50 a day for each car that was not running. The company, however, did a little refusing on their own account, and after the strike had lasted over three weeks, the municipality instructed the defaulters to return

to work, and promised them the increased wages at the company's cost, thus successfully fulfilling the creed of the modern socialist of being generous at somebody else's expense. The underaking is now being operated under municipal control, the wages required being forcibly taken from the company's receipts. We should imagine there would be no great rush to obtain tramway concessions in South America, or even to emigrate there if the Geddes axe fails to fulfil its functions.

The Miners and Electric Coal Cutters.

The Miners' Federation, fresh from more or less successful attempts to settle the wages question in their industry, are turning their attention to electrically operated coal cutters, whose use, they contend, should be confined to mines where no gas is present. This is very subtle. For in effect it would practically prohibit the employment of coal-cutters, and is therefore significant of the unenlightened attitude with which Labour still regards the employment of machinery generally. With their contention that such machinery should be faultlessly designed and properly operated by skilled workmen we can, however, agree. That the second condition is not always fulfilled is clear from the evidence recently given in a compensation case at Glasgow. Here the coal-cutter was a specially designed flame-proof machine, in perfect working order; but an accident occurred owing to a workman neglecting, as so often happens, to exercise ordinary care.

An Unwise Decision.

The cause of the accident was the failure of a workman to screw down a switchbox cover, so that the gas was ignited by the flame. The sheriff held that taking off and fixing such switchbox covers was not a skilled electrician's work, but could be performed by a man operating the coal-cutter. This decision seems to us to be unnecessarily general, and is, in fact, in the letter, and not in the spirit, of the regulations for the use of electricity in mines. Taking off of a switchbox cover in a gaseous mine is a dangerous if not a difficult operation, and should, therefore, only be effected by a skilled person, especially as the safety of the workers largely depends on proper precautions being taken, and on no unnecessary risks being incurred.

The Relief of Rates Again.

One of the principal arguments against municipal electricity supply is that the committee in charge of the undertaking may allow its political bias to direct its actions to gain some temporary financial advantage in a way which no prudent board of directors would sanction. For instance, in pre-war days it was a common practice to raid the tramway and electricity accounts for sums which should have been allocated to reserve or depreciation in order to reduce the rates or to wipe out deficits elsewhere. We regret to notice that this practice is being revived, for it is finance of the worst kind to take sums from the " profits " of the electricity supply department until a substantial reserve has been provided and until the price of electrical energy has been reduced to as low a figure as possible.

Cardiff's Unwise Action.

We regret, therefore, to see that Cardiff City Council has again agreed to the proposal of its Finance Committee that £5 000 of the estimated electricity profits be applied for the " relief of the rates." It is true that in the past the undertaking has made contributions to the rate fund because it owed money which had been lent to meet deficiencies in its early years. There is no objection to this, but relief *ad hoc* from " profits " is another matter, especially as in 1921 the Electricity Committee contributed £15 000, a sum which more than repaid the outstanding debt. The Finance Committee now, however, wish to adopt a settled policy of a regular annual contribution out of the profits. This is most retrograde.

The Argument for Relief.

It is argued in support of this procedure that if the electricity department had gone to the public as a private enterprise to get £400 000 capital it would not have been able to borrow at anything like so low an interest as it is paying. The difference is put at about 1½ per cent., and the Council were, therefore, asked to adopt the principle of requiring their trading departments to contribute at the rate of 1½ per cent. on the capital raised. This is a plausible but not very convincing argument, and though the electricity department will have to part with £5 000 this year the question of applying the general principle, which was strongly opposed by some members, has been deferred for further consideration.

A Matter for the Ratepayers.

In the meantime we hope that the consumers who provide the money out of which the contributions are to be made will organise opposition to the proposal. We contend that the first duty of the electricity department is to provide a cheap supply for its customers, and next to develop the undertaking by extending the service to the remainder of the city. This cannot be done if any surplus is to be periodically raided to provide doles. In a city like Cardiff £5 000 cannot represent a penny rate. On the other hand, if this sum were devoted to reducing the prices, which is still 75 per cent. above the pre-war rates, or even in extensions of the mains, the city would reap a far greater advantage. We hope, therefore, that the Corporation will not sanction the principle of a regular annual contribution to the rate funds.

Australian Industrial Arbitration.

Compulsory arbitration in industrial disputes has been in operation in Australia since 1904, and though it has been obvious for a long time that the system was breaking down, it has only now been acknowledged to be a failure by the Commonwealth Premier. It will be remembered that the awards of the Conciliation and Arbitration Court were binding on employers and nominally on the employees, but the militant unions frequently flouted the decisions of the court; strikes continued, and in the end recourse had to be had to special tribunals. Australia has made itself conspicuous by its experiments in advanced labour legislation, but, as we learn by the failures as well as the successes of others, it will be interesting to watch the fate of the substitute which Mr. Hughes proposes to adopt instead of compulsory arbitration. It is now suggested that these tribunals be composed of equal numbers of employers and employees, with an independent chairman, who is not to be a lawyer. This is a body not unlike the Victorian Wages Board, which is claimed to be simple in operation, and has proved fairly satisfactory in industrial disputes in that State. It will be agreed that anything which would put a stop to or minimise industrial strife, the bane of modern civilisation, should receive careful and sympathetic consideration, and we shall watch with interest the outcome of Mr. Hughes's new idea.

International Electric Traction.

The meeting of the International Railway Congress in Rome last week was fortunately seized as an opportunity for putting forward a collection of up-to-date information on the position of electric traction in the various countries of the world. Reports which have already been published by the Association were presented and contained accounts of the conversion work now in hand in the United States, Italy, Switzerland, Great Britain, Holland and Scandinavia. From these, and more from the comments on the design, practice and performance of the equipment employed on electric railways, it is possible to draw conclusions and so construct a useful leaping-off place for future progress.

It is quite evident that in all its phases electric traction is still in a state of fluidity. Owing to great differences of opinion on questions of practice and performance, it has not begun to crystallise, and should not be allowed to do so. For with our present limited knowledge of its problems, if we try to dogmatise we are likely to be led into errors which future experience will show to be profound, and from which the escape will not only be difficult but expensive.

The United States.

Turning first to the United States, as the country where both the theory and performance of electric traction are more advanced than elsewhere, we find Mr. George Gibbs reporting that all railway conditions have been successfully met by electric traction, including city terminal operation, long tunnel operation, passenger and goods haulage, suburban passenger services, heavy grade freight traffic, and main line operation. Mr. Gibbs, we know, is an enthusiast, but the facts and figures which he puts forward seem effectually to dispose of the argument that there are certain classes of traffic with which electric traction cannot deal, and throws us back on the much more difficult problem of determining whether and when it is possible, economically, to bring about the conversion which, as abundantly appears, is an advantage in all countries, and highly remunerative in the savings it allows in others.

King Charles Again.

On the question of the system which permits the greatest advantages to be obtained, that King Charles' head which cannot be kept out of any discussion on electric traction, Mr. Gibbs is less definite. To some of those who are enthusiasts for electric traction he even may appear less sound. Surely, some will argue, the experience which has been gained in the United States with electric traction should have made it possible by this time to say that one or other of the numerous possible systems is the best. The fact that it has not been possible is itself the answer to this implied question. No " best " system has yet been found because there is none to find. The most that Mr. Gibbs can do to help towards that impossible ideal is to ban rather mildly the 3 000 V direct current system on the score of difficulties in current collection, to bless hardly more enthusiastically the 11 000 V alternating current system on the grounds that it can meet all the conditions of current collection on American railways, and to point out that the overhead conductor is likely to blossom, while collection by contact rail, though it can provide sufficient current carrying capacity even at low voltages, is likely to fade.

Italy and Switzerland Favour Overhead.

Inferentially the same conclusion has been reached in Italy, where in fact the increasing use of the three-phase system leaves little choice, and very much more definitely has it been reached in Switzerland, where the single-phase system is considered, under Swiss conditions, the most favourable, both technically and economically, for main and other lines. In Scandinavia the single-phase system has also been adopted, of course with overhead equipment, though France and Holland have decided in favour of high tension direct current traction. In the latter case the choice was made because the advantages were more patent where there is only medium density of traffic, and especially because the numerous level crossings and bad soil are against the use of the contact rail.

The British Position Through Dutch Eyes.

The position in Great Britain is, of course, well known. We have standardised, and yet we have not standardised. We are apparently wedded to a system to which most other countries object, in spite of the fact that, as Mr. Van Loenen Mentinet, chief of electric traction on the Netherlands State Railways reports, there is no material difference between the systems in costs of installation, upkeep or efficiency; and though, as we have pointed out, the single-phase system has great advantages in simplicity of generation, transmission and transformation. On the other hand we have, it is believed, a loophole by which, with the sanction of the Ministry of Transport, a railway company may adopt any system that meets its own needs best, a loophole of which full advantage is not unlikely to be taken.

How Far is Standardisation Necessary.

We hope that one of the questions which the International Congress will bring out clearly is how far standardisation of system is economically necessary, not only for an entire country but for the whole area covered by one large railway group. Because, for instance, the new London and North Western Railway group finds it best to use the conventional d.c. system in the London suburban area, and between Liverpool and Southport, and the high-tension d.c. system between Manchester and Bury, is it to be debarred from using the single-phase system over Shap Fell or between Derby and Manchester because, though that system has been proved best for such difficult sections, it runs counter to the gospel of standardisation?

Very Nearly the Whole Truth.

In this connection we think Mr. Gibbs' words are worth a moment's pondering. It is " too early to fix the features of any one system to the extent required for purposes of standardisation without restricting development."

It is, therefore, to be hoped that the greatest result of this useful Congress will come from the interflow of ideas which it will render possible. Each enthusiast—and most electric traction engineers are enthusiasts now-a-days—will be able to learn from supporters of opposite views something which will bring about the softening of prejudices and make the reception of new ideas easier. Each problem, be it connected with system, design or performance, can be dealt with *de novo*, and the solution sought will be the one most likely to satisfy the requirements of particular needs. In electric traction we are only beginning. It is too early to say what is the best, though we should be right to be satisfied with nothing less. From this point of view we are glad to see that more technical matters than the choice of system were taken up in the reports and discussed at the meetings, and to those we shall refer in a subsequent issue.

Practical Armature Winding Formulæ.

By L. WOLLISON.

The object of this article is the simplification of the usual armature winding formulæ for the benefit of the man in the workshop. The operative is chiefly concerned with two practical considerations, the pitch between any two sides of a coil in terms of the slots and the pitch between the segments of the commutator, to which the two ends of any coil unit are connected, in terms of the segments. Taking these as his basis Mr. Wollison works out a number of practical examples, and shows that for any type of series drum d.c. winding it is possible to express the commutator pitch in terms of the segments without knowing anything beyond the number of segments and the type of winding.

While lecturing on the subject of "Practical Armature Winding" to students engaged in that trade, the writer has been impressed with the extreme difficulty which confronts the average worker who seeks reliable information in simple practical terms, regarding the principles which underlie the various modern types of d.c. armature windings.

In the majority of text-books this subject is dealt with largely, if not entirely, from the design point of view, and in terms which necessitate a fair knowledge both of mathematics and the general principles of electrical engineering. In particular, the methods of determining the winding pitches—the all-important subject both theoretically and practically—are usually involved in terms and formulæ which are as Greek to the man in the workshop; especially is this so in the case of multiplex d.c. windings of various re-entrancy.

The Drawbacks of Prevailing Methods.

The prevailing method of explaining the winding pitches in terms such as "Front," "Back," and "Mean" pitch (y_f; y_b; and y) as measured in "coil sides" or conductors is

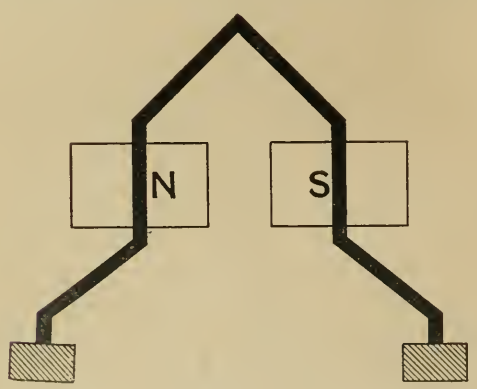


Fig. 1

needlessly confusing to the man who has to do the actual winding. He is chiefly concerned with two practical considerations. Given an armature containing so many slots and commutator segments he seeks two pieces of information; first, the pitch between the two sides of any coil in the slots, *in terms of slots*; and second, the pitch between the two segments of the commutator to which the two ends of any unit are connected, *in terms of segments*. In other words, if one side of a coil is placed in slot 1, in which slot should the other side be placed? and, similarly, if the one end of a unit is joined to segment 1, to which segment should the other end be connected?

A little consideration will show that these two factors completely determine an armature winding of any modern type. In point of fact, the multiplicity, re-entrancy, progression and number of circuits are all determined in any d.c. armature winding by the commutator pitch alone. It may, therefore, be of interest to show that these pitches for any type of simplex or multiplex winding can be simply expressed in terms of slots or segments, without involving anything more than simple arithmetic.

Two Initial Definitions.

For this purpose two initial definitions are necessary:

UNIT = One or more turns (each of two conductors) in series, the two ends of which are joined to certain commutator segments. Fig. 1 shows a one-turn unit.

COIL = One or more units assembled together in the same two slots of the core. (Thus with a winding containing 125 units in twenty-five slots, each coil would consist of five units.)

From this it will follow that as each commutator segment is joined to one end of each of two units there will be as many segments as there are units in any winding.

In dealing with the pitch of the winding in the slots of the core, the winder is necessarily chiefly concerned with coils and slots. As it is essential that for good commutation and maximum efficiency the pitch of the coil should correspond as nearly as possible with the pole pitch of any machine, the pitch of the coil or the core-pitch, as it is generally termed, will be the same for any type of winding, and in the vast majority of cases may be expressed:

$$\text{Core-pitch} = \frac{S}{P} = N \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

or where necessary:

$$\frac{S \pm 1}{P} = N \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

in terms of slots; where S = slots, P = poles and N = any whole number. A certain amount of latitude is possible with the core-pitch, a little variation one way or the other having only slight effect on the capacity of the machine. For fully 90 per cent. of machines of British manufacture the above two expressions will serve. Three examples will suffice in this respect.

Example (*a*). An armature for an eight-pole machine has 144 slots. The core-pitch will be:

$$\frac{144}{8} = 18 = \text{Step of } 1\text{—}19$$

(*i.e.*, the coil will occupy the bottom half of slot 1 and the top half of slot 19 or *vice versa*).

Example (*b*). A four-pole armature contains thirty-nine slots:

$$\text{Core-pitch} = \frac{39+1}{4} = 10 = \text{Step of } 1\text{—}11.$$

Example (*c*). The windings of a four-pole armature are arranged in twenty-five slots:

$$\text{Core-pitch} = \frac{25-1}{4} = 6 = \text{Step of } 1\text{—}7.$$

Some Examples of Series Drum Windings.

With the span of the unit across the commutator (or the commutator-pitch) absolute accuracy is required as the slightest alteration may enormously affect the rating of the machine

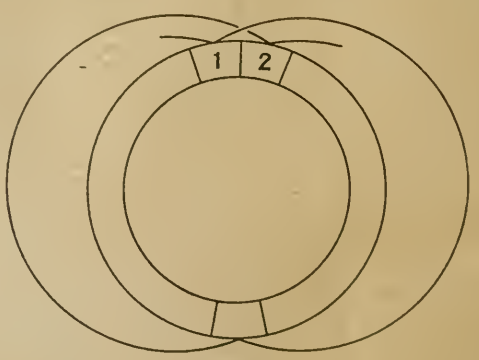


Fig. 2.

In any of the following examples only series drum windings will be referred to. Consider first an ordinary simplex re-entrant winding (◯). This is of the type shown in Fig. 2, which represents a portion of a four-pole series winding. Here it is obvious that, as all the units are equal in every respect

and are of equal pitch, the entire segments of the commutator plus or minus 1 (according as the winding is progressive or retrogressive) are spanned by $\frac{P}{2}$ units.

Hence for all simplex re-entrant series windings :

$$\text{Commutator pitch} = \frac{U \pm 1}{p} = N \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

where U = total effective units in winding, or commutator segments ; p = pairs of poles, and N = any whole number.

Example (*d*). A four-pole progressive winding has 125 units (or segments) :

$$\text{Commutator pitch} = \frac{125+1}{2} = 63 = \text{Step of } 1-64$$

in terms of segments, *i.e.*, the winding starting at segment 1 will pass through the first unit to segment 64 ; through another

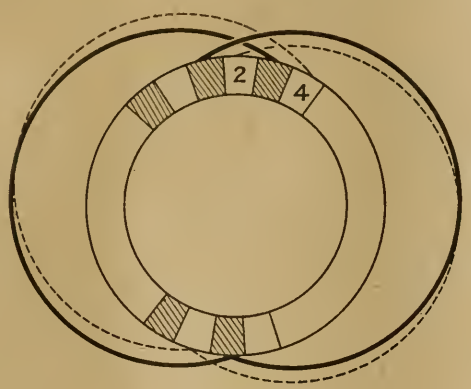


Fig. 3.

unit to segment 2 (= 127—125) and so on until it finally closes at segment 1. It is, of course, obvious that all commutator pitches must be whole numbers, as the end of a unit cannot be connected to the fraction of a segment.

Duplex Doubly Re-entrant Series Winding.

Next consider a duplex doubly re-entrant series winding (○ ○). This in effect is two separate simplex windings interspaced in the core and commutator (Fig. 3). In this case it will be found that one winding connects with all the segments of odd number, and the other winding to segments of even number. The two windings are electrically separate. It will follow, therefore, that $\frac{P}{2}$ units will span the entire segments of the commutator plus or minus 2.

The formula for any duplex doubly re-entrant series winding is therefore :

$$\text{Commutator pitch} = \frac{U \pm 2}{p} = 2N \quad \ldots\ldots\ldots\ldots \quad (4)$$

(Since the commutator pitch for a simplex winding = N, it should be clear that for a duplex winding, consisting of two separate windings, the commutator pitch must = 2 N).

Example (*e*). A six-pole duplex doubly re-entrant retrogressive winding contains 122 units (61 per winding).

The commutator pitch is $\frac{122-2}{3} = 40$ ($N = 20$) = Step of 1—41.

Winding A passes round the commutator in the order :

1—41—81—121 &c. and winding B :
2—42—82—122 &c.

Similarly for a triplex trebly re-entrant series winding (○ ○ ○) (three electrically separate simplex windings), as each winding is connected to every third segment, it follows that :

$$\text{Commutator pitch} = \frac{U \pm 3}{p} = 3N \quad \ldots\ldots\ldots\ldots \quad (5)$$

Example (*f*). A four-pole triplex trebly re-entrant progressive series winding contains 297 units (or segments).

$$\text{Commutator pitch} = \frac{297+3}{2} = 150 = (N = 50) = \text{Step } 1—151.$$

The passage round the commutator will be :

Winding A 1—151—4 = (301—297) &c.
Winding B 2—152—5 = (302—297) &c.
Winding C 3—153—6 = (303—297) &c.

From the foregoing three formulæ 3, 4 and 5, it follows that for all series windings of this type where the re-entrancy is equal to the multiplicity (*i.e.*, where the winding consists of so many electrically separate simplex windings) we may develop the general formula :

$$\text{Commutator pitch} = \frac{U \pm M}{p} = MN \quad \ldots\ldots\ldots \quad (6)$$

Where M = the multiplicity (*i.e.* = no. of pairs of circuits).

Unequal Multiplicity and Re-entrancy.

We have next to consider the type of winding in which the multiplicity and re-entrancy are not equal. Fig. 4 illustrates a duplex singly re-entrant series winding (◎). It will be seen that this winding is very similar to the duplex doubly re-entrant (○ ○) in that in $\frac{P}{2}$ spans the winding covers the whole of the segments plus or minus 2. The essential difference, however, is that, after advancing along segments 1, 3, 5, &c., it reaches segment 2 and proceeds along the segments of even number, finally re-entering at segment 1). This is due to the fact that the commutator pitch is one less or more than a multiple of two, so that after passing through one half of the units the winding, instead of closing on itself at segment 1, passes to one beyond that point and thus reaches segment 2 and the remainder of the segments, finally closing at segment 1.

Similarly in the retrogressive example given in Fig. 4 the winding, starting at segment 1, recedes two segments after

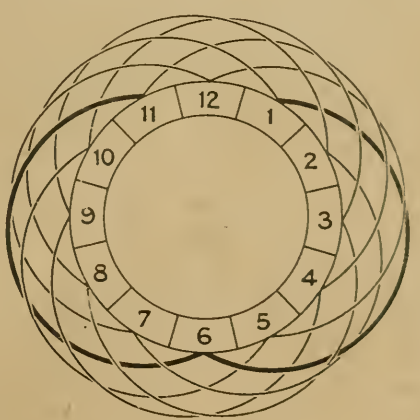


Fig. 4.

passing through $\frac{P}{2}$ units, its passage round the commutator being as follows :

1—6—11—4—9—2—7—12—5—10—3—8—1

For all duplex singly re-entrant series windings (◎) it follows :

$$\text{Commutator pitch} = \frac{U \pm 2}{p} = 2N \pm 1 \quad \ldots\ldots\ldots\ldots \quad (7)$$

Example (*g*). A four-pole duplex singly re-entrant series progressive winding contains sixteen units.

$$\text{Commutator pitch} = \frac{16+2}{2} = 9 \; ; \; (N = 5) = \text{Step of } 1—10$$

The winding will connect to the commutator in the following order :

1—10—3—12—5—14—7—16—9—2—11—4—13—6—15—8—1.

Next consider what happens at the commutator of a triplex singly re-entrant series winding (◎◎). This is very similar to the triplex trebly re-entrant winding (○ ○ ○) for again in $\frac{P}{2}$ spans the winding covers the whole of the segments plus or minus 3, but here, again, the commutator pitch has to be

one less or more than a multiple of 3 so that the winding may advance from the one set of segments previously associated with winding A to those in winding B and so from those to winding C.

Hence for triplex singly re-entrant series windings :

$$\text{Commutator pitch} = \frac{U \pm 3}{p} = (3N \pm 1) \quad \ldots\ldots\ldots\ldots \quad (8)$$

Example (h). A four-pole triplex singly re-entrant progressive series winding contains nineteen units.

$$\text{Commutator pitch} = \frac{19+3}{2} = 11 \; ; \; (N=4) = \text{Step of } 1\text{—}12.$$

The passage of the winding round the commutator will thus be as follows :

1—12—4—15—7—18—10—2—13—5—16—8—19—11—3—14—6—17—9—1.

It will be seen that for multiplex, singly re-entrant series windings the commutator pitch must not be a multiple of M, otherwise the winding would close after one tour and so result in a winding where $M = R$. It will also be seen later that the commutator pitch must not contain a factor (greater than unity) of M, otherwise the winding will not be singly re-entrant. We may, therefore, say that for all multiplex series windings where $R = 1$, and is less than M :

$$\text{Commutator pitch} = \frac{U \pm M}{p} = MN \pm B \quad \ldots\ldots\ldots\ldots \quad (9)$$

where B is a whole number (usually 1) not containing a factor of, and less than, M.

Multiplex Winding.

We have finally to consider the multiplex winding where R is greater than 1 but less than M; (◎ ◎ ; $M=4, R=2$); (◎ ◎ ◎ ; $M=6, R=3$); (◎◎ ◎◎ ; $M=6, R=2$) ; &c.

These are the most complicated to deal with, but upon analysis they will be found to be simply combinations of two or more similar sections, each of which may be expressed by formula 9. That is to say the commutator pitch for any winding of this final type is simply a multiple of the commutator pitch for one of its separate sections.

Example (i). Consider a quadruplex doubly re-entrant series progressive winding for a four pole armature containing ninety-six units (◎ ◎ ; $M=4, R=2$). This winding will be seen to consist of two similar sections, each of which is a duplex singly re-entrant (◎), winding with forty-eight units.

For either section, *in terms of its own segments only* we may therefore say :

$$\text{Commutator pitch} = \frac{48+2}{2} = 25 = (2N \pm 1 \text{ as per formula 7}).$$

But as there are two sections to the winding interspaced in the core and commutator (*i.e.*, the one section connecting to all segments of odd number and the other to those of even number, just as in the case of the duplex doubly re-entrant (○ ○) winding, the only difference being that each section is now a duplex singly re-entrant, instead of a simplex winding), it follows that as the number of segments and units is doubled the pitch must also be doubled. This will easily be understood if the winding is imagined as consisting in the first place of one section only, a certain unit having its ends joined to segments a pitch of twenty-five apart, the commutator then being opened out to receive the segments of the second section. As the number of segments is now twice as great it follows that the distance between any two segments has been doubled, consequently the segments to which the unit is joined are now a pitch of fifty apart.

For the combined (◎ ◎) winding, therefore, in terms of the *total segments* in the commutator :

$$\text{Commutator pitch} = \frac{96+4}{2} = 50 = 2\,(2N \pm 1) \quad \ldots\ldots\ldots \quad (10)$$

The windings will connect to the commutator in the following order :

Winding A. 1—51—5—55—9—59—13, &c. ..... (1)
Winding B. 2—52—6—56—10—60—14, &c. ..... (2)

From the foregoing it follows that the general formula for this final type, where R is greater than 1 but less than M, can be easily developed from formula 9, which gives the pitch for any separate section.

Since R = number of separate sections, U = total segments in the commutator, and M = total multiplicity, we may say that for any one section in terms of its own segments only :

$$\text{Commutator pitch} = \frac{\frac{U}{R} \pm \frac{M}{R}}{p} = \frac{MN}{R} \pm B \text{ as per } \ldots\ldots\ldots \quad (9)$$

Therefore, for the combined winding, consisting of R sections :

$$\text{Commutator pitch} = R\frac{\left(\frac{U}{R} \pm \frac{M}{R}\right)}{p} = R\left(\frac{M}{R}N \pm B\right) \ldots\ldots\ldots \quad (11)$$

$$= \frac{U \pm M}{p} = MN \pm RB \ldots\ldots\ldots\ldots \quad (12)$$

where B is a whole number not containing a factor of, and less than $\frac{M}{R}$.

We thus see that all multiplex series windings fall under one of two classes, (a) those consisting of one or more simplex singly re-entrant windings, and (b) those consisting of one or more multiplex singly re-entrant windings. The commutator pitch in each case is simply R times the pitch for one section. It is for this reason that in formula 9, B must not contain a factor of M in order that $R = 1$.

For suppose that the commutator pitch for a sextuplex singly re-entrant ($M=6, R=1$) series winding were to be :

$MN \pm 2$ or 3 ; (*i.e.* B containing a factor of M)
$= 6N \pm 2$ or 3.

But this may be expressed

(a), 2 $(3N \pm 1)$ or (b), 3 $(2N \pm 1)$,

which means that in (a) the winding would contain two sections each of which would be a triplex singly re-entrant, or as in (b) three sections each a duplex singly re-entrant (see formula 7). Hence it follows that B must not contain a factor of M.

Three Simple Rules.

We have thus reduced the commutator pitches to three simple rules which may be usefully summarised :

1. Where $M = R$ (○) ; (○ ○ ○), &c. :

$$\text{Commutator pitch} = \frac{U \pm M}{p} = MN \quad \ldots\ldots\ldots \quad (6)$$

2. Where $R = 1$ and is less than M (◎) ; (◎◎◎) &c. :

$$\text{Commutator pitch} = \frac{U \pm M}{p} = MN \pm B \quad \ldots\ldots\ldots \quad (9)$$

3. Where R is greater than 1, but less than M (◎◎ ◎◎) ; &c.

$$\text{Commutator pitch} = \frac{U \pm M}{p} = MN \pm RB \ldots\ldots\ldots \quad (12)$$

From all of which it will be seen that the greatest factor common to the commutator pitch and the multiplicity is equal to the degree of re-entrancy ; which fact may be expressed as

A Fourth and Final Rule.

4. The G.C.F. of Y and $M = R$, where Y = commutator pitch.

It will also be seen that in each case the commutator pitch is :

$$Y = \frac{U \pm M}{p}$$

Where U = Total units = total segments in commutator.
M = Multiplicity = Number of pairs of circuits.
p = Pairs of poles.
R = Re-entrancy = Number of electrically separate sections.
N = Any whole number.
B = A whole number (usually 1) less than, and not containing a factor of $\frac{M}{R}$

It will thus be seen that for any type of series drum d.c. winding of any degree of multiplicity or re-entrancy, the commutator pitch may be easily expressed in terms of segments by a simple formula for which it is necessary to know nothing beyond the number of segments in the commutator and the type of winding.

The Sea Return Impedance of a Submarine Cable.

By JOHN R. CARSON and J. J. GILBERT,
American Telephone and Telegraph Company and Western Electric Company.

The transmission characteristics of a conducting system, such as a submarine cable circuit, are determined by its propagation constant, Γ, and characteristic impedance, K, which may be calculated for the frequency $p/2\pi$ from the formulæ :

$$\Gamma = \sqrt{(R+ipL)\ (G+ipC)} \quad \ldots\ldots\ldots\ldots\ldots\ (1)$$

$$K = \sqrt{\frac{R+ipL}{G+ipC}}$$

where R, L, G, and C are the four fundamental line parameters, resistance, inductance, leakance, and capacity, all per unit length of the system, including the return conductor. These formulæ are rigorous for all types of transmission systems ; but the determination of the line parameters is not always possible by elementary methods, and may indeed be a matter of considerable complexity and involve rather difficult analysis.

Effect of Sea Water on Transmission.

It is the practice in submarine cable telegraphy to employ an earthed system, in which the earth and the sea water surrounding the cable are made a part of the cable circuit. It is obvious that even where very low frequencies are involved the return current will not be distributed uniformly through the sea water, but will show a tendency to concentrate in the vicinity of the cable core. This effect, together with the complications introduced by the presence of the armour wires, makes the computation of the resistance and inductance of the "sea return" a difficult problem, and no satisfactory solution is to be found in the literature of submarine telegraphy. There is, therefore, an element of uncertainty introduced into the theory of cable transmission, since the sea return plays the same part as the core conductor and its resistance and inductance are involved in the determination of the characteristic impedance and the propagation constant of the cable.

This uncertainty is not always very serious. In the case of slow speed cables, for example, it is safe to assume that the resistance of the sea return is small compared with the resistance of the core conductor, and that the cable inductance has a negligible effect upon transmission.

Where Exact Information is Necessary.

There are many cases, however, where these assumptions do not hold and where exact information regarding the resistance and inductance of the sea return is desirable. In duplex operation, for instance, unbalance disturbances of a certain type are encountered due to failure to correct, in the artificial line, for the inductance and resistance of the sea return at frequencies much beyond the transmission range of the cable. Also, in the case of telephone or high speed telegraph cables the sea return impedance becomes a very important and even controlling factor in transmission, and this fact has led to a modification of cable design, so that cables of this type are furnished with conducting sheaths composed of copper tape laid on the cable core, which provide a low resistance path for the return current.

The writers have made a study of this problem as part of an investigation* of submarine cable transmission, in connection with the research programme of the American Telephone and Telegraph Company and the Western Electric Company, the object being, not only to develop methods of predetermining cable characteristics, but also to furnish a theoretical guide for analysing the effect of the various factors involved, for interpreting and supplementing experimental studies, and thus to furnish a basis for a sound and economical design of the cable.

Mathematical Difficulties.

In taking up the analysis of the propagation of alternating currents over a submarine cable, the problem was first simplified by replacing the armour wires by a continuous iron sheath concentric with the core. This appeared to be a reasonable approximation that would not introduce any serious errors, and in fact it has been made in every prior study of the problem. This assumption facilitated the mathematical analysis, since, in the simplified structure, everything is symmetrical with respect to the axis of transmission. The mathematical solution offered no difficulties beyond those of computation, which were considerable, because of the facts that the solution involved Bessel functions and that the investigation was extended so as to include the effect of metallic sheaths in addition to the armouring. The main feature of this preliminary study is, that by introducing directly the engineering concepts of linear resistance, inductance, capacitance and leakance it was possible to express the solution in the usual engineering form. As a consequence, the formulæ admit of considerable direct interpretation without computation, and it is possible to determine directly the impedance of the group of conductors, including the sea water, which constitutes the path for the return current. This is of advantage, inasmuch as prior studies along similar lines, such as those of J. J. Thomson, leave the analysis in such shape as to require considerable further work to reduce the formulæ to a form suitable for engineering calculations.

The results of the calculations based on this preliminary study in which the armour wires are replaced by a continuous sheath showed that the effect of this sheath was so surprisingly large, even at moderate frequencies, as to make the simplifying assumption of very doubtful validity. For example, in one calculation it was found that at a frequency of less than 36 cycles per sec., 90 per cent. of the return current was carried by the sheath, and at 100 cycles per sec. the return current was completely excluded from the sea-water, which, therefore, played no part in the electrical system. These effects were accompanied by a pronounced increase in attenuation.

Effect of the Armour Structure.

These results made it evident that in order to arrive at a reliable solution a more thorough analysis of the problem was essential, with particular reference to the actual structure of the armour. The simplifying assumption regarding the armour wires was abandoned, and the general problem was attacked, in which the armour wires were taken as they actually exist on cables, and no special assumptions were made regarding their geometry or their electrical properties. This greatly increased the analytical difficulties, since the structure lacks the circular symmetry which was the essential simplifying property in the previous solution, and it was found necessary to develop several novel mathematical methods in order to arrive at a solution.

Concentration of Return Current.

Numerical solutions, obtained by this general method, of a number of problems involving existing types of cable and their possible modifications have furnished a considerable fund of information which throws much light on the phenomena of cable conduction and is of great value in transmission studies. As may be seen from Tables I and II, the return current shows a decided tendency, even at comparatively low frequencies, to crowd in towards the core and thus concentrate in the innermost of the group of return conductors. In these particular instances the innermost conductor was the armour sheath, and the effect of seemingly slight changes in the structure of the armouring can be seen by comparing the results in the various cases.

Table I.—*Percentage of Return Current carried by Armour Telegraph Cable.*

Frequency p.p.s.	Armouring.	
	Continuous Sheath.	Wires.
25	84	9
50	96	17·5
75	99	25
100	100	31·5

Table II.—*Percentage of Return Current carried by Armour Wires Seattle-Sitka Cable.*

Frequency p.p.s.	Structure of Armouring.	
	Open	Closed
100	43·0	55·0
200	61·0	75·0
300	79·5	82·5
400	73·5	86·5
500	76·0	88·5
600	77·5	91·0

Since the armour wires are of high impedance it would be expected that large values of return resistance would result ; and such is

* See "Transmission Characteristics of the Submarine Cable," John R. Carson and J. J. Gilbert. Journal of the Franklin Institute. vol. 192, p. 705. December, 1921.

the case, as may be seen from Tables III and IV. In fact, these results indicate that the return resistance would be reduced to a small fraction of its value in the range from 25 to 100 cycles if the iron armour wires were removed from the cable.

In a similar manner, it can be shown that if a thin copper sheath be interposed between the core and the armour wires of the cable

Table III.—*Resistance and Inductance of the Sea Return.*

Frequency p.p.s.	Armouring. Sheath. Res. ohms/km.	Sheath. Ind. mh./km.	Wires. Res. ohms/km.	Wires. Ind. mh./km.	None. Res. ohms/km.	None. Ind. mh. km.
25	0·74	4·00	0·075	1·90	0·025	2·25
50	1·15	3·22	0·175	1·70	0·050	1·85
75	1·35	2·70	0·278	1·60	0·075	1·76
100	1·49	2·50	0·450	1·51	0·100	1·75

it would tend to carry the major portion of the return current as the frequency increased. This would result in a considerably diminished return resistance, on account of the low resistance of the sheath compared with the armour wires. This improvement is

Table IV.—*Resistance and Inductance of the Sea Return Seattle-Sitka Cable.*

Frequency p.p.s.	Resistance ohms/km. Open	Resistance ohms/km. Closed	Inductance mh./km. Open	Inductance mh./km. Closed
100	0·41	0·51	1·54	1·80
200	0·77	0·92	1·15	1·29
300	0·95	1·12	0·96	1·08
400	1·06	1·25	0·88	0·98
500	1·16	1·35	0·82	0·95
600	1·25	1·45	0·80	0·91

especially noticeable in the audio and carrier ranges of frequency, and in fact conducting sheaths are an essential feature of cables designed to transmit such frequencies.

Theory and Practice Agree.

As a check of the method, calculations of the resistance and inductance of the Seattle-Sitka cable were compared with the results of measurements made upon that cable. Considering the error involved in measurements of this sort, the check between theory and experiment is remarkably good. A further comparison was made of the return resistance at 3 000 and 10 000 cycles per sec., employing measurements made by the American Telephone and Telegraph Company upon the Vancouver cable. The results are shown in Table V. Here, again, there is good agreement between

Table V.—*Resistance of Return Conductor ohms/mi Victoria-Vancouver Cable.*

Frequency p.p.s.	Computed.	Experimental.
3 000	2·87	2·92
10 000	4·45	4·60

the measured and calculated values; and it is safe to say that the method which has been described is exact for all frequencies which are likely to be transmitted by submarine cables.

The conclusions that have been drawn as a result of this study are: (1) The resistance of the sea return of a submarine cable is by no means negligible, even at low frequencies, and it has a considerable effect upon transmission; (2) the resistance and inductance of a cable are greatly dependent upon the geometrical arrangement and the electrical properties of the armour wires; (3) the return resistance at high frequencies can be decreased by providing the cable with a thin metallic sheath in electrical contact with the armour wires.

In addition, the method furnishes rigorous formulæ for computing the resistance and inductance of cables with structures of various degrees of complexity, and indicates the modifications that must be made in the methods of cable design in order that the elements of the cable external to the core may function efficiently as part of the conducting system of the cable.

High-Power Mercury Arc Rectifiers.

At a recent meeting of the North-Western Centre of the Institution of Electrical Engineers at the Engineers' Club, Manchester, the subject of "Mercury Arc Rectifiers" produced a most interesting informal discussion. Mr. R. L. Morrison, who introduced the subject by a very able paper illustrated by lantern slides, outlined briefly the theory of operation and the various difficulties encountered in commercial manufacture,* the chief of these being probably that of constructing an arc chamber, which must be both accessible and absolutely gas-tight. It is claimed that this difficulty has been completely overcome by the invention of the mercury seal, but the fact remains that a mercury vapour pump for maintaining the vacuum is still the indispensable first of a number of auxiliaries necessary for working these installations efficiently.

A Multiplicity of Second Cousins.

This "multiplicity of second cousins," as Mr. A. G. Ellis humorously described the auxiliaries, received, together with other features of the apparatus, a good deal of adverse criticism. Mr. H. A Ratcliffe, who opened the discussion, suggested that the object of the meeting was to gain information on a new subject, and perhaps the best method of obtaining this from the manufacturer was by criticism of his product. Criticism certainly was keen, and Mr. Morrison, who said he had been warned that the Manchester meeting would be "a hard nut," found his arguments and figures assailed on all sides. Mr. Ratcliffe doubted whether the rectifier could substantiate any claim on the grounds of price, space or simplicity. Price figures were not given, the space necessary was not small. The simplicity, he thought, was questionable. In reply, later, Mr. Morrison said that the price of a rectifier installation would be somewhat higher than that of rotary converter equipment and with auxiliaries included the space needed might also be a little more. In answer to other questions, Mr. Morrison explained that the efficiency figures claimed were overall efficiencies, from high-tension a.c. to d.c. busbars, thus including auxiliaries. The comparative weights given, however, did not include auxiliaries.

Rectifier and Converter Efficiencies.

Mr. R. Townend claimed that the maximum efficiency, 90 to 92½ per cent., attributed to the rotary converter was too low; 93 to 93½ per cent. was often attained, and efficiency much below this would not have much chance in competitive markets. He thought the power rectifier was good in its simplest form, as for a 2-wire system of fairly constant load where fine voltage regulation was not essential. This granted the rectifier a field of service in high voltage traction work, but for lighting services there would be additional expense of automatic regulators. In reply to questions, Mr. Morrison gave the natural regulation of power rectifiers as 12 per cent., which could be reduced to 4 per cent. by the use of a suitable cathode coil. The addition of an automatic regulator would allow regulation of 1 per cent.

The necessity of providing a transformer of so much higher power than the output of the rectifier set provoked some criticism. Taking the output of the rectifier as 100 the power of the attendant transformers was stated to be 135 for three-phase, 155 for six-phase, and 184 for twelve-phase.

Use in Automatic Sub-Stations.

The question of suitability of rectifiers for automatic sub-stations received a good deal of attention. Mr. Morrison had mentioned that a rectifier resuming operation after some hours of inaction might need from 12 to 15 min. working of the vacuum pump, and this possible delay was quoted by several speakers as a serious objection. In reply, however, it was stated that a recently developed electrical system of vacuum indication and pump control would enable the plant to be kept ready automatically for immediate operation at any time. Many other points were dealt with, of which, perhaps, the most important was the behaviour of rectifiers in the event of short circuit.

The general tendency of opinion was to admit the probable usefulness of rectifiers for certain kinds of traction work. Mr. Paxton emphasised several points in this connection, especially the absence of flashing at heavy loads and the advantages resulting from the elimination of magnetic circuits from converting apparatus. One disadvantage quoted by several speakers was the non-reversible nature of the rectifier, which renders it unable to co-operate in schemes of regenerative braking. For this reason an installation for the French Midi railway included 16 1 200 kW rectifiers and 4 1 200 kW rotary converters, the latter for purposes of regeneration.

The power rectifier has undoubtedly made an impression, and in spite of the keen criticism of some of its claims there was a marked desire to consider this new development with an open mind and to remember, as Mr. Morrison pointed out in his reply to the discussion, that the apparatus has scarcely yet emerged from the "teething troubles," having but some five years of development as against the twenty-five of its competitor, the rotary converter.

* See The Electrician, Jan. 2, 1920, p. 10.

Radioactivity.

(*Concluded from page* 413.)

In the second three of a series of six lectures which Sir Ernest Rutherford, Cavendish Professor of Physics at Cambridge, delivered before the Royal Institution, the properties of the members of radioactive families were dealt with, and it was pointed out that the study of radioactive disintegration had forced the idea of isotopes upon us. Methods of detecting radioactive discharges were described and the determination of nature, velocity and radioactive heat dealt with. In the final lecture a concise account of recent developments was given.

Dealing in his fourth lecture with the properties of the members of the radioactive families, Sir Ernest Rutherford pointed to the peculiar differences in the characters of successive members. Radium, a metal of distinct chemical affinities, gave emanation, an inert gas. Was there any order in these changes and any connection with the chemical properties of ordinary elements? Radioactivity was an atomic property, and we had to consider the structure of the atom. An atom, it was now established, resembled the solar system. The mass was concentrated in the nucleus, the diameter of which was yet very small compared with the diameter of the atom. That diameter was determined by the rings of electrons surrounding the nucleus. An electron was simply an atom of negative electricity, and in the neutral atom the sum of the negative charges balanced the positive charge of the nucleus. In the case of oxygen we had 8 electrons, 2 near the nucleus, 6 in a ring further out, and the positive charge was 8 units. That charge, or the number of electrons, determined the whole properties of the atom. Hydrogen had one unit charge, helium 2, lithium 3, and so on, to uranium, the heaviest known atom, with 92 units. These numbers were the Moseley or atomic (ordinal) numbers. The whole structure was held together by the forces between the positive and negative units; the properties would also depend upon the distribution of the charges, but the lecturer did not propose to deal with that. The nuclei of certain atoms, though having the same nuclear charge, or excess of positive over negative electricity, might yet differ as to nuclear mass. All the atoms of that element would then have the same properties, in spite of their different mass, and these bodies were called isotopes; chlorine had such an isotope, and mercury had several.

Radioactivity and Isotopes.

The study of radioactive disintegration had forced this idea of isotopes upon us. In the changes α, β, or γ particles were expelled, and they came from the interior of the nucleus, which must itself therefore be of a complex structure. The α particles were atoms of helium, carrying each two positive charges; the β particles were electrons; the nucleus therefore must contain both helium and electrons and be a little world in itself. The resultant nuclear charge was the excess of the positive charge over that of the electrons. In the subjoined diagram, Fig. 6, the number

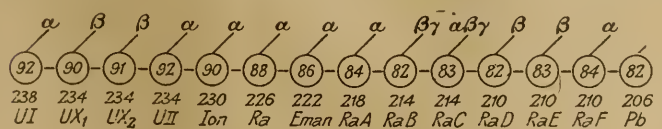


Fig. 6.

within the circle expresses that resultant charge or ordinal number, as determined by X-ray analysis, and the number underneath is the atomic weight or mass. Uranium UI had the mass 238·2 and the ordinal number N = 92. By losing an α particle or atom of helium of mass 4, it turned into UX_1 of mass (238 − 4) = 234 and number N (92 − 2) = 90, because the UI had lost 2 unit charges. UX_1 lost one β particle of very small mass, only 1/1845 of the mass of an α particle; hence that loss could be neglected. UX_2 (the new product) had mass 234, but its N was 91, by 1 greater than 90, because the loss of one electron increased the resultant positive charge by one unit. UX_2 again lost a β particle in passing into U II; the mass therefore still remained 234, but the N rose once more by unit back to 92.

When U II next changed into ionium, an α particle was lost; the mass therefore decreased by 4 to 230, and the N by 2 to 90. With U II we had thus come back to U I as to the resultant charge, but not as to mass, and these two bodies were isotopes, bodies which—as had been proved in other cases—could not be separated by chemical means. With the next change we came down to radium, Ra, mass 226, N = 88; both these figures had been confirmed by analysis and by X-ray study respectively. The last member of this family was lead, called radium-lead, in order to distinguish it from ordinary lead. As the successive changes from uranium to this lead involved the loss of 8 α particles, the mass of radium-lead should be 238 − 4 × 8 = 206; but ordinary lead had the atomic weight 207·2.

Changes in the Thorium Family.

Sir Ernest then traced the similar changes through which the members of the thorium family passed, leading finally to a thorium-lead, which, accepting the evolution outlined, ought to have an atomic weight 208. When actinium was also considered, and all the radioactive members were tabulated together, the possibility of many isotopes was at once apparent. When it was observed that ionium and thorium had the same properties and were inseparable, and that similarly radium and mesothorium should be the same, except for a difference in their radioactive properties, Russell, Fajans, and Soddy simultaneously suggested in 1913 the generalisation that the loss of one α particle would take an element by two steps down the periodic table, in which the elements were arranged in the order of their atomic weights, and that the loss of one β particle would raise it by one step. Thus elements might both come down or be raised to positions already occupied by other elements; hence the name "isotopes." The suggestion naturally appeared strange to chemists. But as regards the end-products mentioned, the experimental confirmation was striking.

These experiments were particularly difficult because in the radioactive minerals uranium and thorium were generally mixed. The thorite found in very ancient rocks of Ceylon was fairly free from radium, however, and the relatively younger pitchblend of Joachimsthal contained very little thorium. From these minerals Soddy and Hönigschmid had independently isolated two kinds of lead of the following properties, differing from ordinary lead:

Ordinary lead	atomic weight	207·19	density 11·337
Radium lead	,,	206·08 (206)	,, 11·280
Thorium lead	,,	207·9 (208·12)	

the figures in brackets being the masses calculated according to the theory of radioactive disintegration.

Further, ordinary thorium had an atomic weight 232·12; thorium from pitchblende gave 232·5, probably because it contained some ionium. Ordinary lead might be a mixture of the two lead-isotopes; but it might also have an origin of its own. With regard to further possible elements and isotopes, elements of the atomic numbers N = 43, 61, 75, 85, and 87 were still unknown, whilst one of the numbers 81, 82, 83, 84 was represented by as many as 8 isotopes; lead had 7 isotopes, thorium 5, radium 3.

Detection of Discharges.

Coming to the numbers of particles discharged, Sir Ernest remarked that each α particle passing through its limited range of air surrounded itself with a cylinder of ionised molecules; but the electric change so produced was just on the verge of detection. The way to magnify the effect had been shown by Townsend. In their first experiments on these lines Sir Ernest and H. Geiger had made the α particle enter through a small bore an exhausted vessel in which a high potential difference was maintained between an axial wire (connected to an electrometer) and the walls of the vessel; any ion was thus speeded up; it ionised other molecules, and thus magnified the effect thousands of times. With, say, four particles entering per minute the counting of the electrometer deflections was, however, very laborious. Geiger therefore made the apparatus photographically recording with the aid of a string electrometer consisting of a silvered quartz fibre or a very fine Wollaston wire or string (used in the demonstration). The string was joined to the axial wire at one end and earthed through a

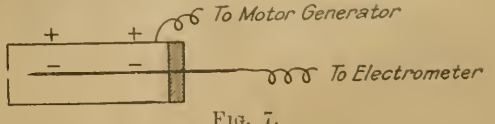


Fig. 7.

very high resistance at the other; it was vertically stretched between the plates of a condenser, and was bodily deflected (shifted to right or left) each time a particle entered. In the final form the axial wire (a polished needle) faced with its sharp point the small opening in the tube, which had the size of a thimble (Fig. 7). The needle was connected to the string electrometer. In the demonstration the tube was charged to 1 400 V from a

motor generator. The source of the α radiation was a speck of polonium on a foil, the frame of which was slowly pushed up to the hole in the box. The range of those α particles was 3·86 cm., and when this approach was reached the string began to kick. Then the polonium was replaced by thorium, which gave α particles of a range of 8 cm., and the kicking began at that larger distance; in both cases all effects stopped when a piece of paper was interposed between the source and the box. The numbers of particles thus counted were not constant; the kicks did not succeed one another at regular intervals, and sometimes two were almost simultaneous; the number was subject to the laws of probability. A gram of radium alone, free of other radioactive

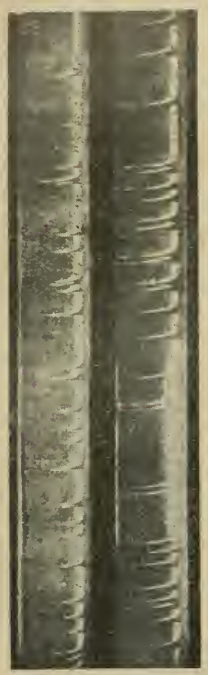


Fig. 8.

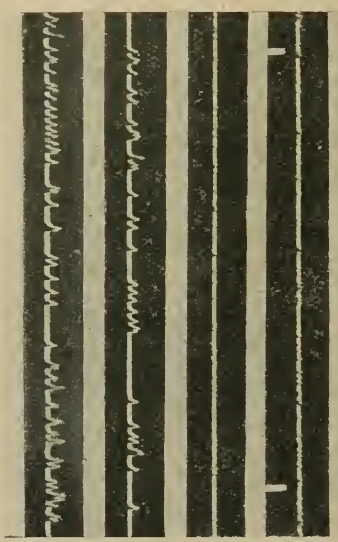


Fig. 9.

materials, would give $3{\cdot}6 \times 10^{10}$ α particles per sec., and when that amount of radium was in equilibrium with the other products, the number would be 4 times greater. Figs. 8 and 9 illustrate the kicks due to α and β particles.

Another way of demonstrating the α particles was to put a speck of radium on a fine needle and touch the photographic plate with the needle for a short time; the developed plate then showed the

Fig. 10.

splash of Fig. 10 (highly magnified), in which each ray represented the path of one α particle through the grains of the plate emulsion.

Detection by the Scintillation Method.

In the fifth lecture Sir Ernest Rutherford stated that the number of α particles could also be determined by the scintillation method of Crookes. Each α particle hitting a screen of zinc sulphide (the sulphide was dusted on a glass plate) produced a very intense flash lasting only 1/40 000 of a second. In order to make the microscopic field of these observations large, Messrs. Adam Hilger had constructed a peculiar-looking microscope which gave a field of view of 40 sq. mm., on which up to 25 α particles might fall per minute. The counting of these scintillations was a very trying operation, even when the eye had first been rested in the dark for half an hour, and since the emission of the particles was governed by the law of chance, many countings had to be made to arrive at a fair average; the error varied as the square root of the number of observations.

In the method of determining the numbers of particles due to C. T. R. Wilson the particles were sent through air saturated with moisture, which they ionised. On passing through moist air an α particle from Ra C (range 7 cm. in air at ordinary pressure) would produce 235 000 pairs of ions, each of which might serve as a nucleus for the condensation of water vapour in tiny drops. Those drops were very crowded in the case of α particles, and less crowded when β particles were used; the former gave a straight track, the latter a crooked track. In another photograph exhibited a trace of emanation had been put into the moist air; the α particle track looked remarkably straight and long (though the real length was only $\frac{1}{8}$ mm.), and the track showed the recoil of the air molecule from which it had started at its origin.

Determination of Nature and Velocity.

The nature and velocity of the particles had since 1903 been determined, for some years with little success, by experiments on their deflection by electric and magnetic fields. In magnetic fields the deflection depended upon the velocity u of the particle, in electric fields on u^2, and in both cases also on the mass of the particle m. The particle was made to hit a photographic plate; if deflected first upward and then, by reversing the field, downward, the particle would describe two curved paths and strike two spots, the distance between which would represent twice the deflection; from that the E/m, the ratio of the charge on the particle to its mass, could be deduced. These experiments were very much more difficult with α particles than with β particles or kathode rays, and the deflections for the α were very small, unless fields 10 000 times the intensity of those required for kathode rays were used. Yet Geiger and Rutherford had found that range R of the α particle varied approximately as the cube of its velocity u, so that $u^3 = kR$. Any screen interposed in the path of the α particle reducing its velocity u by $\frac{1}{2}$ would reduce the range R by $\frac{1}{8}$. By such experiments with very intense fields they had found that for α particles the E/m was 4 823 electromagnetic units. If the α particle were, as we believed, an atom of helium carrying two electric charges, the ratio should, from electrochemical considerations, be ·4 826, a very striking agreement. From experiments with RaC (yielding α particles of range 7 cm.) Rutherford and Robinson had deduced $mu/E = 3{\cdot}985 \times 10^5$, or $u = 1{\cdot}922 \times 10^9$ cm. or roughly 20 000 km. per sec. From this velocity and the Geiger u^3 rule, the velocities and energies of the other particles of known ranges had been determined for the members of the uranium series.

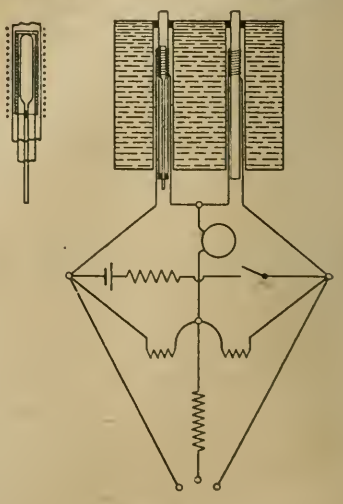


Fig. 11.

Radioactive Heat.

Passing to the heat continuously given out by radioactive bodies, Sir Ernest mentioned that the first measurements of Pierre Curie and A. Laborde had been made in 1903 with the aid of a Bunsen ice calorimeter. The calorimeter shown in Fig. 11, used for Sir Ernest's demonstration, was more suitable. Two equal fine platinum spirals (resistance thermometers) wound on glass tubes formed two arms of a Wheatstone bridge; the source of heat was placed inside the one tube, and the other tube was surrounded (see small diagram of Fig. 11) by a compensating coil through which a current was sent to balance the deflected galvanometer of the bridge. In order to prove that this evolution of heat continued at the low temperature of liquid air and was independent of the surrounding temperature, Sir Ernest made use of the method of Sir James Dewar, who measured the amount of liquid oxygen (within a Dewar vessel) vaporised by the respective body or

radiation; the rate of liberation of oxygen for oxygen remained unchanged, as the radium salt used (once cooled) remained in the apparatus during the course of the lecture.

Shares of the Rays in Heat Evolution.

With the aid of the above-mentioned electric calorimeter and the radium deposit collecting on the wall of emanation tubes (previously referred to) it was possible to apportion the shares which the α, β, and γ rays had in the heat evolution. The emanation was drawn off and condensed; the Ra A decayed quietly, and after about 30 minutes, when the heat curve dropped strongly, practically only Ra C would be left. The γ rays finally remaining could be absorbed by lead, though that would require 6 in. of lead, and so H. Robinson and Sir Ernest had arrived at the following table of heat effects in gram-calories per gram of radium per hour:

	α	β	γ	Total.
Radium.....	25·1	—	—	25·1
Emanation ..	27·6	—	—	27·6
Ra A.....	30·5	—	—	30·5
Ra B+C....	39·4	4·3	6·5	50·2
Total	123·6	4·3	6·5	134·4

Thus 1 gram of Ra in equilibrium with its descendants would liberate 134·4 gram-calories. The figures showed that the α rays contributed the main share of the kinetic energy; the observed heat effect of Ra C seemed, however, to be a little too small, and that was an interesting problem. That the α particles were really charged atoms of helium had been known long before these determinations of the E/m. Each gram of Ra gave $1{\cdot}36\times10^{11}$ α particles per sec., or $4{\cdot}28\times10^{18}$ α particles per year; the cub. cm. of helium contained $2{\cdot}74\times10^{19}$ atoms, and the gram of radium should then give 158 cub. mm. of helium (at normal pressure and temperature) per year. Similarly uranium gave $2{\cdot}75\times10^{-5}$ cub. mm. of helium per year, thorium 3·1, and uranium mineral in equilibrium 11, all expressed in 10^{-5} units. In some compact minerals of ancient formations the helium accumulated, not being able to escape; carnotite, which was not compact, and the relatively young pitchblende, contained little helium, whilst 1 gram of samarskite (very old mineral) contained 1·2 cm³ of helium per gram. Sir Ernest demonstrated the evolution of helium from pitchblende by heating this mineral strongly in a quartz tube and leading the gas into a spectroscopic tube after condensing all the gases present, except helium, by charcoal.

Recent Developments.

Opening his last (sixth) lecture, Sir Ernest remarked that he had intended to refer to the conclusions which the helium contents of minerals enabled us to draw as to their ages. But he would rather speak of recent developments in the study of β and γ rays. The β rays were very swift electrons; the γ rays highly penetrating X-rays. We could work discharge tubes at potentials of 150 000 V, but it would take two or three million volts to produce electrons of β ray speed and energy, and the energy equivalent to that of the α rays would require forces of four million volts. Using the string electrometer and the pointed-needle tube (with hole) as before, Sir Ernest showed that the β rays from radium D strongly deflected the electrometer, but not when the magnetic field turned the β particles off. When the source was held in such a position that the particles could not pass directly through the hole there was no deflection; but when a plate of some metal (aluminium) was held like a mirror so as to reflect the particles roughly in the right direction, deflection was at once observed again, because the β particles were easily scattered. A lead plate reflected better than aluminium. In the further experiments, the source, 6 mg. of radium, was held several feet away from the electrometer, and the effect was yet very strong—too violent almost for the instrument, in fact. A screen of aluminium interposed in the path of the rays weakened the effect; but some particles penetrated even through 2 in. of lead.

The Nuclear Structure of the Atom.

This last effect now was not due to any direct β or γ particles of the radium, but to secondary β particles released in the lead by the γ rays from the radium. The same effect, though very much weaker, was known in X-ray experiments. The γ rays passed right through the 2 in. of lead and caused the ejection of swift β rays from the far surface of the block. The primary β rays could not force their way right through that thickness of lead, and if the secondary rays had come directly from the lead surface, they would have the same speed as the primary β rays; if they were excited at some depth within the metal, their speed was smaller. What was the wave-length of these highly-penetrating γ rays? To answer that question we had to consider the nuclear structure of the atom, and these recent studies had enabled us to investigate the nucleus of the heavy atoms which we had so far been unable to attack. The nucleus was supposed to be surrounded by successive rings (not necessarily circular) or shells of electrons, known as the K, L, M, N rings (see Fig. 15, to be explained presently). A β particle shot out from the nucleus might occasionally collide with an electron, *e.g.*, in the K ring, and drive it out. But the external (ring) system would rapidly return to its former state, we believed with Bohr, and pick up an electron from outside which, in falling back into position, would emit radiations characteristic of that particular K ring. Thus we should anticipate occasionally to observe, in addition to the characteristic radiation (in this case the K radiation), a much more penetrating nucleus radiation. Prof. Rutherford came back to this point at the end of his lecture.

Sorting the γ Rays.

In order to sort out γ rays, Rutherford and H. Richardson placed, within a box mounted in a magnetic field, some Ra B and C behind one or several absorbing screens of aluminium and allowed the radiation to enter an electrometer chamber filled

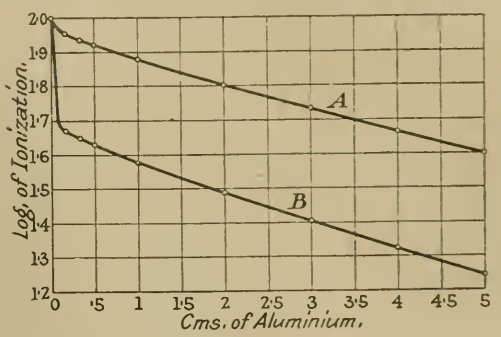
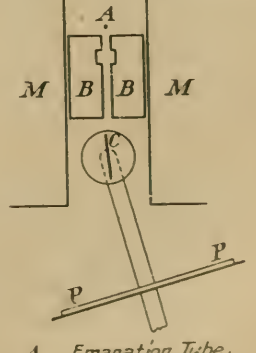


Fig. 12.

either with air or with a heavier vapour, methyl iodide. Curves A (air), Fig. 12, and B (methyl iodide) showed in both cases, but particularly in B, an initial drop indicating first a rapid absorption, and then a steady diminution in the rate of absorption, though not quite the same diminution in the two cases. By these means three components of the γ rays were distinguished, of absorption coefficients 230 cm.$^{-1}$, 40 cm.$^{-1}$, and 0·51 cm.$^{-1}$, the last being the most penetrating rays. The former two coefficients were also the characteristic M and L radiations of lead which, it was noteworthy, was not known at that time to be an isotope of Ra B. The smallest coefficient found for γ rays from Ra C was 0·115 cm.$^{-1}$. Wave-length measurements were made with the aid of the apparatus illustrated in Fig. 13, representing a modification of Bragg's X-ray method. The source, an emanation tube, was at A, the B were blocks of lead, and C was the crystal of rock salt, mounted on an arm which supported the photographic plate PP; the whole was placed between the powerful electromagnets MM.

Arrangement for γ-Ray Spectrum.



A. Emanation Tube.
BB. Lead Block.
C. Crystal.
MM. Electro-Magnet.
PP. Photographic Plate.

Fig. 13.

The long exposures required, a day or more, were apt to fog the plates, and some of Sir Ernest's early photographs of 1903 showed only two distinct strong lines (others less distinct) at deflections of about 12 deg. and 10 deg. But these and other lines were found by the later work of Siegbahn and Friman to agree exactly with characteristic X-ray lines of lead. The agreement was not quite so good for the more penetrating γ rays, reflected at almost grazing incidence, down to 42 minutes of arc and corresponding to a wave-length of $0{\cdot}71\times10^{-9}$ cm. The method was not suitable for measurements at still smaller angles, and the spectrum was evidently very complex, as we might expect from the fact that experiments with X-rays at about 100 000 V could only give us the low-frequency range of radiations, whilst the shortest γ rays would require potentials of 2 000 000 V or more for their excitation.

β Ray Spectra.

Passing to β ray spectra, Prof. Rutherford said that, with the arrangement of Fig. 14, where S was the source of the rays fixed

within the wide slit of a thick block of lead, and PP a photographic plate, all in a strong magnetic field, the γ rays would shoot up up in a conical pencil, whilst the β rays would be bent off in circular paths, the wider, the swifter the particles. When the source was Ra F, which gave few γ particles, the spectrum was practically continuous; when Ra B C were used, in which γ rays were prominent, bands could be distinguished in the β spectrum, and these bands (the strong lines of Fig. 15) arose from the conversion of γ rays into secondary β rays (previously spoken of) by the collisions between γ rays and the shells of electrons surrounding the nucleus. For this conversion the quantum relation held: $E=h\nu$. But some energy, ω, would be expended in removing the electron from its position in the shell, and the equation should therefore be within $h\nu\gamma=E\beta+\omega$.

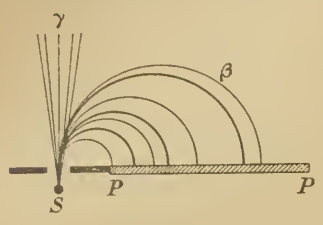


Fig. 14.

When the source was an emanation tube placed in a lead cylinder (or wrapped with foil), most of the β rays would be stopped or scattered, but the γ rays would be able to pass, and they would

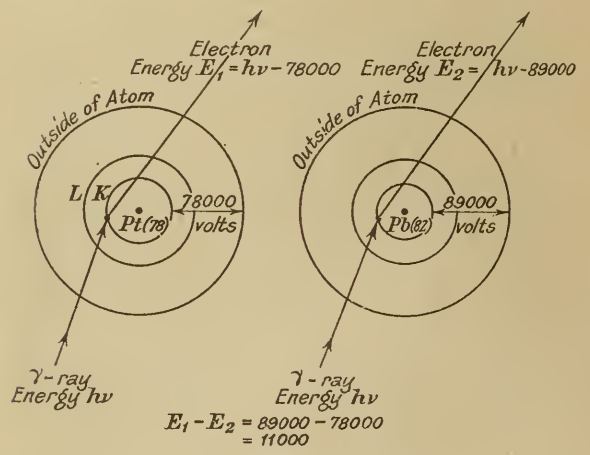


Fig. 15.

generate secondary β rays yielding diffused bands, sharp on their high-frequency side and diffused on the other; the sharp edge would correspond to the swiftest rays from the outer lead surface, the diffused edge to rays from inner layers.

Change in Absorption Spectra.

The absorption spectra changed with the metal through which the γ rays were shot (the cylinder material). Sir Ernest showed some photographs referring to cylinders of tungsten, platinum, lead and uranium. Each spectrum consisted of a rectangle, dark black on the left and less dark on the right, and the edge of the dark portion receded more and more to the left in the order stated. That showed that β particles from the lighter metals* travelled more swiftly than particles from the heavier metals. The relations would better be understood from the two atoms, one of platinum, one of lead, in Fig. 15. In both cases a γ ray of frequency ν collided with an electron in the K ring; to remove that electron required (as we knew from X-ray experiments) 78 000 V for Pt and 84 000 V for Pb. The energy with which the β ray would emerge from Pt, *i.e.*, the $(h\nu\gamma-\omega)$, would hence be $(h\nu-78\,000)$, and in the case of Pt it would be $(h\nu-89\,000)$, that is, the energy would by 11 000 V be less in the case of the heavier element; in other words, the particle lost more energy in escaping from the element of greater mass.

Energy of the γ Rays.

Modifying the arrangements of Fig. 14 in such a way that the particles of the same speed were brought to the same focus, C. D. Ellis had found last year in the Cavendish Laboratory that each of the four heavy metals just referred to gave 3 strong lines in the β ray spectra, of the following energies (in 10^5 V): tungsten W (atomic number 74): 1·66, 2·20, 2·76; Pt (78): 1·58, 2·12, 2·69; Pb (82): 1·49, 2·03, 2·60; U (92): 1·22, 1·74, 2·31; some of these lines had previously been determined by de Broglie. If each of these lines were excited by a γ ray, as Prof. Rutherford had suggested, the energy of the respective γ ray should be greater than the above figure by the energy required to remove the respective electron from the atom; these removal-energies ω were known from the X-ray work of Siegbahn, and they amounted to: W 0·693; Pt 0·762; Pb 0·891; U 1·178. Adding these ω terms to the first figures, we obtained for the 3 lines: W 2·35, 2·89, 3·45; Pt 2·36, 2·91, 3·46; Pb 2·38, 2·92, 2·49; U 2·40, 2·92, 3·79, that is to say, the same γ energies for each of the three lines of the four elements. That proved that the various secondary β rays observed were really excited by three γ rays coming, not from the respective metal, but from the radioactive source.

Deduction of Wave Lengths.

From the energies of the γ rays the frequencies ν and hence the wave-lengths could be deduced by the Planck relation, and in this way Ellis found that the whole of the six β rays (three faint lines, in addition to the three strong ones spoken of) could be accounted for by six γ radiations ranging in wave-length from 0·0 519 down to 0·0308 Ångström unit. Now the energy relations were also known from other researches, and it was thus possible to calculate in which regions, rings, or levels in the atoms the β rays originated. The first of these levels (Figs. 15 and 16) was the K ring; instead of the single L ring indicated in Fig. 15 we had, from Sommerfeld's work on the fine structure of the spectrum lines, to assume three levels, that made the 4 levels above zero level 0 marked by the numbers 1, 2, 3, 4, 5 in Fig. 16. The drop from 5 to 1 would cause the emission of a ray of energy $4{\cdot}025\times10^5$ V; the drop from 4 to 1 would correspond to 3·636, and so on; there would have to be γ rays corresponding to these transitions, and rays of those respective energy differences had actually been measured by Rutherford and Andrade in 1914, as the following figures showed:

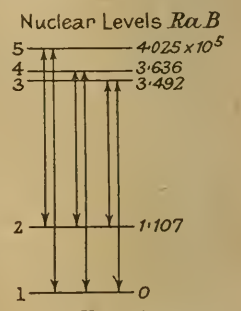


Fig. 16.

Origin 5 to 4	energy 0·389	λ calculated 0·318	obs. 0·324	Å. U
5 to 3	0·533	0·231	0·229	
7 to 3	0·144	0·857	0·853	
2 to 1	1·107	0·112	0·115	

Another noteworthy relation had been pointed out by Ellis. The six γ lines from Ra B consisted, as mentioned, of three strong lines and three weak lines. When we tabulated their energies in pairs like this

4·000	3·639	3·492
2·918	2·529	2·385
1·082	1·110	1·107

we saw that the difference between the strong and the weak line of a pair was constant. That should be so if the drop was not from 5 to 1, but from 5 to 2, *e.g.*

The Origination of Gamma Rays.

Finally, Sir Ernest came back to the question why we believed these γ rays to originate in the nucleus and not perhaps in the space between the innermost K ring and the nucleus. The two isotopes, Ra B and lead, of atomic number 82, were identical also as to the K and L rings, and Ra B emitted the full K and L spectrum of a body 82 (Rutherford and Andrade). If the γ rays were emitted previous to the actual disintegration of the Ra B nucleus, the atomic number should be 83. That there were, in lead, no electrons inside the K ring was proved by bombardment experiments; since Ra B differed from lead only as to the constitution of the nucleus, that argument of Ellis would also apply to Ra B, and the γ rays must hence come from the nucleus. There was then strong evidence, Sir Ernest remarked in concluding, that we had a system of very high-frequency oscillations inside the nucleus, as well as the system of electronic oscillations outside the nucleus with which Bohr had dealt. For these reasons experiments with the highest possible discharge potentials had become so desirable, and he hoped that we should, in the course of a few years, advance considerably beyond the million volts of the most recent experiments.

Mr. G. R. Crowe assisted in the demonstrations.

* Sir Ernest's terms "light and heavy" do not refer to density, but to atomic weight; the atomic weights of the four elements are, W=184, Pt=195, Pb=207, U=238; the densities are in ascending order, Pb=11·3, U=18·7, W=19·1, Pt=21·5.

Counterbalancing the Slump.

The Electricity Supply Authorities' Opportunity.

By W. A. GILLOTT, A.M.I.E.E.

In many districts, the industrial areas in particular, the central station engineer views with mixed feelings the lessened output due to slackness of trade, lock-outs, &c. It is evident that some measures must be taken to improve present conditions, and place us in a better position should these unhappy circumstances recur at a later date. Industrial troubles and fluctuations are ever present; therefore, a profitable load that is stable under practically any condition is to be desired and fostered. Such a load is waiting at the door of every central station, and by proceeding in the right direction it can be connected to the mains, and will bring a substantial reward. I refer to domestic electrification.

Many authorities have, and some still do, look upon the domestic load with indifference, thinking it not worth while. This is a great mistake, and I repeat, as on many previous occasions, that with a well-planned campaign and the "will to do," the domestic load can be made to reach the proportions of a moderate industrial load. Difficulties! Of course, there are difficulties, what "worth while" object is reached without meeting obstacles. If one cannot jump over them, one must go round or under them so long as the other side is reached.

Realising there are various matters to adjust, plans can be made to meet them. Let us take the case of cables, this being, in all probability, the most difficult matter, as many existing networks in the residential areas were laid out for lighting. In the very bad cases there is no other alternative than strengthening. But why delay?—it must be done some day. Prices will not fall to such a degree that it will pay to lose the load awaiting this problematical time. Experience teaches that it is advisable to extend cables gradually to meet this class of business; the increased revenue will provide capital for further extensions.

Diversity of Electric Cooking Load.

It is extremely doubtful, however, if all the districts of any undertaking, particularly the large ones, are overloaded, and a good deal of the fully loaded networks are only apparently so. Cases have arisen in the writer's knowledge where certain networks were stated to have reached saturation point, but wishing to connect new load, many hundreds of kilowatts of cooking were added without strengthening the cables or meeting trouble. Why? Because electric cooking load is of high diversity. There is a certain village where over 200 6 kW cookers are installed, yet the maximum load on the feeders at any one time does not exceed 120 kW, this demand occurring at a time when the central station needs the load, *i.e.*, midday. There are many instances of this nature, but those given will suffice for the moment. Station capacity very seldom enters into the question, as this is usually adequate for immediate needs.

The Question of Cookers.

What of the cookers, how are these to be disposed of—sold, hire-purchased, or hired? This, of course, depends upon local conditions. If load is rapidly required, hiring should be adopted. These powers are given to all undertakings in the 1919 Act. If slower progress is desired, cookers may be hire-purchased, and if the district permits it, and still more moderate progress is the order, selling only should be adopted.

If it is decided to secure load quickly cookers should be supplied by simple hiring. Substantial and reliable cookers for families of four to six persons can be obtained in reasonable quantities from £9 to £12 each, rentals from 30s. to 40s. per annum are a sound proposition. The maintenance is not very serious; on a number, 100 or over, it will average approximately 10s. to 12s. per cooker per annum. Certain cooker manufacturers are prepared to support electricity supply authorities by offering maintenance schemes which, to a large extent, relieve the authorities of anxiety. This is a step in the right direction. Upon this basis the rental pays the maintenance costs and returns roughly 10 per cent. upon the outlay. Not this, however, but increased consumption is the direction in which substantial gain should be looked for. From careful observation, extended over a long period, it is found that the electric cooking load provides a return of approximately 320 to 350 kWh per annum per kW installed. Therefore, taking as an illustration, a station with 500 6 kW cookers on the mains, this will account for roughly 1 000 000 units per annum, the *M.D.* being approximately 300 kW amd *off peak*. The greatest advantage of the cooking load, however, is in the fact that slackness of trade and industrial troubles do not materially effect it, as people must eat, and it is the electricity supply industry's business to see that as many people as possible eat food cooked by electricity. Compare this load with a works providing an *M.D.* of 300 kW, when a strike or lock-out occurs, and the whole load is lost until the difficulties are settled. We cannot afford to proceed along these lines, as it allows too much capital to lie idle.

Result of Cultivating the Domestic Load.

If we inspect the load curve of an average gas works it will be found that Sunday's load is, in the majority of cases, heavier than any week day. This is a result of cultivating the domestic load. A similar condition cannot yet be expected in the electricity station, but there is no reason why a start should not be made to bring about such a tendency. It will not cost the householder more to cook electrically than by his present method, providing, of course, tariffs are designed to stimulate progress, and this being one of the essential features there should be no doubt about it. The restaurants, hotels, &c., also offer a good proposition, and it is worth the effort to secure their business.

No doubt, the question passing through the minds of my readers is, how are we to secure this business? By carefully planning the district, concentrating upon its development by practical demonstrations in the showroom and the home, the free use of suitable literature from E.D.A., the "will to do" and showing the courage of our own convictions by employing electricity freely in your own home, as an encouragement to others.

Briefly these are the outlines to follow. Every supply authority, however small, could add a little to its mains and, even if only for experience to base future developments upon, let a start be made. It's worth while.

An Interesting Type of Switchgear.

A correspondent who has recently visited "Jaarmarkt," Utrecht, Holland, gives some details of a number of outdoor sub-stations for the 10 000 V system installed in that district. The system covers

Fig. 1.—A Small Outdoor Sub-Station.

a fairly large area and the cables are run to feeder points, where a three-unit switch allows a branch cable to be taken off and any of these cables to be connected or disconnected. About forty of

Fig. 2.—The Switch Ready for Operation.

these small self-contained sub-stations are in use in the district, some in buildings, but the majority are simply placed by the roadside in the splendidly wooded neighbourhood.

The arrangement employed seems to be entirely rainproof, and many of the pillars are erected with a simple wrought-iron cover, which must be removed before the switches can be worked, but most of them are housed in neatly-designed pillars allowing the handles to be exposed as soon as the door is opened. There is room in the pillar for a testboard and a telephone. It is stated that automatic devices can, if desired, be fitted to the switches. We understand that this gear is not only popular in Holland, but also in Belgium

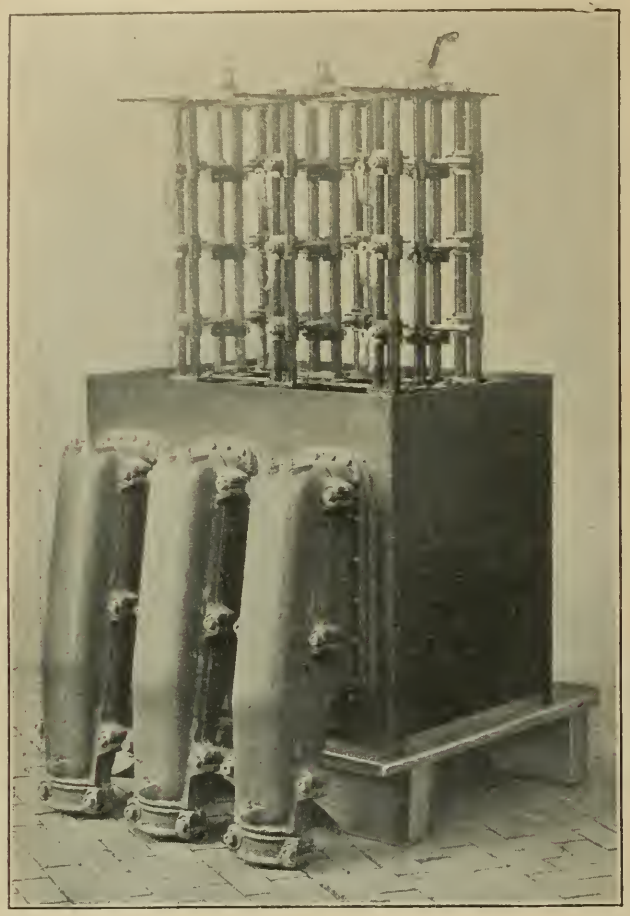


Fig. 3.—A "Close Up" of the Switch Used.

and Denmark, and in all there are about one hundred of these sub-stations in use.

The makers claim that the cost of this gear is so reasonable that it will be employed where, up to now, the expense of a building has made a project impossible.

From the illustrations it will be seen that each switch is fitted with three cable sealing boxes, where the three three-phase cables are brought in. Inside at the back of the tank are fixed three busbars, to which the three cables are connected through the three pole switches, the unit is therefore a complete sub-station in itself. Five-unit switches and single-unit switches are also standard, and the gear is made up to 10 000 and 20 000 V. Fig. 1 shows one of the simple switches by the roadside. Fig. 2 shows a similar switch with the cover lifted, ready for operation; and Fig. 3 gives some further details.

Miners' Blindness.

The committee recently appointed by the Medical Research Council to inquire into the causes and prevention of miners' nystagmus have published a first statement of their findings. They are unanimous in the opinion that the CHIEF CAUSE OF THE DISEASE IS DEFICIENT ILLUMINATION, due to the low illuminating power of the safety lamps generally used by coal-miners, and they recommend that everything possible should be done to make the standard of illumination of the objects looked at by the miner equal to that of an open-light pit by greatly increasing (to about two or three candles) the illuminating power of safety lamps as ordinarily used, or by the use of an electric light capable of being fixed on a miner's head, belt, or other convenient position, so that the light is automatically brought nearer the working area and does not impair clear vision by shining directly into the eyes. Such a lamp, in fact, has lately been perfected by Mr. F. J. Turquand, of Turquand & Kew, and we propose to give full details of it in a subsequent issue.

Correspondence.

CHANGING TUNGSTEN TO HELIUM GAS.

To the Editor of THE ELECTRICIAN.

Sir,—Apropos of the note on "Changing Tungsten to Helium Gas," in the issue of THE ELECTRICIAN of March 17, 1922, p. 322, it may be interesting to quote one paragraph of my Vice-Presidential address, delivered at the Columbus, Ohio, meeting of the American Association for the Advancement of Science, in August, 1899, and published on p. 778 of the issue of THE ELECTRICIAN of Sept. 22, 1899. The statement quoted follows a consideration of electric furnace temperatures.

A superior limit is, however, already set for us by the vaporization of all known substances, no materials for lining the furnace being available, not subject either to fusion or vaporization, thus using up the energy which would otherwise go to increase the temperature. A suggestion as to a possible extension of temperature range may be made here. It may be requisite to work with closed receptacles under pressure, and to discharge through them electric currents of so great energy-value as to attain almost instantaneously the highest temperatures, to be maintained for only a very short time. We may imagine a huge condenser charged to a potential of, say, 10 000 V as discharged through a limited body of gas contained in a small space within a strong steel tube which has a lining of refractory non-conductor. The energy may thus possibly be delivered so suddenly to a very limited body of material as to result in a momentary elevation of temperature passing all present known limits and capable of effecting profound changes in molecular constitution. We need all possible extension of the limits of research in this direction in order to discover some clue to the relations which the chemical elements bear to each other. The limit of possible strength of the containing receptacle, or some unforeseen factor, would probably set the new bounds. The point to be here enforced, however, is that far beyond any increase of working range in temperature obtained in any way, there must still exist a further range unattainable by our best efforts and possibly for ever outside of the field of experimental research. Our knowledge of this higher range can alone be derived from a study of the actions going on in the stars and nebulæ.

It may be interesting, also, while on the subject, to call attention to the fact that very early in the history of electricity, very heavy condenser discharges were produced and known, and a special instance of which was the production of the so-called "Tylerian" machine used by Van Marum, and well known to the students of the early stages of our science. It is recorded, in connection with this machine (which was a large example of the plate type frictional) that the battery used by Van Marum with the machine consisted of 100 jars, each 13 in. in diameter and 2 ft. high, the total coated surface of which aggregated 550 sq. ft. It instantly deflagrated small iron wires 25 ft. long, and vaporized various metals placed in the path of the discharge. Blocks of hard wood 4 in. square were split into fragments. This is interesting as probably the first instance of the use of a large capacity discharge.—I am, &c.,

West Lynn, Mass., April 11, 1922. ELIHU THOMSON.

A Metallurgist on the Electric Furnace.

Mr. F. Rowlinson, lecturing on the present and future scope of the electric furnace in the manufacture of tool steel before the members of the WEST YORKSHIRE METALLURGICAL SOCIETY recently, said that it was no exaggeration to say that the electric steel furnace had had, and would have, as great an influence on the metallurgy of steel as had the processes of Huntsman, Bessemer, Siemens, Martin, and Thomas. In this country at least the electric furnace was at present under a cloud—more particularly because of the high cost of energy, because of unsatisfactory work turned out by half-trained operators who had not the experience in electric steel that the old-timers had in other processes, and chiefly because of the extravagant claims of some of the pioneers. It was still true that quality of the finished steel depended mainly upon the ingredients put into it, and not on what was refined out of it. The old crucible steel-makers, therefore, chose their materials from the best in the world—the best steel-making Swedish irons, the best Sheffield blister bar, every piece hand-fractured and graded, the best Swedish white irons, and the best Sheffield tool scrap. To this day the finest tool steel in the world—Sheffield crucible steel—was made only from the most expensive materials of unquestioned purity and quality. Comparing conditions in the electric tool-steel industry, the lecturer said the electric furnace was a superb refining agent. Material of only moderate purity was charged, and a steel was produced which on analysis and in appearance was exactly equivalent to the best crucible steel. But trial soon showed that it was deficient in quality. It lacked that indefinable "body" possessed by a high-class crucible steel. The claims that the electric furnace could be charged with any old scrap, provided it was steel, and that by clever chemical manipulation and elaborate refining a tool steel of the finest quality could be produced, had done incalculable harm. The electric furnace could produce tool steel equal in every respect to the finest crucible steel, but the necessary precautions must be those taken in the making of crucible steel.

Electric Traction in South Africa.

A White Paper issued by the Government of the Union of South Africa contains reports on the ELECTRIFICATION OF THE NATAL MAIN LINE by the General Manager of Railways and Harbours (Sir Wm. Hoy), and by the consulting engineers (Messrs. Merz & McLellan), together with estimates of cost, annual charges for working and maintenance, &c. In our issue for December 9 last we were able to announce that the Government had decided to proceed with the electrification of the Pietermaritzburg-Glencoe section, and at the same time we gave some particulars of the engineers' proposals.

In his report Sir Wm. Hoy supports Messrs. Merz & McLellan's recommendation to start with the section from Glencoe Junction to Pietermaritzburg (a distance of 171 miles), instead of the Durban-Pietermaritzburg portion, and he also endorses the view that the best means of improving the capacity of the Natal main line is by electrification. The line north of Pietermaritzburg is very congested, and relief is urgently needed, but the section between Durban and Pietermaritzburg is not so urgent, and it can be undertaken when financial considerations permit.

Duplication No Remedy.

The duplication of the railway north of Pietermaritzburg would enormously increase the capacity of the line, but it is not a remedy for present difficulties. Electrification would give practically the same relief as doubling and in as short a time as if the latter remedy were chosen, and, in addition, electrification offers the advantages of improved working conditions and reduced operating costs. Messrs. Merz & McLellan estimate that the electrification of the Pietermaritzburg-Glencoe Junction section would save £237 510 a year in working expenses, compared with steam traction. The cost of electrifying the section on the basis of a down load of 30 000 tons gross per day is estimated at £4 453 690, with a liberal margin for development. During the four months of last year which showed the highest traffic movement, the average traffic carried in a downward direction over the busiest section of the main line was only 18 369 tons gross per day. It will, however, be possible, over short periods, to carry a greater tonnage than 30 000 tons per day, and the power station will be designed so that it can be readily extended as required.

Sir William Hoy thinks it inadvisable to purchase locomotive equipment to deal with more than 20 000 tons at the outset, and new electric locomotives can be ordered as required. The locomotives that will be ordered will be able to deal with a greater traffic over short periods. This reduction in the number of locomotives reduces the cost of locomotives, plus contingencies, to £1 005 000 and the total expenditure to £4 183 000. Provision is, however, being made for the full scheme so that additional locomotives may be obtained as required.

The power station will be equipped to meet the industrial as well as railway requirements. It is thought that the power station and transmission lines will be taken over by the proposed electricity authority in the Electricity Bill, which will be introduced into Parliament this session. By providing for an industrial load the Administration (or the electricity authority) will be able to supply current along the route of the railway and at Pietermaritzburg for municipal and industrial purposes. The site of the power station has not yet been determined, but it will be conveniently situated in relation to the section of line to be electrified and to possible future expansion. If the power station and transmission lines (estimated to cost £1 534 690) are taken over by the electricity authority, and as locomotives would have to be purchased in any case, the total additional capital cost to the administration of the electrification scheme will be £1 643 310.

Branch Lines to be Electrified.

When the proposed electrification is finished, other sections, such as that from Glencoe Junction to Tendega and from Durban to Pietermaritzburg should also be electrified. The sections Glencoe Junction to Pietermaritzburg and Glencoe Junction to Tendega are the only sections on which, in the absence of electrification, traffic developments will entail heavy expenditure in the near future on track improvements beyond those already in hand. The Glencoe Junction—Tendega line is ideal for electric traction. If development continues on this section at the rate at which it has been proceeding recently, relief will be needed at a comparatively early date, because of the heavy grades and the difficult conditions of working under steam traction. The estimates provide for electrifying both tracks between Pietermaritzburg and Merrivale and a single track beyond to Glencoe Junction, except for the short length of double track between Ladysmith and Daimana Junction, and the proposed double track between Umbulwana and Ladysmith. A double track is not a necessity for through traffic under electrification, and, except where parallel doubling already exists, the old route between Pietermaritzburg and Merrivale will not be used except for local traffic. It cannot be abandoned because of the vested interests and residences that have grown up around it. The old line can, however, be lifted between Merrivale and Nottingham-road and between New Leigh and Estcourt, though the latter should be retained for a time as a safeguard against further landslides or washaways on the new line. The Nottingham-road—Merrivale improvements had to be taken in hand in view of the delay in proceeding with electrification.

Advantages of Electric Traction.

There are numerous tunnels on the Natal main line which render electric traction necessary, and with electric working the liability to grass fires will cease. When the main line is electrified, it will be possible (Sir Wm. Hoy thinks) to equip at a comparatively small expense some of the more important and difficult adjoining branch lines. Overland coal for the Cape Province has to be sent *via* Volksrust—Germiston—Fourteen Streams whenever the traffic exceeds a certain tonnage, owing to the difficulty of working trains over the Van Reenen Pass. The time-table load for a coal train up the Pass is 300 tons with a branch line Mallet. If the line over the Pass were electrified it would simplify and considerably cheapen through working between Natal and the Orange Free State. On the Greytown branch difficulty has been experienced from time to time in working the traffic. This line is heavily graded, and if traffic continues to expand, it will be necessary to spend large sums in re-location and regrading. This line could be electrified at comparatively small expense, and the cost of re-location and regrading saved. The Cape—Natal line is a very expensive line to work, because of severe grades and curves, and the advisability of electrifying it should be investigated. The short Howick branch (2½ miles in length) could be electrified very cheaply as no sub-stations would be required. This line is very expensive to work under steam, and it should be electrified as part of the present scheme. The cost is comparatively small, about £7 500.

Delays through derailments and engine failures would be avoided by electric traction, and other advantages would also accrue. In addition, the national aspect of electrification is very important. The industrial advantages will also be great. Electrification will provide all along the railway a trunk electrical line, from which power can be distributed for industrial and other purposes. It will also open up great possibilities for by-product production at the power stations from waste coal; and Sir William Hoy recommends that Messrs. Merz & McLellan be asked to consider the advisability of designing the power station so that the necessary plant can be added for by-product recovery as soon as practicable.

Electric Safety Lamps.

The "VAG" ELECTRIC SAFETY LAMP has been approved for use in all mines, subject to the conditions set out in the Order of March 31. Including the lamps in the present list, there are now twenty-six approved lamps for general use and thirteen for use by officials or for special purposes only.

The "Vag" miners' electric safety lamp comprises: (1) An accumulator case of pressed steel, lead lined and strengthened by transverse ribs. A steel ring at the top of the case provides a bayonet joint for attachment of the cover. (2) A two-cell accumulator, with casing of celluloid or of ebonite with celluloid top, for use with either (*a*) semi-solid electrolyte, or (*b*) liquid electrolyte; in the latter event it is fitted with a device for preventing the escape of liquid whatever the position of the lamp, whilst allowing for the release of gases. The terminals are of the spring-plunger type, and the capacity of the accumulator is 4·5 Ah with a voltage drop to not less than 3·6. (3) A cover or lantern, which can be attached to the case by a bayonet joint. The lantern carries a lampholder with dome-shaped reflector mounted on a disc of ebonite or other non-inflammable insulating material, in which are embedded contact pieces of brass, which make electrical connection with the terminals of the accumulator. The lampholder is held in position by a bayonet ring. The lamp-bulb is protected by a dome-shaped cover-glass, with four steel pillars and a steel crown piece. The current consumption of the bulb is 0·45 to 0·5 A. (4) A magnetic lock.

Approval is subject to the further conditions:—(i) That the total weight of the lamp is not more than 6 lb. 10 oz. (ii) That the strength of material and attachments throughout the lamp is not less than in the samples submitted for official test. (iii) That the lamp shall be capable of maintaining a light of not less than 1 c.p. all round in a horizontal plane for not less than nine hours, and also of giving a light of not less than 1·5 c.p. over an arc of 45° in a horizontal plane. (iv) That the lamp has been made at the "Venta" Accumulator Works (Leipzig). (v) That the integral parts of each lamp shall have marked upon them the name or distinguishing mark of the lamp; and that the case shall also bear the name of the maker.

Lamps for Special Purposes.

The following electric safety lamps have been approved for use by officials, or for special purposes only:—

The "Wefco" officials' electric hand lamp (Watts, Fincham, & Company, Ltd.) has an alkaline accumulator with a steel casing and fixed spring terminals. The current consumption of the bulb is 0·95 A, and the lamp is capable of giving 1·5 c.p. over an angle of 45° in a horizontal plane for nine hours.

The "Ceag" bull's-eye lamp No. 2 ("Ceag" Miners' Supply Company, Ltd.) is a modification of the "Ceag" electric lamp bull's-eye type, and the specification of that lamp applies generally, except that the case is shorter, and the accumulator is therefore shorter and of smaller capacity. The capacity of the battery is not less than 4·5 Ah, with a voltage drop to not less than 1·9 V, and the current consumption of the bulb is not more than 0·5 A.

The "Ceag" bull's-eye lamp, type 3 ("Ceag" electric torch), is intended to be used in conjunction with another approved lamp capable of maintaining the required light during the required number of hours.

The Miners' electric hand lamp, type H 1 (Patterson & Company) comprises a cylindrical accumulator case of cast aluminium screwed at the top to receive the cover; a cover or lantern of aluminium, containing the bulb-holder and contact-plate. The current consumption of the bulb is 0·50 A. There is a two-volt lead-acid accumulator, with celluloid casing, so constructed as to prevent escape of liquid whatever the position of the lamp whilst allowing escape of gases. The capacity of the accumulator is not less than 5 Ah, with a voltage drop to not less than 1·8 V. A lens is held by a screw from within the cover, and a lead plug lock is similar to that approved for Pattersons' miners' electric safety lamp, type G 1.

Stonework Cubicle Gear at Southport Power House.

Owing to the increasing demand for electric power in the Southport district considerable extensions were recently made to the Corporation station. In connection with these extensions an order was placed with the General Electric Company for a large quantity of h.t. switchgear to be installed in stonework cubicles, two 500 kW rotary converters, together with the necessary synchronising panels and d.c. switchgear for these machines. The h.t. switchgear was

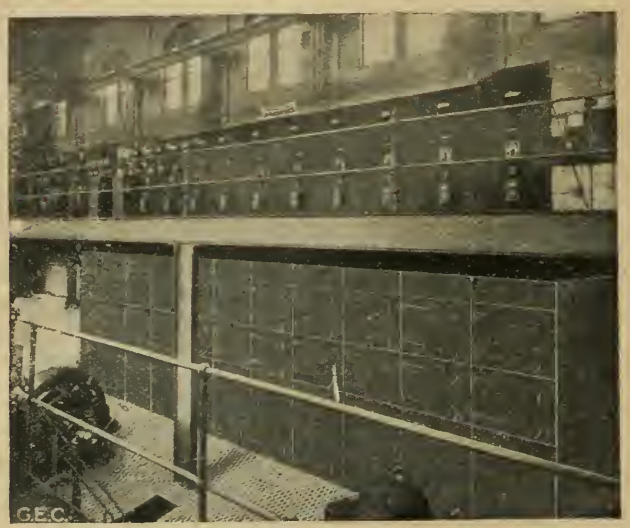


Fig. 1.—General view of 6 600 V G.E.C. cubicle Switchgear and Mechanical Remote Control Operating Board.

required for the control of three 3 000 kW turbo-alternators, the h.t. side of the transformers supplying the two 500 kW rotary converters, three 1 500 kW, and two smaller feeders. The voltage of the apparatus was 6 600, and, as already indicated, the busbars, isolating links, instruments, transformers, oil switches, &c., were accommodated in stonework cubicles. These were erected in a semi-basement, the oil switches being operated from a mechanical remote control board

Fig. 2.—Interior view of cubicle controlling h.t. side of Transformer.

on a gallery immediately over the cubicles. A good idea of the arrangement can be obtained from Fig. 1, which also shows part of the rotaries in the foreground, and the rotary switchgear on the left of the control board.

Isolation Arrangements.

In accordance with the general practice for this type of switchgear the cubicles were divided into compartments by stonework partitions in order to isolate the various units of apparatus to the greatest practicable extent, thereby ensuring the highest possible degree of safety. Thus, the top compartment contains the busbars, this compartment being sub-divided by stonework slabs so that each bar is in a separate cell. Immediately below the busbars is a compartment with isolating links, while the two lower compartments contain instrument transformers and oil switches respectively. The above arrangement is clearly shown in Fig. 2, the cubicle shown controlling the h.t. side of the transformers supplying power to one of the rotaries.

A Fume-Tight Insulator.

An interesting accessory used between the various compartments is a special type of fume-tight insulator, which effectively prevents any gas which may be generated in the oil switch compartment, due to a short circuit, spreading to the other compartments. The oil switches are of the G.E.C. type III., with the usual overload trips and time-limit fuses. The speed of break of such a switch is over 10 ft. per second. Careful attention has been given to the mechanical design of these switches, so that they may be able to withstand the heavy stresses set up should a short circuit occur on the system. It should be noted that no porcelain is used in tension. The instrument transformers were made at the G.E.C. Chamberlain & Hookham Works. They are bolted to stout bars fixed in the appropriate compartment. The secondary l.t. connections are run in conduit to the instruments on the control board. The cubicles are protected with strong steel doors, each fitted with a stout padlock.

A slate flat-back type of operating board was adopted. On this is mounted the oil switch operating handles, also the necessary indicating and measuring instruments. Connection is made from the operating handles to the oil switches by a system of bell cranks and levers. The 500 kW rotary converters are of the standard G.E.C. self-synchronising design for reactance control, the d.c. voltage being 500/550 and the speed 1 000 revs. per min. On the left of Fig. 1 is the switchgear for these converters. The G.E.C. patent self-synchronising panel affords an extremely simple method of starting. Only two elementary operations, controlled by a correct sequence device, are necessary. Another valuable point in the starting arrangement is that the main rotary current does not pass through the starting motor, but external reactances are provided on the back of the panel.

We are indebted to Mr. E. Moxon, the Borough Electrical Engineer to Southport Corporation, for permission to publish the information and photographs in this article.

"Heatrae" Fires.

The extensive range of stoves manufactured by Electric Fires, ltd., Norwich, is designed to meet every conceivable requirement, whether it be for the house, hotel, cabin, public hall, factory, or garage. The fires, which bear the trade mark "Heatrae," are manufactured in a modern factory, specially equipped for mass production, and care has been taken to ensure complete standardisation and interchangeability of parts.

A successful effort has been made to break away from the common

Interior of "Heatrae" Boiling Ring.

practice of using a solid mass of porcelain or fire clay as the basis of the heating unit. The body of the "Heatrae" fire-bar is constructed of a metallic alloy. It is claimed that the metal does not tarnish, and materially adds to the working efficiency. Another novel design is an electric boiling ring, the interior of which is shown in the illustration. It is made of steel, with fine cast-iron top grid, and embodies a reflector that increases the heating power.

At the Chapel-street Congregational Church, Southport, on Saturday, a demonstration was given of an instrument known as the Acousticon, which enables the sermon to be heard by persons of defective hearing. It is claimed that, whilst this invention is in general use in America, so far only one other church in Great Britain has had it installed, namely, St. Andrew's, Edinburgh, though one has been fixed at the Lyric Theatre, London. A small microphone is placed immediately behind the Bible desk in the pulpit, and attached to each of the pews in which the receiver is fixed is a miniature switchboard, which may be manipulated so as to strengthen or increase the volume of sound according to the degree of deafness of the user.

Wind-Power for the Generation of Electricity.

The problem of generating electricity by means of wind-power has always been an attractive one, and many attempts have been made to solve it. Some of the reasons that have, however, militated against the more general use of this form of power are that it has been necessary to employ large and expensive slow-speed windmills mounted upon towers of heavy construction, entailing considerable erection costs, and to drive the dynamos by means of gearing, with a consequent loss of power.

While it is true that, providing the wind wheels are of large diameter, power can be obtained with moderate winds, it is necessary for arrangements to be made to stop the machine when the velocity of the wind exceeds 20 to 25 miles per hour to obviate the possibility of wreckage, and also to prevent the storage battery from being damaged by reason of it being charged at a higher rate than that for which it is designed. It has been impossible, therefore, to take advantage of the power available from high winds and gales, which is obtainable from windmills in proportion to the cube of the velocity of the wind, without the great expense of construction of the windmill, battery, and dynamo.

Dynamos of High-Speed Winds.

In order to overcome these disadvantages a system for the generation of electricity by means of AUTOMATIC HIGH-SPEED WIND DYNAMOS has been designed by F. A. Wilkinson & Partners which,

A TYPICAL WIND INSTALLATION WITH OVERHEAD LINE TO BATTERY.

while the output obtainable from the dynamos is not a large one, becomes appreciable when used for charging storage batteries over long periods, the result being exactly the same as that of correspondingly charging a storage battery at a normal rate for a short period.

The general arrangement of the automatic high-speed wind dynamos for battery charging is shown in the illustration. The system comprises a number of dynamos with direct-coupled impellers, mounted upon a tubular crossbar, fitted with a swivel head and wind-direction vane, which causes the impellers always to face the wind.

The improvement, which is a vital one, consists mainly in the employment of a dynamo having a field magnet system, which rotates in the opposite direction to the armature under the agency of its own direct-coupled impeller. This is found, in practice, to result in an output very considerably greater than that obtainable from the ordinary rotating armature dynamo of the same size. The installation is supported by a vertical tube, which may either be sunk in the ground or mounted upon the roof of a building.

Technical Details.

Each dynamo is rated at 100 W, and battery charging is commenced in winds of 15 miles per hour, the output and speed increasing with the velocity of the wind. The dynamos have laminated fields, and are self-regulating for battery charging purposes. They are of the ventilated type and are enclosed in removable steel cases. Ball bearings are fitted to both the armatures and also to the revolving field magnet systems, the lubrication of the machines thus requiring but little attention. To enable the rotating connections of the armature and field magnets to be readily coupled up to the battery, each dynamo is provided with a multiple contact plate and a terminal board, upon which carbon brushes fitted in spring holders are mounted.

A feature of the system is an automatic cut-out which requires no electrical energy for its operation, the connection and disconnection of the dynamo to and from the battery being automatically effected and governed by the velocity of the wind, thus saving some three or four W required by the usual type of automatic cut-out. One of the dynamos of the installation is arranged as a "control" dynamo, and upon its armature shaft is fitted a sleeve free to move in a lateral direction. Mounted upon this sleeve is a contact plate, while a terminal board provided with adjustable contact fingers is attached to one of the end plates of the machine. When the velocity of the wind is sufficient the contact plate is forced against the contact fingers, making the necessary connection between the dynamos and battery, and conversely breaking the connection when the wind falls below a predetermined value.

Tucker Switches,

The switch which we illustrate has recently been placed on the market by J. H. TUCKER. It shows a marked advance upon the type of quick make and quick break switch in which the action relies entirely upon the spring, or which has only an "initial" positive action which may allow the switch arm to be withdrawn from the contacts, but only sufficiently just to clear them without breaking the "arc." Recognising the "necessity" of a complete positive make and complete positive break, the firm, for the past two years, have been engaged on producing a combination embracing these features.

The spring is of the compression type, enclosed in a specially-designed chamber, forming in itself a complete "spring unit." In the unlikely event of the spring breaking, it is still contained within the chamber and continues to function. A direct drive (quite apart from the spring or the spring chamber) is obtained from the switch "dolly" to the contact arm, in such a manner as to cause the latter to travel its full extent in either direction. The switch can consequently be placed in its correct "on" or "off" position, even if the entire spring mechanism is removed.

THE NEW SWITCH.

In addition to the features already mentioned there are many minor improvements in this new switch. The contact clips are specially designed to give even contact to the switch arm, and are of flexible hardened copper, permanently fixed in their correct position by heavy brass clamping plates. To prevent the possibility of arcing across the contacts, an exceptionally high and wide dividing wall of china has been employed. The contacts are placed well away from the switch bridge and cover so that arcing on to any dead part of the switch is impossible.

With the object of obtaining a clear wide break, the cable clamping screw in the terminal has been reversed, so that it is impossible for this to shorten the arcing distance when the switch breaks, as it does not project towards the contacts. The reversing of the screw will also be appreciated by contractors generally, as it gives ample room for manipulation by an ordinary screwdriver without the risk of damaging the china.

Faraday Entrance Scholarships.

As a result of the Entrance Scholarship Examination held at FARADAY HOUSE ELECTRICAL ENGINEERING COLLEGE on the 11th, 12th, and 13th inst., the following awards have been made:—

R. W. Griffin, County School, Beckenham, the "Faraday" Scholarship of fifty guineas per annum, tenable for two years in college, and one year in works.

D. Moody, Central Foundation Boys' School, London, the "Maxwell" Scholarship of fifty guineas per annum, tenable for one year in college, and one year in works.

W. Swindells, Municipal Secondary School, Brighton, an Exhibition of thirty guineas per annum, tenable for two years.

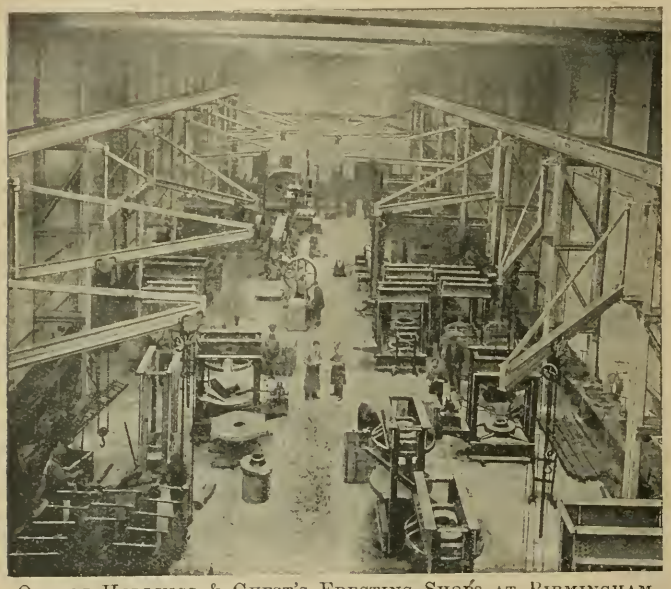
J. K. Watts, Aldenham School, an Exhibition of thirty guineas per annum, tenable for two years.

J. W. Bailey, Elizabeth College, Guernsey, an Entrance Prize of twenty guineas

D. F. Gover, Dulwich College, an Entrance Prize of twenty guineas.

Building Hydraulic Machinery Electrically.

The lay-out and organisation of a modern engineering shop so as to get a maximum of production is a subject of much interest, and we need not apologise for giving some details of a large erecting shop in the works of Hollings & Guest, Ltd., Birmingham. This shop, which we illustrate, is 200 ft. long, and 60 ft. wide. It is well lighted and well equipped for the purpose of dealing with the erection of hydraulic presses, pumps, and accumulators of all kinds in which this firm specialise. The shop is served by a 20 ton electric overhead travelling crane, with an available head room of 25 ft. under the crane. In addition to this the shop is also fitted



One of Hollings & Guest's Erecting Shops at Birmingham.

with fourteen light jib cranes spaced at intervals down each side of the shop, and these cranes are capable of dealing with loads up to 30 cwt. so as to prevent any delay in waiting for the large crane. This ensures that there is no waste of time in the production of the work. The shop is also equipped with a well-laid-out marking-off table of a large size, and also testing apparatus for testing hydraulic cylinders of all capacities and pressure. It is further equipped with a light erecting pit, which can be uncovered in sections for use as required.

A variety of machines in the course of construction can be seen in the illustration. In the foreground are a number of the firm's well-known hydraulic tyre presses, some completely finished, and others partially so. In the centre of the shop can be seen a belt-driven hydraulic pump, and at the far end, towards the left, may be seen another large and powerful press used for joggling plates, as used in the shipbuilding trade. A number of hydraulic girder frame baling presses, of which details have been given in The Electrician, in various stages of progress can also been seen. It may be mentioned that Hollings & Guest, Ltd., specialise in the girder frame type of hydraulic presses, as well as being makers of the old type of four-column press.

One corner of the shop is entirely devoted to the manufacture of gas-heated enamelling stoves, which is an important branch of the firm's activities, and is fitted for this purpose with power-driven punching and shearing machines.

Electric Butt-Welding.

The Whitlock Coil Pipe Company, Hartford, Conn., who for about two years have been employing electric butt-welding for steel and wrought-iron pipe, have found, states the "Times" Trade Supplement, that the time required to make the welds is practically dependent upon the current only, the higher currents requiring the shorter time and also giving the strongest welds.

The cost of a typical butt-weld in 1¼ in. extra-heavy pipe was 15c., including labour, material and energy. By the hand methods formerly employed approximately 45 minutes were required, as compared with an average of 38 seconds when butt-welding with 180 A. Another advantage of this method over arc or oxy-acetylene welding is that the original material is used for making the joint. In a number of tensile tests on butt-welds made at these shops the pipe was torn in every instance before the weld was damaged in any way.

The butt-weld is made by cutting a female scarf in each pipe and then pressing the ends together under an oil pressure of 5 tons while the current is passed through the joint. As the current heats the ends to be welded the scarfed portions are forced outward and the area of the weld is increased over the annular area of the pipe. The inside of the pipe is left smooth and clean without any constriction. The only objection is that the outside diameter of the pipe is increased at the weld, and it is thus impossible to use the pipe in spiral or other coils made on a former which is shaped to fit the ordinary outside diameter of the pipe. Lap welding with a mandrel is employed where it is necessary to obtain a weld without any reduction of the bore or enlargement of the outside diameter.

Country House Lighting Sets.

The design of country house lighting sets seems now to have settled down to well-recognised standards, and it is seldom that any strikingly novel features are developed. But the semi-automatic switchboard which forms part of the set made by the Alden Engine Company has a certain number of features which differ from the usually accepted standard for small plants. Briefly, the sets are made in four sizes, namely model "A," ¾ kW, 25 V, with 120 Ah battery, rated for 30 lights; "B," 1½ kW, 50 V, with 120 Ah battery, 60 lights; "C," 2 kW, 50 V, with 200 Ah battery, 100 lights; "D," 2½ kW, 100 V, with 120 Ah battery, 130 lights.

The engines employed are of the vertical paraffin type, but run at the comparatively slow speeds of 500 to 600 revs. per min., making them suitable for general work in addition to generating. The usual arrangement is a belt drive to the dynamo, though as an alternative the generating sets can be supplied direct-coupled. The capacity of the batteries is at 10-hour rate down to 1·85 V. The glass boxes have open tops, and the plates are Planté type.

The Alden plants are supplied either hand-operated or semi-automatic, the makers favouring the former method; but their semi-automatic board differs appreciably from the usual run of such boards with their rather meagre equipment of instruments, in that it embodies quite as full a range of instruments as a hand-operated board, viz., 3¼-in. dial ammeter (charge), 3¼-in. dial ammeter (discharge), voltmeter, 2-way and "off" voltmeter switch, 6-way regulating switch (charge), 6-way regulating switch (discharge), s.p. dynamo switch and fuse, s.p. lighting switch and fuse, shunt regulator, semi-automatic starting switch.

The illustration shows a 1 kW switchboard which is designed for 50 to 55 discharge V. By its means the following operations can be performed: charging the battery, starting the generating set off the battery, lighting from the battery, simultaneous charging and lighting, direct lighting and power from dynamo.

To start the engine from the battery, both knife switches are closed and the left-hand (charge) battery switch is turned on to the top stud. The starting switch arm is then moved slowly and steadily over the contacts until it is held by the series "hold-on" coil. The dynamo, working as a motor, will now begin to run,

The 1 kW Switchboard.

and when the engine picks up will start to charge the battery. When the battery becomes fully charged the series coil becomes de-magnetised, and allows the starter arm to fly back to the first stud, this arm being fitted with a phosphor-bronze brush, which, when the arm is in the "off" position, locates between and short-circuits two brass studs connected with the magneto.

The overall size of the panel is 21 in. by 16 in., and it is mounted separately upon an angle-iron frame from the floor, not upon the dynamo or engine. Although the range of instruments and the means of regulation on this switchboard are so full, the total price of the set is not increased on this account.

An invention designed to make the detection of fire-damp possible with the electric hand lamp is at present undergoing tests at the Home Office. The invention comprises a small attachment for use with the lamp which enables the user to note the actual amount of fire-damp, which can be easily read from a scale. In the development of the invention there is a device which gives an automatic alarm, either by flashing a signal light or operating a bell or hooter, as soon as the fire-damp reaches a dangerous point.

Legal Intelligence.

Fraudulent Consumption of Electricity.

Gideon George Grieve and Archibald A. Manges, carrying on business as electrical and mechanical engineers at West Bute-street, Cardiff, were charged at Cardiff Police Court on Friday last with laying an electric wire to the Corporation supply main so as to obtain electricity without it passing through the meter, with using such electricity, injuring the meter and the fittings, and with culpable negligence and wilfully injuring the fittings and using the electricity without the consent of the Corporation electricity department.

Mr. Kenvyn Rees, who prosecuted on behalf of the Corporation, stated that defendants made application for a meter to be installed. There was a meter on defendants' premises, and this was connected up and the various fittings and fuses sealed up. The first reading, up to Dec. 8, showed that they used 15 units, on Jan. 15 the metre recorded 64 units, but on Feb. 13 the meter recorded nothing. It was then found that the meter was "blown," and it was evident that defendants had tried to get through the meter more power than it would carry, with the result that the coil burst. The seals on the Corporation fuses had been broken and a fuse, capable of carrying more electricity, had been substituted. A wire had been connected by which electricity could be consumed without passing through the meter. By another wire defendants could get electricity for heating purposes. The men sold electric supply and electric heating apparatus, and it was assumed they had been demonstrating these goods to probable purchasers without paying for the current.

Frederick Geo. Barnard, electrical engineer employed by the Corporation, said the reason the meter burnt out was because an overload of current had passed through it. If consumption had gone on at the same rate as before there would have been approximately £2 worth of electricity used for lighting only, but that did not include any current which might have been used for heating or any of the extra supply which burned the meter out. The cost of replacing the meter would be £3 10s.

Defendants pleaded guilty to fraudulently and feloniously consuming the current, and on this count the stipendiary magistrate (Sir Thomas Lewis) fined them £50 each, or three months' imprisonment, and ordered the withdrawal of the other charges.

Marconi's Wireless Telegraph Company v. Hamilton.

On Tuesday the Court of Appeal dismissed the appeal of Mr. Hamilton against a refusal of Mr. Justice P. O. Lawrence to relieve him from an undertaking given by him in a former action. On May 3, 1920, Mr. Hamilton entered into an agreement with the Marconi Company and Mr. Godfrey Isaacs for compromising certain litigation. The agreement contained a clause by which he covenanted not to disclose the contents of the pleadings. On June 6, 1920, the Company and Mr. Isaacs commenced proceedings against Mr. Hamilton to enforce by injunction the covenant so entered into. The action was tried on October 20 without Mr. Hamilton pleading that the covenant restrained him in the exercise of his business or was contrary to public policy, and an order was made substantially in accordance with the relief asked for. Mr. Hamilton subsequently started an action to have the agreement set aside, alleging that it was obtained by certain misrepresentations by the Marconi Company and Mr. Isaacs; and that it was in undue restraint of his trade and against public policy. The Lord Chief Justice stayed these proceedings, but Mr. Hamilton was given an opportunity of taking proceedings in Chancery for the relief asked. Before taking those proceedings he moved Mr. Justice P. O. Lawrence in the original action to be relieved from the undertaking for the reasons stated. The Judge refused to make the order asked for, and Mr. Hamilton now appealed. The Master of the Rolls, in dismissing the appeal, said it would be unheard of to allow such an appeal where the contention was that the clause complained of was only on the borderline of public policy.

German Wireless Inventor in Trouble.

A German, named William Brandes, was charged at Sunderland on Saturday with having unlawfully broken the conditions of landing in the United Kingdom, and was remanded for a week in custody.

The police statement was to the effect that Brandes was the inventor of wireless apparatus for ascertaining the movements and distances of ships at sea, and for some time he had been in correspondence with persons in London, from whom he wanted £15 000 for the invention. He had come over on a schooner by working his passage, and got permission at Hartlepool to go to London on business. From correspondence found on him, his price of £15 000 was under consideration. He had gone back to Hartlepool too late to board the schooner for Germany. In the hope that a German vessel would be at Sunderland he had gone there, but, being unable to find one, he went to the police station and gave himself up. The man's invention was said to be a clever one, and it had impressed the persons to whom it had been submitted.

Gosforth All-Electric House.

An all-Electric Exhibition House has been open to the public in Gosforth since the 8th inst. The house is a semi-detached villa, and is one of fourteen villas which are being erected on the outskirts of Gosforth, one of the residential areas of Newcastle. The Newcastle-upon-Tyne Electric Supply Company had to extend their mains a short distance in order to give supply to these houses, but all the builders concerned agreed to wire the houses, and also put in one electric heating circuit before offering them for sale.

Following their usual practice, the Supply Company obtained the co-operation of a local furnishing firm and a firm of electrical contractors, and have given the house the title of The Home Ideal. The whole of the electrical installation has been carried out by Robson & Coleman, of Newcastle, who have wired all the houses for the builders, and supplied all the small electrical apparatus. The Supply Company have put in the large apparatus, such as electric cooker, electric clothes washer, dish washer, hot-water circulator, wash boiler, &c., and are giving daily demonstrations of electric cooking, vacuum cleaning, &c.

A luncheon was given at a private inspection for the exhibitors and press, the entire cooking for eight people being carried out on a Jackson No. 21 electric cooker.

New Method of Packing Rubber Wires.

From the beginning of the electric cable industry coils of vulcanised indiarubber wire have been wrapped for delivery in strips of hessian wound spirally around the coils. This method of wrapping has become, from long use, almost a part of the business of electric cable manufacture, and it, therefore, would seem to require a bold man to make a change. However, for some months now W. T. Henley's Telegraph Works Company have been experimenting with the packing of coils of V.I.R. wire in cartons and containers of strong fibre-board, and they now announce that all qualities in sizes 1/0·044 in. (0·015 sq. in.) and 3/0·029 in. (0·002 sq. in.) will be delivered in this improved manner in future. It will be extended to other sizes subsequently, and as soon as arrangements can be made.

The New Method of Packing.

To such an extent had the wrapping of coils in hessian become a custom of the trade that its disadvantages seem to have been generally overlooked. It undoubtedly costs the contractor a considerable sum per annum in wireman's time spent in slowly unwrapping the coils, and it also produces litter which must involve further cost in clearing up. Once a coil is unwrapped it is extremely unlikely ever to be wrapped up again, and so parts of coils left unused may suffer damage. In any case they would deteriorate in appearance and probably in value.

With cartons, the coils are very quickly unwrapped, the litter is infinitesimal and the carton can be used again for keeping portions of unused coils.

The company inform us that the cost to them of this new method of packing is higher than packing by hessian, but they are convinced that it will be such a great advantage and convenience to their customers that they are going on with it. Each coil is packed in a separate carton, and these in turn are packed in containers holding respectively three, four or five cartons.

The containers comply with the railway companies' conditions, and they can be sent by rail anywhere without further protection. Both cartons and containers are clearly marked with their contents, so the taking of stock at any time will be easy.

We show an illustration of the cartons and containers, and are informed that the same method has been adopted for packing "Henley" tape. In this case the cartons each contain 7 lb. of tape, and four of them go in a container.

Hackney Electrical Exhibition.

An interesting exhibition of electrical appliances for household use, organised by the Borough Council's Electricity Department, was opened at the Baths, Lower Clapton-road, on Monday, and will remain open until to-morrow (Saturday). A charge of 6d. is made for admission, which prevents overcrowding, but does not deter interested people from attending.

The Mayor (Councillor W. J. Parker), in performing the opening ceremony, referred in terms of admiration to the excellent progress made by the Council's electricity undertaking and the progressive policy carried out under the direction of the borough electrical engineer, Mr. L. L. Robinson. The department's charges for energy were now the lowest in the country.

The department's new tariff offers several alternative methods of charging, and one which is being especially pushed at present is the following: "In consideration of the premises being wired throughout for electric light, and a fixed charge of 2s. per quarter being paid for each 60 W lamp or equivalent installed, any quantity of electrical energy used per quarter will be supplied at 1d. per unit."

An announcement has been issued that the first twenty cookers ordered from the department will be supplied on trial for three months without any financial liability upon the consumer except to pay for the electricity used. Orders for ten cookers under this system were taken on the opening day of the exhibition.

Lectures have been given during the week by Mr. S. M. Hills and Mr. J. W. Beauchamp.

Some Particulars of the Exhibits.

Demonstrations of electric cooking are given at the stands of the British Electric Transformer Company and the Jackson Electric Stove Company. The former company shows, in addition to "Tricity" cookers, a variety of hot plates, radiators, irons, kettles, &c., while the latter exhibits electric fires and radiators, suction cleaners and other appliances. Other exhibitors are the Sun Electrical Company, who show the "Sunshine" electric cleaner, the "A.B.C." super-electric washer and wringer, table and hanging lamps with silk shades, and illuminated signs; Geo. Nobbs, Ltd., electric cookers, the "Genii" distilling apparatus, and electric coil boiler (which boils a quart of water in ten to fifteen minutes), an electric foot warmer, and the "Rayvac" electric cleaner; the Falkirk Iron Company, "Falco" cookers and double-ray table heaters and toasters, boilers, radiators, kettles and irons; the Carron Company, 2 kW electric fires, which, we are informed, were sold at the rate of 300 a day last autumn, a 6 in. boiling plate, sold at 20s. complete with flex and adapter, a 6 in. boiling ring, which consumes three-quarters of a unit per hour, and also larger rings and a hot-water circulator system; the Wholesale Fittings Company, a fine collection of hanging lamps with alabaster and opal bowls and silk and glass bead shades, flambeaux lamps supported by bronze figures on pedestals, the "Alto" ventilated enamelled steel shades, and the "Reflecto" semi-indirect light fitting with opaline bowl and white enamelled reflector; the British Thomson-Houston Company, sign lighting by floodlights, spotlight projectors with revolving and slide colour screens, a comparison of the "Trutint" artificial daylight unit, for colour matching, with ordinary carbon, gasfilled and vacuum lamps, pedestal and table lamps, and opal and alabaster bowls for semi-indirect lighting; the Hart Accumulator Company, batteries for motor-car starting and lighting, wireless, telephone and other purposes, and portable hand-lamps, with a 4 V accumulator giving 45 hours' light on one charge; Hotpoint Electric Appliance Company, cookers, washing and sewing machines, suction cleaners, radiators, &c.; Metropolitan-Vickers Electrical Company, electroliers and wall sconces with shaded candle lamps, pedestal and table lamps with silk shades, cookers, hot plates, &c.; Belling & Company, electric fires, cookers, hot plates, irons, "M.K." wall plugs and sockets, switch plugs and connectors; Holophane, Ltd., the "Holophane" daylight colour-matching unit contrasted with a light from a bare bulb, and a demonstration of "Holophane" light control, which has the effect of securing a better distribution of light on a given surface than that obtained with bare lamps, and a variety of bowls and shades; Frank Feesey & Company, the "Cascade" electric washer and "Cascado" electric ironer. The ironer is made with 44 in. and 50 in. rolls. Although the stands are confined to manufacturers, Messrs. Linzell Dickinson, & Company, of 7, Cazenove-road, Stoke Newington, are in attendance to hold consultations with visitors requiring the services or advice of contractors.

The Orwell Electric Truck.

A noticeable feature of the exhibition is Ransomes, Sims, & Jefferies' "Orwell" electric truck, which carries two tons at five miles an hour on the level, and is driven by chloride batteries of 129 Ah capacity. A special advantage of these trucks is the small radius in which they can turn.

Mr. Robinson states that these trucks have been found so useful for refuse collection that Hackney Council is buying a fleet of thirty.

There is a good assortment of literature on electricity for the household available at the exhibition, and there is on view a letter from Sir John Snell (the Chief Electricity Commissioner) praising the progressive policy of the Hackney undertaking, and referring specially to the pamphlet on "An Electric House" issued by the department, and consisting of a letter from a Hackney consumer which appeared originally in the "Electrical Times." This sets out the benefits the consumer has obtained by choosing the telephone system of charging, the saving secured on the butcher's bill by means of electric cooking, the reduction of coal consumption from eight tons a year to two tons, &c.

I.M.E.A. Yorkshire Centre: Annual Meeting.

The annual meeting of the Yorkshire centre of the I.M.E.A. was held in the Town Hall, Bradford, on Wednesday, April 5. Representatives were present from Barnsley, Batley, Bradford, Dewsbury, Doncaster, Halifax, Holmfirth, Hull, Leeds, Shipley, Spenborough, Wakefield, and apologies for absence were received from Bridlington, Grimsby, Harrogate, Huddersfield, Lincoln, Mexborough, Rotherham, and Sheffield. Mr. C. N. Hefford (Leeds), Vice-Chairman of the Centre, took the chair, in the absence of Mr. S. E. Fedden (Sheffield), the Chairman of the Centre, who was unable to attend owing to the death of a near relative. Councillor Longley, the Deputy Chairman of the Bradford Electricity Committee, apologised for the absence, owing to indisposition, of Alderman Turner, the Chairman of the Committee. He welcomed the Centre to Bradford, and extended to those present a hearty invitation to inspect the Bradford works during the course of the afternoon. The Chairman of the meeting suitably replied. The report of the Centre Committee for the year ended March 31, 1920, was taken as read, and adopted, and the election of the committee for the ensuing year resulted in a member of the Electricity Committee and the engineer of each of the following undertakings being elected:—Large towns: Bradford, Hull, and Leeds; medium-size towns: Barnsley, Halifax, and Wakefield; small towns: Batley, Harrogate, and Spenborough. The election of officers for the ensuing year was left in the hands of the newly-appointed committee.

At the termination of the annual meeting, a meeting of the newly-appointed Centre Committee was held, at which the following officers were elected for the ensuing year: Chairman of Centre: Mr. W. M. Rogerson (Halifax); Vice-Chairman of Centre, Mr. E. A. Parker (Barnsley); Hon. Secretary and Treasurer, Mr. S. Derwin Jones (Batley). Mr. W. M. Rogerson was re-elected to represent the Yorkshire Centre on the Council of the Incorporated Municipal Electrical Association.

Annual Meeting of the E.T.B.I.

The annual meeting of the Electrical Trades Benevolent Institution was held on Monday at the Institution of Electrical Engineers.

Mr. Highfield, President of the Institution of Electrical Engineers, who presided, said that it was a great pleasure to preside over the meeting, because he appreciated the way in which this Fund, and the Benevolent Fund of the Institution of Electrical Engineers, were acting hand-in-hand. The two funds were clearly desirable, and by working harmoniously together were able to assist, not only those who were members of the I.E.E., but also the large number of employees of the staffs of members of that Institution, and of the staffs of manufacturing concerns, who were not qualified to be members of the I.E.E.

In moving the adoption of the report of the committee and the accounts, Mr. Highfield pointed out the gratifying increase in membership of nearly 100. The sum of £3707 had been invested in the course of the year, bringing the total investments at cost to £18 063. Although every person who was qualified for assistance had been helped, the number of those helped and the amount given in grants was still small, but, none the less, it was more than double that paid out in the previous year, and the largest amount paid out since 1915.

The retiring members of the committee were all re-elected. Price, Waterhouse & Company were reappointed hon. auditors, and a hearty vote of thanks was passed to the Electrical Press for the valuable assistance they had given to the Institution. Votes of thanks were also passed to the honorary solicitors, the Institution of Electrical Engineers, and the hon. secretary, and the meeting concluded with a vote of thanks to Mr. Highfield for presiding over it.

Electric v. Petrol Vehicles.

Mr. F. Ayton points out, with reference to the recent reports in the daily Press on the discussion which followed Mr. R. J. Mitchell's address on Electric Vehicles before the Western Centre of the I.E.E. at Swansea on the 3rd inst., that his remarks have been wrongly reported in some instances. He believes that the advantages of the electric vehicle, in the way of economy, reliability, &c., are such that, whatever may be the price of petrol, it is bound to be increasingly adopted in the sphere of town delivery and transport work. In the discussion he put forward these views, and referred to recent statements in technical journals in the U.S.A., foreshadowing the likelihood of supplies of petrol falling short of the rapidly growing demand, and the probable concomitant increase in the price of that commodity. He pointed out that, where petrol vehicles were at present used for short-distance work in towns and cities, they could with advantage be replaced by electric vehicles.

Silver Medal for Electric Cooker.

On Wednesday, April 19, at the Princes Restaurant, London, the Countess of Carnworth presented the awards made at the recent Cookery and Food Exhibition. Among the recipients were the Falkirk Iron Company, who received a Silver Medal for their domestic electric cooker, this being the highest possible award in the Commercial Class. This firm have also received an order for electric hot cupboards for the liner "The Empress of Scotland," which is being refitted at Portsmouth. Although these hot cupboards had several alterations to their standard pattern, they were made and despatched in five days from the receipt of the order.

Electricity Supply.

Menai Bridge Urban Council have decided to purchase the local electricity undertaking on the terms offered by the company—namely, £700.

Notice is to be given Hove Corporation that, owing to other developments in the district, the Brighton Corporation's arrangement for the supply of electricity in the Aldrington area (which has been a separate service in bulk for some years) is to be discontinued.

The Minister of Transport proposes to confirm the Special Order granted to Lord Weston, Sir George Young, Mr. R. N. Caught, and Mr. H. E. Cooper, and authorising the supply of electricity in Cookham, Berks. Any objections must be sent to the Ministry of Transport by May 13.

Redditch Urban Council is inviting tenders for loans amounting to £92 670. The money is required for various purposes, but mainly for the electricity undertaking. The loans have been sanctioned by the Electricity Commissioners and the Ministry of Health, and are available for trustee funds.

Mr. C. G. Morley New, Cardiff city electrical engineer, reported to the Electricity Committee last Friday that for the year ending March 31 last the units generated showed an increase of approximately two millions, that there were 997 additional consumers connected, and that the total increase in connections was 4 350 kW, including 202 motors of 2 026 h.p. The maximum load on the system shows an increase of 858 kW.

Col. T. C. Ekin will hold an inquiry at Blackpool, on May 2, into the application of the Corporation for sanction to borrow £220 000 for plant and extensions in connection with the Electricity Department. The inquiry will have additional interest in view of the proposals of Preston and Blackburn Corporations for a joint electricity scheme for the whole of Mid-Lancashire, stretching from Blackpool to Bacup. Blackpool regards the scheme as too unwieldy. The scheme provides for the retention of the Blackpool station for peak load purposes only.

The National Industrial Council for the Electricity Supply Industry considered last Friday the dispute, mentioned in our last issue, which has arisen over the refusal of a jointer employed by the Chelmsford electricity undertaking to connect a house to the supply mains on the ground that the wiring had been installed by a man who was not a trade unionist. We understand that there is a reason to hope that some mutually satisfactory solution will be reached before the next meeting of the National Council in the latter part of May.

Fochabers power-house had a narrow escape last week. A heavy rain fell in the district, and the Fochabers burn became flooded. Breaking its left bank at the lowest fall in sight of the Spey, the swollen stream, curving to the left, threatened the electric power-house, which stands at its junction with the Spey. By the time assistance could be summoned the burn had scooped out its bed till within about 3 ft. of the power-house to a depth of fully 3 ft. Fortunately, the flooded stream began to abate as the workmen arrived on the scene, and a hastily-constructed bulwark staved off any immediate danger.

New Schemes and Mains Extensions.

Dundalk Urban Council have applied to the Minister of Economics for sanction to a scheme for extending the municipal electricity works at a cost of £18 500.

Lynn Electricity Committee have decided to apply for sanction to a loan of £10 000 for various alterations and additions in connection with the electricity works.

Porthcawl Council has decided to appoint a sub-committee to examine a scheme for supplying the town with electricity. The total cost is estimated at £10 000.

Stroud Rural Council have decided to offer no opposition to an electricity scheme for the district proposed to be carried out by the Norchard Electric Power Company.

Guildford Corporation has been authorised to borrow £20 000 for a scheme of extensions of the generating plant and mains prepared by Mr. G. W. Spencer Hawes, consulting engineer.

Accrington Council passed a resolution last week authorising application for powers to borrow money in order that the service of electricity may be extended to Oswaldtwistle and other districts.

The secretary of the Walmer Gas Company has informed the Urban Council that the company have decided not to carry out the proposed electric light scheme, owing to the altered circumstances since the War.

Weston-super-Mare Urban Council has granted permission to the Electric Supply Company to erect an overhead line from their station to the Great Western Railway Company's premises for the supply of electricity for power.

Barry Chamber of Trade on Monday considered a report from Sir Charles Bright & Partners regarding the proposed electricity scheme, in which it was suggested that the mains should be laid in the principal thoroughfares. The estimated cost of the scheme is put at £40 000. The Chamber have decided to call a special meeting to deal with the matter, and their observations will then be put before the Council.

Llandudno Council have granted the use of the Town Hall to the Electricity Commissioners on or about May 25 next for a further inquiry required by section 5 (4) of the Electricity Supply Act, 1919, in regard to the supply of electricity in bulk for the North Wales and Chester district. The Commissioners held an inquiry at Llandudno in May, 1921, into the scheme submitted by the North Wales Power Company and the Chester Corporation, and later made an order in favour of the former company.

Following up an interview with the Electricity Commissioners, the directors of the Cannock Chase Colliery Company have decided to proceed with their scheme for the provision of a supply of electricity for Chasetown, Chase-terrace, Burntwood, and Hammerwich. The current will be carried from the Colliery Company's power station at Chase-terrace by means of overhead cables, and the voltage will be 440 for power purposes and 240 for lighting. A sub-station will be erected at Watling-street, and if Brownhills Urban Council require a supply there will be another sub-station at Brownhills. It is proposed to charge a maximum of 8d. per unit for lighting, and for public lighting £3 per lamp per year for Brownhills West, and £3 5s. for the remainder of the Brownhills area. The Colliery Company has intimated to Brownhills Council that if that authority adopt electricity for street lighting, and 100 private consumers can also be secured, the company will supply the necessary current.

Electric Traction.

The manager of the West Ham tramways, in an analysis of the result of cheap midday fares, points out that the increased number of twopenny riders has not even equalled the falling off in the threepenny and higher fares. He says, however, that, having regard to the present financial position of the undertaking and the uncertainty of the future, he cannot recommend any alteration in the fares at present.

After a strike of over three months a settlement has been reached between the employers and employees of the Sunderland and District Tramways Company, and the car service has been resumed. At the suggestion of Mr. Robert Richardson, M.P. for Houghton-le-Spring, both sides agreed to a conference, and at this meeting the employees agreed to accept a reduction of 5s. per week in wages. Eleven weeks ago the men were asked to accept reductions up to 10s. a week over and above the national reduction of 3s. a week.

Mr. R. L. Horsfield, manager of the Cardiff Corporation Tramways, submitted a report to the Tramways Committee on Friday which showed that the passenger receipts for the year ended March 31 amounted to £277 855, a decrease of £13 054 compared with last year. Total car mileage was 2 894 286 miles, a reduction of 92 592 miles, and the number of passengers carried 37 589 443, against 40 114 675. Mr. Horsfield attributed the decrease of receipts to the depression in trade and the interference with traffic by the reconstruction of the tramway track. The wages bill for the year shows a decrease of £5 651.

In a paper read before the Institute of Transport last week, Mr. J. K. Bruce, traffic manager of the L.C.C. Tramways, stated that cars fitted with a new type of motor were capable of an increase in speed of 10 per cent. If this increased speed were maintained throughout the service of, say, fifteen hundred cars, it would mean a saving of approximately 170 cars, and this would effect a saving, in repairs alone, of £70 000 a year. If one second were saved at every stop made by the cars the total daily saving would be 220 hours, which would enable about 2 000 additional miles to be run each day without increase in the number of cars.

Manchester Tramways Committee have decided to contribute £50 000 towards the relief of the rates. Last year the undertaking was expected to make what was then an annual contribution in relief of rates, and the sum required of it was £115 000. The undertaking was not then in a position to make such a payment, but since then it has been decided not to make demands on the trading departments for rate relief. The £50 000 now voted seems to be a breach of this understanding. The approximate expenditure for the year ended March 31 last was £1 994 551, or £43 449 less than the estimate. The estimated revenue for the new year is £1 894 495—a reduction on last year, in view of the probable loss on the new fares, of, roughly, £100 000.

The draft financial statement of the Leeds City tramways for the year ended March 21 last was presented at a meeting of the Tramways Committee on Monday. The income for the year was £959 702, or an average of 24·695d. per car-mile, compared with £995 638, or 23·480d. the previous year, the decrease, therefore, being £35 935. The total working expenses were £702 250, an average of 18·070d. per car-mile, the corresponding expense for the previous year being £729 345 and 17·2d., a decrease of £27 095. The gross profit left to be carried forward was £257 453, a decrease of £8 840. The war charges, income-tax, rent of lines, permanent way renewals, &c., exceeded the gross profit carried forward by £43 266. This deficit is accounted for by the fact that during the year £140 561 has been expended on permanent way renewals and £63 556 on permanent way repairs, a total of £204 000, compared with £155 000 in 1920. The amount in the reserve fund on March 31 was £56 818. £36 818 being to general reserve and £20 000 in respect of third-party risks. Wage reductions of all classes of employees amounted to £23 000 approximately. The Committee adopted the statement. A year ago it was estimated that there would be a loss of over £100 000, whereas it has proved to be £43 266. This is the first time in the history of the undertaking, which dates back to 1897, that there has been a deficit, and, on the other hand, the total contributed by the tramways department by March 31, 1921, to the relief of rates was £1 514 492.

Personal and Appointments.

Mr. W. J. Smither has been appointed electrical engineer to the Dorchester Town Council.

Faversham Town Council has reduced the salary of the electrical engineer (Mr. G. Somerville) from £450 a year to £416.

Mr. J. C. Austen, managing director of Austen & Barnes, Ltd., electricians, has been elected chairman of the Tonbridge Urban Council.

Mr. Frank B. Jewett, of New York, has been nominated president of the American Institute of Electrical Engineers for 1922-3.

Mr. P. Robson, of Clayton & Shuttleworth, has been appointed by the Federation of British Industries to go to the Genoa Conference in the capacity of expert on agricultural machinery.

Mr. J. A. Bromley, manager of the Keighley Corporation Tramways, has been appointed tramways manager at York at £600 a year in succession to Mr. J. W. Hame. Mr. Bromley went to Keighley from Leeds, where he was chief assistant rolling stock superintendent, about eighteen months ago.

In recognition of his many and long services for the benefit of Sheffield, the Freedom of the City was conferred on Sir William Clegg last Friday, the anniversary of his seventieth birthday. Among the many positions held by Sir William is that of chairman of the Tramways Committee since the introduction of electric traction.

Mr. H. C. Tofield has resigned his position as managing director of Tofield & Robinson, Ltd., electrical engineers, of 165, Edmund-street, Birmingham, and has commenced business on his own account at Temple-passage, Temple-street, Birmingham, to which address all correspondence should be sent. He has been appointed sole agent for "Delco" electric lighting and pumping plants for the county of Warwickshire, and will be exhibiting these at the Birmingham and Midlands Industrial and Commercial Efficiency Exhibition to be held at Bingley Hall from May 25 to June 3 next.

Major Henry Mattinson, chief civil engineer to Manchester Tramways Department, has been appointed general manager in succession to Mr. J. M. McElroy, who has resigned owing to ill-health. Major Mattinson's salary will be £1 400 a year, and he will begin his new duties on July 1. Manchester tramways system covers 220 miles of single track in the city and surrounding districts, and Major Mattinson has been responsible for the construction of practically all of it. He accompanied Mr. McElroy on his visit to America and the Continent to study traffic conditions, and collaborated with him in reports on tramway traffic congestion. During the war, as construction engineer of light railways, he built over 100 miles of light railway from Gaza to Aleppo, and after the Turks were defeated in 1918 he took over the restoration of the 600 miles of captured railway from Haifa to Damascus, Beirut and Aleppo.

Business Items, &c.

Horace Green & Company have opened offices at Amberley House, Norfolk-street, London, to deal with home and export business in London.

Mr. C. G. Dunster announces that in future he will carry on alone the business of Dunster & Bacon, electrical engineers, of 19, North Holmes-street, Canterbury.

Important orders recently received by the Underfeed Stoker Company include travelling grate stokers for Eastbourne, St. Marylebone, Wolverhampton, Stafford, Liége, and Cossipore (India) electricity undertakings.

In reference to the No. 10 model 50-ton tyre press recently introduced for small garages and overseas depots, by Hollings & Guest, which is listed at £120, the makers now state that they are prepared to quote a special discount on this model. Also, each of these presses will be tested up to 80 tons pressure before leaving the works.

In addition to manufacturing all classes of electrical machinery and cables, the A.C.E.C. (Ateliers de Constructions Electriques de Charleroi) specialise in the production of moulded insulating materials for switch handles and bases, brush spindles, terminal covers and bases, arc shields, &c., and have recently built a new factory for the mass production of these parts.

From Monday next, May 1, the London offices and stores of J. H. Tucker & Company will be removed from 217, Shaftesbury-avenue, to 101, Dean-street, W. 1, close to Frascati's Restaurant and three doors only from Oxford-street. The telephone number remains the same as hitherto, namely, 3215 Gerrard. In addition to greatly increased stock accommodation, the new premises will also provide showrooms, in which a representative display of "Tucker" accessories, ironclad gear and switchgear will be permanently displayed, as well as a series of practical demonstrations by the many different controls available by the use of different types of "Tucker" switches. The trade are cordially invited to visit the firm at their new address.

Mr. J. W. Beauchamp read a paper on Monday before the Liverpool Sub-Centre of the Institution of Electrical Engineers entitled, "Engineering Advertising and the Work of the E.D.A." The paper was well illustrated by lantern-slides showing various forms of advertising. Among those who took part in the discussion which followed were Messrs. Dickinson, Clothier, Hansom, Collie, Holttum, Collin, and Nisbett.

Wireless and Telephone Notes.

The extension of the Bergen wireless service, for which the Storting has voted 100 000 kroner [about £4 000], is expected to be completed in June. The radius of the wireless telephone will enable it just to reach the North of England.

The Grimsby telephone exchange, which was the first complete automatic installation in the country, is to be equipped this month with an extension providing 550 additional lines. A new underground cable between Grimsby and Hull is being laid.

It is reported from Moscow that the Council of People's Commissaries have granted a concession for telegraphic communication between India and Europe. Communication will be through Russian territory, and there will be connection with Turkey, Egypt, Persia, and the Mediterranean countries.

Owing to numerous requests from amateur users of wireless receiving sets, the two daily weather messages sent out from the Air Ministry are now being distributed at a slightly lower rate than previously. Investigation of the requests showed that a number of amateur wireless users situated in remote rural localities are carefully picking up the Air Ministry weather forecasts, and are handing them on at once to neighbouring farmers.

It is stated that the Marconi Company has proposed to the Mexican Government a scheme whereby the company would control for fifty years all wireless stations built or to be built on Mexican territory. After the expiration of the fifty years the wireless stations would be turned over to the Government or the concession renewed. The Government regards the offer in its present form as unacceptable, but it is believed would be prepared to give it favourable consideration if modified.

A wireless-telephonic service, claimed to be the longest line of its kind in the world open to public use, was opened between Peking and Tientsin on March 7. The equipment was supplied by the China Electric Company and was manufactured exclusively by the International Western Electric Company (Inc.), New York. The system as perfected in the Peking-Tientsin service ensures transmission when connected with telephone central offices. The tests that were applied at the opening ceremony were entirely successful. The distance between Peking and Tientsin is 80 miles.

The "Cornell Special," an express train which runs between New York and Ithaca, has just been fitted with a complete radio-telephone installation capable of receiving and transmitting messages over a considerable distance. In the buffet car there is a loud-speaking telephone, and receiving sets are affixed to the chair of each passenger. Referring to experiments made before the present apparatus was fixed, the "Radio Globe" says it was found that while the train was moving through cuttings and over bridges the signals frequently ceased entirely, while they were invariably weaker than when on the ordinary open track. This defect has not been entirely overcome, but is being corrected. In tunnels the apparatus worked excellently, but again, when in the train sheds in Hoboken all signals stopped, due to the great quantity of steel used in the construction of the buildings.

Institution Notes.

The annual convention of the Canadian Electrical Association will be held in Ottawa from June 15 to 17 inclusive.

The 69th anniversary festival of the London Association of Foremen Engineers will be held at Cannon-street Hotel, London, on Saturday, May 6, at 6 p.m. Mr. F. W. Bellamy will take the chair.

The Association of Engineers-in-Charge will hold an informal meeting on Saturday, May 6 (7.30 p.m.), at St. Bride's Institute, Bride-lane, Fleet-street, E.C. 4, to discuss "Uniflow v. Multiple Expansion Steam Engines." Visitors are invited to be present and take part.

The Sessional Examinations of the Institute of Cost and Works Accountants will take place on June 19, 20, and 21, and will be held in London, Manchester, Birmingham, Sheffield, Glasgow, and Bristol. Application should be made on Form "C," obtainable from the Secretary, 38, Grosvenor-gardens, at least twenty-one days before the date of examination.

At the Congress of the Institute of Transport, which will be held in London from the 17th to the 20th prox., all branches of transport will be represented. Delegates will attend from the British Dominions, the United States and the Continent. On the mornings of the first three days papers will be read and discussed at the Institution of Civil Engineers, Great George-street, and the afternoons as well as the Saturday following will be devoted to visiting places of special interest. The third dinner of the Institute will be held on May 18.

Members of the West of Scotland Branch of the Association of Mining Electrical Engineers last Saturday afternoon visited the Clydesmill Power Station, Cambuslang, of the Clyde Valley Electrical Power Company. They were shown over the station, and the plant and general arrangements were fully explained by the resident engineer and other officials of the company. The following officers have been elected for the next session of the Branch:—President, Mr. D. Martin, Glasgow; vice-presidents, Messrs. D. M'Queen and D. L. Frew; treasurers, Messrs. C. L. Brown and Melville, C.A., Glasgow; secretary, Mr. D. S. Baddeley, 50, Wellington-street, Glasgow.

Obituary.

The death took place on April 2 of Mr. WALTER JOSEPH BRINN, of Old Charlton (late of the Western Brazilian Telegraph Company), aged 70.

We regret to record the death of Mr. JAMES BIRD GARNHAM, head of the firm of J. B. Garnham & Sons, metal merchants. Mr. Garnham was eighty years of age.

We regret to record the death, at the age of thirty-five, of Mr. HAROLD EMMOTT, the only son of Mr. Walter Emmott, consulting engineer of Halifax, who died suddenly in his father's office last Thursday. Mr. Harold Emmott was educated at the Higher Grade School and Technical College, Halifax, and at Woodhouse Grove School, Aperley Bridge. He was apprenticed with Mr. Shaw, City Electrical Engineer, Worcester, and afterwards acted as assistant to Mr. Busby, of the British Insulated & Helsby Cables, Ltd., on London cable contracts, and with the L.C.C. Electricity Department. He joined his father in March, 1913, his first work being the installation of electricity supply to the town of Bingley. He was a member of the 6th London Field Ambulance (T), transferring to the 2nd Northern General Hospital, Leeds, and on the outbreak of war he was mobilised, promoted sergeant, and was in charge of the X-Ray Department at Beckett's Park, Leeds, until the end of 1915. He then applied for and obtained a commission in the R.E., and served in France until March 23, 1917, when he was invalided home. He then obtained a position as constructional engineer with the Bradford Corporation, rejoining his father some two years ago. Mr. Emmott was an Associate Member of the Institution of Electrical Engineers, being admitted a student in 1903.

The death took place on Sunday, at the Red Cross Hospital for officers at Brighton, from tuberculosis contracted on service in the Near East, of CAPT. L. C. CARUS-WILSON, M.C., R.C.S., assistant experimental officer at the S.E.E., Woolwich, Associate of the Institute of Radio-Engineers of America. Capt. Carus-Wilson, who was only 25 years of age, was the second son of Prof. Ashley Carus-Wilson, late Prof. of Electrical Engineering at McGill University, Montreal. In February, 1914, he passed into Woolwich second on the list as a prize cadet, receiving his commission in the Royal Engineers in November, 1914. He served continuously throughout the war in France, Belgium, and Italy, and received the M.C. "for invaluable services rendered at the Battle of Messines, where, under heavy shell fire during seven days, he showed the greatest skill and resource" in using, for the first time in action, the latest invention in wireless signals. Through the summer of 1918 he commanded the Signal Company of the 9th (Scottish) Division, which led the victorious march to the Rhine. After lecturing on electricity to the British troops at Ohligs, he was recalled, and appointed by the War Office in 1919 to be the representative British officer at l'Ecole Supérieure d'Electricité of Paris. There he won the diploma in radio-telegraphy, &c., of the University of Paris, and passed out of the wireless school first on the long list of foreign officers who completed the course. He was then attached to the Wireless Headquarters Staff at the Horse Guards, and later on, when engaged in original research at Woolwich, was appointed to represent the War Office during the installation at Cairo of the first link of the Imperial Wireless Chain.

Opening of Anglo-Egyptian Wireless Service.

The ANGLO-EGYPTIAN WIRELESS SERVICE *viâ* the Imperial wireless stations at Leafield and Cairo commenced on Monday. Telegrams are accepted at any post-office for Egypt, Palestine, and Syria for transmission, and a corresponding service is available in the opposite direction. The rates of charge are 3d. a word less than the corresponding cable rates for full-rate traffic, and 1½d. a word less than the corresponding cable rates for deferred traffic. Press messages may be sent to and from Egypt (first region) and Palestine at 2½d. and 3½d. a word respectively. Telegrams intended for transmission by this route should be marked "*viâ* wireless." In addition, arrangements have been made, pending the provision of further stations of the Imperial wireless chain, for telegrams addressed to places beyond Egypt, served by the system of the Eastern Telegraph Company, to be forwarded by wireless to Cairo and thence by the company's service to their destination at the normal through rates of charge.

Miscellaneous.

In view of the need for economy in public expenditure the post of H.M. TRADE COMMISSIONER AT SINGAPORE has been suspended.

The late Mr. ALEXANDER MCGEOGH, of William McGeogh & Company, brass founders and electrical accessories manufacturers, has left estate valued at £37 631.

The Salaries and Wages Committee of EDINBURGH Town Council have decided that all Corporation officials receiving more than £400 a year should be asked to submit to a voluntary reduction of 5 per cent. of their salaries.

MR. WM. OGILVIE, an electrical engineer, was found dead last week in the Rothwell sub-station of the Yorkshire Electric Power Company. At the inquest it was stated that Mr. Ogilvie had suffered from insomnia, and had lately been very much depressed. A verdict was returned that deceased electrocuted himself whilst temporarily of unsound mind through neurasthenia.

Imperial and Foreign Notes.

The WEST MAITLAND (N.S.W.) municipal electrical plant, which cost £15 000, was put into operation on Feb. 22.

BROKEN HILL (N.S.W.) Council, who have their own generating station, have under consideration a proposal to obtain a supply of electricity from a local mining company.

HOBART (Tasmania) and neighbouring municipalities recently discussed a proposal to establish a metropolitan and district water and sewerage board. It was suggested that the engineering works should be designed with the dual purpose of water and electric power supply in view, and a committee has been appointed to deal with the question of funds for the necessary surveys.

The Tasmanian Public Works Committee is inquiring into the proposal to provide the ZEEHAN MINING DISTRICT with ELECTRIC POWER to the extent of 375 kW. The Mount Lyell Company offer to supply the energy required at £6 per H.P.-year, and the transmission line would cost £20 000. The annual capital charges are estimated at £2 500, and the working expenses at £2 000.

The reorganisation of the FRENCH TELEGRAPH AND TELEPHONE SERVICE is provided for in two bills before the Council of Ministers. The accounts of each service will be kept separate, and 1 675 000 francs are to be allocated for telephone line extension and the introduction of automatic telephony.

The fortieth anniversary of the NEW YORK electricity supply service is to be celebrated on September 4 next. The original Edison Company had sixty customers, with 1 200 lamps, connected, but at present there are 296 560 lighting consumers using about 9 million lamps, and, in addition, supply is given to 680 000 H.P. in motors and 12 800 kW for heating.

The Great Western Power Company has completed the installation of two 30 000 H.P. double-hung impulse turbines, operating under a head of 1 008 ft., at the Caribon power-house on the Feather River, CALIFORNIA. Another 30 000 H.P. hydro-electric unit is to be installed in order to complete the first half of the scheme, but ultimately 180 000 H.P. will be developed at the station.

A new steam-driven power station, which will have an ultimate capacity of 240 000 kW, is to be erected in EAST ST. LOUIS (Mo.) by the Union Electric Light & Power Company. The plant will supply the rapidly-increasing demand for electricity in St. Louis and vicinity. The station will be named the Cahokia steam-power plant, and will have an initial capacity of 60 000 kW. The first two units will be of 30 000 kW each, supplied with steam at 300 lb. pressure at the throttle, and will deliver electrical energy at 13 200 V, 50 cycles.

Electric and petrol as well as horse-drawn vehicles are being used by Abraham & Strauss, owners of one of the largest stores in Brooklyn, for transport purposes. Horse vehicles are employed for trips of less than 10 miles, electric trucks for a daily mileage of 10 to 40, and petrol for journeys of 40 to 130 miles. The firm have employed twenty-one electric vehicles for some years, and they report that the ELECTRICS ARE CHEAPER PER UNIT HAULED than any other vehicle, and besides being cheaper, they are much more satisfactory from every point of view. In Chicago 105 electric trucks are now employed for ice-cream deliveries, against one in 19[illegible]. The average mileage is 16 to 30 per day. In every case satisfaction has been given, and one firm reports that the delivery costs were halved by the electric vehicles.

Possible Trade Openings.

An old-established firm of good standing, with suitable connections throughout AUSTRALIA AND NEW ZEALAND, desire to secure the representation of United Kingdom manufacturers of electrical machinery, motors, dynamos, copper cable, &c. The firm have their own offices in Melbourne, Sydney, and Port Adelaide, and agencies in Brisbane and Fremantle. Further particulars can be obtained from the Department of Overseas Trade. (Ref. No. 431.)

The British Consulate at CASABLANCA reports that concessions for electric light and power stations at the towns of Marrakesh, Mazagan, and Saffi, in Morocco, have recently been granted. The station at Marrakesh is apparently to have an initial capacity of 1 200 h.p., the station at Mazagan 750 h.p., and that at Saffi 1 200 h.p., for the generation in each case of three-phase current at 50 cycles, with a consumer's voltage of 115 for lighting and 200 for heating purposes.

H.M. Agent and Consul-General at TANGIERS reports that a concession has also been granted for the supply of electric light and power to the town of Rabat and its surroundings, the supply station to have a capacity of 1 000 kW for the generation of three-phase current at 50 cycles and 55 000 V, which is transformed down to a consumer's voltage of 110 for lighting and 190 for motive-power purposes. Cuttings from the local "Bulletin Officiel," giving details of the concession and the proposed scale of charges, can be consulted by firms interested at the Department of Overseas Trade.

H.M. Consul at Cluj (Transylvania, ROUMANIA) reports that the Municipality of Cluj is trying to arrange for the construction of a pipe-line for the supply of natural gas from the Kissarmas district (60 k.m. distant) for domestic, commercial, and industrial purposes in Cluj (previously known as Klausenburg or Kolozsvar), and that it is possible that the extension of the electric-power station and the introduction of an electric tramway system may be combined with the project. Full particulars are not yet available, but preliminary information may be obtained from the Department of Overseas Trade.

Electrical Imports and Exports.

IMPORTS.—The following are official values of electrical machinery, apparatus and material imported into this country (*a*) during March, 1922, and (*b*) the aggregate figures from Jan. 1 to March 31, with increase or decrease compared with corresponding periods of 1921 :—

Electrical machinery, (*a*) £136 511 (increase £64 658), (*b*) £381 545 (increase £134 629); telegraph and telephone cables, other than submarine, (*a*) £4 818 (increase £2 599), (*b*) £10 915 (decrease £16 824); telegraph and telephone apparatus, (*a*) £13 463 (decrease £20 276), (*b*) £39 287 (decrease £49 145); other electrical wires and cables, rubber insulated, (*a*) £11 188 (increase £9 504), (*b*) £19 361 (increase £11 592); with other insulations, (*a*) £8 269 (decrease £10 801), (*b*) £16 509 (decrease £22 188); carbons, (*a*) £5 157 (increase £512), (*b*) £10 290 (decrease £22 781); glow lamps, (*a*) £11 547 (decrease £9 755), (*b*) £52 710 (decrease £9 964); arc lamps and electric searchlights, (*a*) £50 (decrease £10), (*b*) £50 (decrease £4 741); parts of arc lamps and searchlights (other than carbons), (*a*) £1 031 (decrease £361), (*b*) £2 169 (decrease £2 984); batteries, (*a*) £8 670 (decrease £11 545), (*b*) £15 685 (decrease £34 153); meters and electrical instruments, commercial and scientific, and electricity meters, (*a*) £3 674 (decrease £22 440), (*b*) £14 317 (decrease £53 822); switchboards, (*a*) £414 (increase £414), (*b*) £1 379 (increase £209); other electrical goods and apparatus, (*a*) £47 229 (decrease £47 740), (*b*) £133 990 (decrease £163 824). Total of electrical machinery, apparatus and material (other than uninsulated wire), (*a*) £252 020 (decrease £45 241), (*b*) £698 207 (decrease £233 996).

EXPORTS.—The exports of electrical machinery, apparatus and material (*a*) during March, 1922, and (*b*) from Jan. 1 to March 31, with increase or decrease compared with corresponding periods of 1921 were as follows :—

Electrical machinery, (*a*) £485 115 (increase £67 962), (*b*) £1 436 394 (increase £181 583); including railway and tramway motors, (*a*) £22 554 (increase £13 605) (*b*) £53 610 (decrease £1 545); other generators and motors, (*a*) £277 451 (increase £48 208), (*b*) £799 190 (increase £90 917); and electrical machinery unenumerated, (*a*) £185 110 (increase £6 149), (*b*) £583 594 (increase £92 211); telegraph and telephone cables, submarine, (*a*) £17 773 (decrease £68 909), (*b*) £82 251 (decrease £204 681); other than submarine, (*a*) £29 839 (decrease £101 301), (*b*) £145 736 (decrease £335 037); telegraph and telephone apparatus, (*a*) £180 266 (increase £27 181), (*b*) £541 069 (increase £95 428); other electrical wires and cables, rubber insulated, (*a*) £48 527 (decrease £106 049), (*b*) £145 573 (decrease £348 090); with other insulations, (*a*) £98 510 (decrease £119 718), (*b*) £337 459 (decrease £263 127); carbons, (*a*) £3 502 (decrease £6 030), (*b*) £12 608 (decrease £27 850); glow lamps, (*a*) £38 349 (decrease £11 154), (*b*) £96 942 (decrease £14 201); arc lamps and searchlights, (*a*) £1 753 (increase £1 353), (*b*) £2 845 (increase £15); parts of arc lamps and searchlights other than carbons), (*a*) £611 (increase £544), (*b*) £1 392 (decrease £625); batteries, (*a*) £47 520 (decrease £9 998), (*b*) £105 913 (decrease £111 563); meters and electrical instruments, commercial and scientific, and electricity meters, (*a*) £33 747 (decrease £2 372), (*b*) £105 941 (decrease £10 272); switchboards, (*a*) £15 501 (increase £1 355), (*b*) £125 865 (increase £79 805); other electrical goods and apparatus, (*a*) £113 573 (decrease £121 149), (*b*) £336 849 (decrease £366 776). Total of electrical machinery, apparatus and material, other than uninsulated wire, (*a*) £1 114 586 (decrease £458 285), (*b*) £3 476 837 (decrease £1 352 391).

Tenders Invited and Accepted.

UNITED KINGDOM.

MANCHESTER TRAMWAYS COMMITTEE. May 9.—Trucks for tramcars. Specifications, &c., from the Manager, 55, Piccadilly, Manchester.

PROVIDENCE CONGREGATIONAL CHURCH, MIDDLETON. May 1.—Electric wiring and fitting. Specifications from the Borough Electrical Engineer.

GLASGOW LIGHTING DEPARTMENT. May 1.—Electrical fittings and accessories, lamp pillars, &c. Specification can be obtained at the Lighting Department, 20, Trongate, Glasgow.

PEMBROKE (CO. DUBLIN) Urban Council. May 2.—Two 250 kW rotary converters, with switchgear, cable connections, &c. Specification, &c., can be obtained at the Council offices.

YORK CORPORATION. May 5.—500 kW rotary converter, transformer, switchgear, &c., for Wellington-row sub-station. Specification, &c., from the City Electrical Engineer.

PRESTON ELECTRICITY DEPARTMENT. May 30.—(*a*) two 10 000/12 500 kW turbo-generator sets, complete with condensing plant, auxiliaries, and piping connections; (*b*) house service plant, comprising one 1 200 kW turbo-generator, and two a.c. 6 600/220 V d.c. generators. Particulars from the Town Clerk, Mr. A. Howarth, Town Hall, Preston.

ASIA.

The Acting British Consul at BANGKOK reports that the date for the presentation of tenders for telegraph and telephone material for the Department of Posts and Telegraphs (see THE ELECTRICIAN, April 14, p. 458) has been extended to June 28.

We regret that in our list of "Tenders accepted" last week the name of CHAMBERLAIN & HOOKHAM was incorrectly spelt in two paragraphs.

COMMERCIAL INTELLIGENCE.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

BRADBEER, Jno. Edward, 2c, England's-lane, N.W., electrical engineer. £10 18s. 10d. Feb. 14.

CLARKE, E. E., & COMPANY, Lancashire-street, Morecambe, electrical engineers. £16 6s. 8d. Feb. 27.

HOLMES & CROWTHER, Palatine-chambers, Halifax, electrical factors. £20 4s. Feb. 22.

HURLINGHAM ELECTRIC COMPANY, 283, New King's-road, S.W., electricians. £13 6s. 6d. Feb. 21.

MACAULEY, Mr. R. A., 48, Ashton New-road, Beswick, electrical engineer. £11 15s. Feb. 23.

SPURBER MANUFACTURING COMPANY, 1A, Luxor-street, Camberwell, electrical engineers. £25 13s. 11d. Feb. 14.

STUBBS, Arthur, 200, Midland-road, Bradford, electrical contractor. £17 6s. 4d. Feb. 22.

Bills of Sale.

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1822 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

JACOBS, Ernest, 2, Sidworth-street, Hackney, electrical engineer. April 21. £35.

DEXTER, Robert Hart, 270, Penistone-road, Sheffield, electrician. April 24. £30.

Deeds of Arrangement.

GRIFFITH, Benjamin, trading as EXCEL ELECTRIC COMPANY 30, South Castle-street, Liverpool, electrician. Filed, April 22. Trustee, T. W. Stanfield, 24, Sir Thomas-street, Liverpool. Secured creditors, £50; liabilities unsecured, £1 708; assets, less secured claims, £550.

ROWE, Walter William, trading as M. ROWE 26 Augusta-street, Birmingham, electro-plater. Trustee, A. Cripwell, 12, Cherry-street, Birmingham. Filed April 19. Liabilities unsecured £628, assets, less secured claims, £200.

WEBSTER, E. W., and WEBSTER, W. G. F., trading at 48-50, Rendezvous-street, and the Harbour, Folkestone, as WEBSTER & SON, automobile and electrical engineers. In this matter (see last week's ELECTRICIAN) the following are creditors :—Sloan Electrical Company, Ltd., London, £397; Clark, Hunt & Company, Ltd., London, £254; Callander's Cable and Construction Company, Ltd., London, £110; General Elec. Company, Ltd., London, £69; Baxter & Caunter, Ltd., London, £67; Vulcan Elec. and Mechanical Company, Ltd., London, £55; Rogasine & Company, London, £51; Harper, Geo. R., & Sons, Birmingham, £51; Edison Swan Elec. Company, Ltd., Ponder's End, £52.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

COUNTY OF LONDON ELECTRIC SUPPLY COMPANY, LTD., London, E.C. Registered April 4, Trust Deed dated March 23, 1922, securing £500 000 debenture stock; general charge, excluding certain lands and premises at Barking, subject to existing Trust Deed securing first and second debenture stock. *£1 000 000. March 29, 1921.

SCIENTIFIC TRADERS, LTD. (late TELEPHONE THIRD HAND, LTD.), London W. Registered April 10, £2 000 debentures, present issue £500; general charge. *Nil. March 30, 1921.

Satisfactions.

NAIROBI ELECTRIC POWER & LIGHTING COMPANY, LTD., London, E.C. Satisfaction registered April 6, £12 000, balance of amounts registered Sept. 29, 1913, and July 30 1915.

SPICER & COMPANY, LTD., London, E.C., electrical engineers. Satisfaction registered April 10, £800, balance of amounts registered Feb. 26, 1915, and March 17, 1922.

SUN ELECTRICAL COMPANY, LTD., London, W.C. Satisfaction registered April 12, £275, part of amount registered April 19, 1911.

Private Meetings.

[Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.]

THE B.E. COMPANY (OF LONDON AND BIRMINGHAM), LTD. (in voluntary liquidation), wholesale manufacturing electricians, 57, Upper Thames-street, London, E.C., and at Birmingham. A meeting of creditors was held last week at the Cannon-street Hotel, London, when the representative of the General Accessories Company, the principal trade creditors, was elected to the chair. Mr. Frederick Roland, C.A., of 70, Queen Victoria-street, E.C., stated that the usual resolution for voluntary liquidation had been passed, and he had been appointed as the liquidator. He proceeded to read figures from which it appeared that the liabilities totalled £9 959, made up as follows :—Trade creditors, £7 240; cash creditors, £2 294; and unsecured balance due to bank, £425. Assets were estimated to realise £7 400, from which had to be deducted £310 for preferential claims, leaving net assets of £7 090. The assets consisted of cash in hand, £17; stocks, £2 864, estimated to realise £2 500; office furniture and fittings, £1 340, expected to produce £500; book debts, £3 541, valued at £2 500; lease of London premises, £20; and unpaid calls, £1 850. The company had two branches in Birmingham—a sales depot, and an assembling and manufacturing shop. The Birmingham premises were valued in the books at £3 381, but they were charged to the bank to secure £2 425. The premises might not realise sufficient to discharge the bank's claim, and they had been included as unsecured creditors for £425. The company invested £2 000 in a subsidiary company called The B.E. Manufacturing Company, which had a nominal capital of £6 000, and which manufactured articles for the parent company to sell; at the moment no value had been placed upon those shares. The B.E. Company (London and Birmingham), Ltd., was registered as a private company on June 22, 1916, with a nominal capital of £2 000, and it acquired for £1 000 the stock and fixtures of a business previously carried on by Mr. Fauke in London and Birmingham. In January, 1919, the capital was increased to £10,000, and, finally, the whole of the capital was issued, and the company seemed to have received £9 000 for shares. On November 15, 1920, the capital was increased to £20 000, by the creation of 10 000 cumulative preference shares of £1 each, bearing interest at the rate of 8 per cent., free of income tax. A number of those preference shares had also been issued for cash. During the year to June, 1917, the company made a net profit of £308, and a dividend of 10 per cent. was declared. The following year the profit rose to £1 062, and there was a dividend paid of 15 per cent. During the year to June, 1919, the profit dropped to £475, but there was a dividend declared at the rate of 15 per cent. Since the inception of the company the total amount paid in directors' fees was only £21. The period to June, 1920, was the most successful in the history of the company, the net profit being £2 412. That amount, however, was not available for dividend, owing to the liability for E.P.D., which, however, was never paid, owing to the subsequent losses. The troubles of the company began about that time. There was some difficulty in regard to the output, and the factory was purchased in Birmingham. During the year to June, 1921, there was a loss of over £4 000 on the Birmingham factory, and the trading of the company generally for that year showed a loss of £7 000. The present position of the company was due to the loss at Birmingham, and the slump in trade. The company was only a small one, and when it met with misfortune it had no reserves to fall back upon. In answer to a question, the liquidator said he did not think there was any prospect of a reconstruction scheme being brought forward. On the motion of the chairman, a resolution was passed confirming the voluntary liquidation of the company with Mr. Roland as liquidator, and a committee of five of the principal creditors was also appointed.

TUCKER, Spencer John, trading as TUCKER & BATESON, wholesale electrical suppliers, 55, Berners-street, London, W. In response to a circular letter issued by Mr. T. L. Summers, accountant, of 64, Victoria-street, S.W., a meeting of the creditors of the above was held recently at Winchester House, Old Broad-street, E.C. The statement of affairs presented showed liabilities of £1 108, of which £866 was due to the trade and £242 to cash creditors. After allowing for preferential claims, net assets were estimated to realise £133. It was stated that the debtor commenced the business in 1919 with a capital of £40, but he had since borrowed from relatives, who were now creditors to the extent of £377, but one held securities valued at £135. The business had been carried on at a loss, and the present position was due to that fact. A deed of assignment had already been executed owing to pressing creditors. It was stated that if the deed was accepted by the creditors the cash claims would be withdrawn. A resolution was passed confirming the deed already executed. The following are creditors :—Davies, Kent & Stewart, Ltd., London, £70; Kent, William, Burslem, £61; Falk, Stadelmann & Company, London, £25; Johnson & Jorgenson, London, £24; Electric Heating Company, Croydon, £20; Boyton, Charles, & Company, Ltd., London, £16; Marshall Electric Company, London, £14.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Winding-Up Petition.

HUBERT D. CARTER (BANGOR), LTD. A petition for the winding-up of the above-named company has been presented by Higgin, Ltd., Manchester, and is to be heard at the Court House, Bangor, May 8, at 11 a.m.

Companies Winding-up Voluntarily.

ECLIPSE CARBORUNDUM & ELECTRITE COMPANY, LTD. George Lord, Capel House, 62, New Broad-street, London, E.C. 2, appointed liquidator. Meeting of creditors at the liquidator's office on Friday, May 5, at 12 noon.

SOLECTRIC COMPANY, LTD. F. N. Clarke, 4, Pavilion buildings, Brighton, appointed liquidator. Meeting of creditors at liquidator's office on Friday, April 28, at 10.30 a.m.

STAR ELECTRICAL ENGINEERING & MANUFACTURING COMPANY, LTD. W. R. Boyd, 67, Cleethorpe-road, Grimsby, appointed liquidator. Meeting of creditors at the Royal Hotel, Grimsby, on Friday, May 12, at 3 p.m. Particulars of claims to liquidator by July 1.

Bankruptcy Information.

MAYNER, Robert Victor, lately carrying on business at Narrow-street and Wentworth-street, Peterborough, electrical engineer. Receiving order, April 20. Debtor's petition.

MORRISON, Roy Thomas, 82, Lumb-lane, Bradford, electrical engineering contractor. Receiving order, April 22. Debtor's petition.

Notice of Intended Dividend.

DOYLE, Herbert, carrying on business as ACCESSORIES SUPPLY COMPANY, at 56, Hardman-street, Deansgate, Manchester, factor in electrical accessories. Last day for receiving proofs, May 10. Trustee, J. G. Gibson, Official Receiver, Byrom-street, Manchester.

Edinburgh Gazette.

BROWN (J. L.) & COMPANY (J. L. Brown, trading as), electrical engineers, 920, Pollokshaws-road, Glasgow. Estates sequestrated April 21. Meeting to elect trustee and commissioners on Friday, May 5, Faculty Hall, St. George's-place, Glasgow, at 12 noon.

HANNAH (A. W.) & COMPANY (Alexander Wilson Hannah and Thomas Hutton Scott, trading as), engineers' mill furnishers and electrical engineers, 46, Old Sneddon-street, Paisley. Partnership dissolved as at April 17, 1922, by mutual consent, by the retiral of T. H. Scott. A. W. Hannah will continue the business.

KELVINDALE ELECTRIC & MANUFACTURING COMPANY, LTD. Company to wind-up voluntarily. A. S. Brown, chartered accountant, 121, West Regent-street, Glasgow, appointed liquidator. Meeting of creditors at office of Wm. Murdoch & Son, solicitors, 98, West George-street, Glasgow, on Tuesday, May 9, at 12 noon.

SCOTTISH ELECTRIC LAMP REPAIRING COMPANY, LTD. Company to be wound up voluntarily. Meeting of creditors at the George Temperance Hotel, Paisley, on Monday, May 8, at 12 noon. R. Stephen Milne, C.A., liquidator, 16, Moss-street, Paisley.

Bankruptcy Proceedings.

WILLIAMS, Aneurin Tudor, and BEVAN, William John, trading as THE ELECTRICAL AND GENERAL ENGINEERING COMPANY, 49, Commercial-street, Aberdare. Liabilities are returned at £1 708, and there is a deficiency of £1 272. At their public examination debtors stated that they started business in partnership in December, 1919, with £100 capital, contributed in equal shares. For the first few months the business went on all right, but the moulders' strike in 1920 caused much difficulty in obtaining materials and involved them in loss of work. The coal stoppages of October, 1920, and April, 1921, also affected them, and later prices had to be cut considerably in order to meet keen competition. In August, 1921, they became aware of their insolvency, but they continued to trade and contract fresh debts in the hope that matters would improve. At this period they were asked by the bank manager to submit a statement showing precisely their position. In that statement they indicated that they expected to receive £1 212. This represented the total value of contracts plus their profits. They did not explain this to the bank because they thought the statement would be understood in that way. They denied, when closely questioned, that they had any intention to mislead. The examination was adjourned to enable debtors to amend their deficiency account.

Companies' Meetings, Reports, &c.

British L. M. Ericsson Manufacturing

Addressing the shareholders at the annual meeting of the British L. M. Ericsson Manufacturing Company last week, Mr. W. M. Crowe (chairman and managing director) said it was a pleasure to be able to come before them with a balance-sheet which, in spite of all the evidences of trade depression, was extremely satisfactory. If the Post Office would only now go ahead and place some orders for new material they might expect another good year in 1922, but as things were at present there was little in the shape of new orders coming from that quarter. One would have thought that, after so many years during which little was done in the way of telephone expansion, there would be sufficient work for all telephone manufacturers. But this was far from the case, every telephone factory in the country was not only working short time, but it had been necessary to part with a large proportion of the workpeople, thus adding to the long list of unemployed. Had it not been for the orders received from abroad their company certainly would have had to reduce their staff of experts, as well as the workpeople, to a minimum. Orders from abroad had, however, so far prevented this. They expected a few years ago that by this time operators would have been superseded by the automatic exchange system, but it appeared that they must wait for a few years longer before this system became common. Their Stockholm friends had received many orders for exchanges of their system of automatics. Their own company had the right to use that system, and they were not without hope that the British Post Office would give it a trial. They also had a system of automatics at Beeston factory which they hoped would make a mark in the telephone world. It was unlike any other system, and its working was much more simple than anything else so far invented. An abstract of the accounts appeared in our issue of April 14.

The net income of the American Waterworks and Electric Company for 1921 amounted to $724 493.

The Kaministiquia Power Company announce a quarterly dividend at the usual rate of 2 per cent. on the common stock.

The Montevideo Telephone Company has declared an interim dividend of 6 per cent. per annum, tax free, on the ordinary shares.

The directors of the Ever-Ready Company (Great Britain), Ltd., recommend the payment of a final dividend of 5½ per cent. on the preference shares, making 9 per cent. for the year, and 9 per cent. on the ordinary shares.

The Stock Exchange Committee have ordered 248 075 £1, fully paid, ordinary shares of the Brush Electrical Engineering Company, and £535 000 7½ per cent. prior lien debenture stock of the Lancashire Electric Light & Power Company to be quoted in the Official List.

The directors of Bell's United Asbestos Company recommend the payment of a balance dividend of 1s. 6d. per share on the ordinary shares, which, with the interim dividend paid in October last, makes a total distribution of 10 per cent. for the year. The amount to be placed to reserve is £8 000, and the sum of £34 013 remains to be carried forward.

The directors of the Calcutta Electric Supply Corporation recommend the payment of a final dividend on the ordinary share capital of the company, for the half-year ended December 31, 1921, at the rate of 6 per cent. actual, making 10 per cent. for the year, plus a bonus of 1 per cent. Relief will be given as heretofore in respect of Indian taxation.

The Board of Referees appointed to deal with Excess Profits Duty have, on the application of the Para Telephone Company, ordered that the statutory percentage as regards the business of supplying public telephone service in Brazil shall be 7½ per cent. in the case of a company or other body corporate, and 7½ per cent. plus 2 per cent. in the case of any other trade or business.

The directors of the Oriental Telephone & Electric Company recommend the payment of the following final dividends for the year ended December 31 last: 3 per cent. on the preference shares (less income tax), making a total of 6 per cent. for the year; 6 per cent., on the ordinary shares (free of income tax), making a total of 10 per cent. for the year, free of tax; and a bonus of 2 per cent. on the ordinary shares, free of income tax.

The report of the North of Scotland Electric Light and Power Company for 1921 shows a credit balance of £7 776, which, with £634 brought forward from last year, leaves £8 410 to be dealt with. The directors recommend the payment of a 10 per cent. dividend on the preference shares, absorbing £2 500; 1¼ per cent. dividend on the ordinary shares, absorbing £625; placing £4 500 to renewal reserve account, and carrying forward £785.

Presiding at the annual meeting of the British Automobile Traction Company last week, Mr. C. Shirreff Hilton said that the past year had been one of the most successful in the history of the company. Including the amount brought forward, there was a surplus of £49 637, out of which it was proposed to place £10 000 to reserve and to pay a dividend of 10 per cent. on both the participating preference shares and the ordinary shares, carrying forward £19 706, subject to Corporation Profits Tax. The net traffic receipts and other revenues amounted to £56 269, compared with £44 932 in the previous year. Administration and general expenses showed an increase of £867, which, in view of the largely increased turnover, was a very small percentage.

The accounts of the British Electric Transformer Company, Ltd., for the year ended Dec. 31, 1921, show that, after paying all manufacturing costs and expenses of administration, there remains a net profit of £91 416 10s., to which is added the amount brought forward from last year (£6 178), making a total available balance of £97 594 10s., which the board recommend be allocated as follows: To reserve account, £15 000; to depreciation reserve, £4 000; to payment of preference dividend of 7 per cent. for the year ended Dec. 31, 1921, £21 000; to payment of a dividend of 10 per cent. on the ordinary shares (3 per cent. of which was paid as an interim dividend on Sept. 1, 1921) and bonus of 2½ per cent., £40 625; to extra remuneration to the directors in accordance with the articles of association, £4 261 6s.; leaving 12 708 4s. to be carried forward.

The net revenue of the River Plate Electricity Company for 1921 (including arrears of interest for the years 1914-19 upon the 5 per cent. obligations of the German Trans-Oceanic Electric Company, £35 458) amounted to £80 693 (against £62 025), and the sum bought forward is £6 982. The directors have transferred £30 000 to general reserve, as well as other sums amounting to £10 654 held in suspense to cover certain contingencies, and that fund now totals £161 234. A dividend is proposed of 7 per cent. for the year on the ordinary stock, a sum of £10 000 is reserved for taxation, and £9 105 is carried forward. For 1920 the dividend was at the same rate. The directors propose to increase the capital to £500 000 by the creation of 25 000 ordinary shares of £1 each, ranking in all respects *pari passu* with the existing ordinary stock and shares. It is further proposed to capitalise £49 573 of the reserve fund and to issue 49 573 fully-paid ordinary shares of £1 each to the stockholders in the proportion of one ordinary share for every £6 stock held.

Meetings of the Southern Brazil Electric Company six per cent. mortgage debenture holders, eight per cent. 10-year noteholders and shareholders are to be held to-day (Friday) to consider a scheme of arrangement which provides as follows:—(1) The redemption of the first debentures to be suspended for a period of four years; (2) the £182 800 eight per cent. notes to be converted into £182 000 ten per cent. cumulative preference shares, ranking for dividend as from July 1, 1926, and preferential as to repayment of capital and arrears of dividend in a winding-up. In consideration of the noteholders agreeing to forego dividends up to July 1, 1926, the preference shares are to carry a cumulative dividend of 10 per cent. as from that date, and no part of the profits earned prior to July 1, 1926, is to be applied in payment of dividends on the ordinary shares without the sanction of a separate meeting of the preference shareholders; (3) the present paid-up share capital —namely, £650 000—to be reduced by 50 per cent., making the present £1 shares 10s. shares fully paid, and the amount thus written off—namely, £325 000—with the whole or part of the sum of £70 050 standing to debenture redemption reserve, together £395 050, to be utilised for writing off or writing down the following:—The debit balance on profit and loss account to Dec. 31, 1920, of £37 850; the estimated loss for 1921, £30 000; preliminary expenses, £25 000; discount on issue of debentures and expense of further issue, £36 087; eight per cent. notes issue expenses, £440; depreciation reserve, to be applied in writing down investments and assets in Brazil, £265 673.

Prices of Metals, Chemicals, &c.

Tuesday, April 25.

		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£63 0 0	—	—
Electro Wirebars ..	,,	£66 10 0	—	—
H.C wire, basis	per lb.	0s. 10 1/16d.	—	—
Sheet	,,	0s. 9 7/16d.	—	—
Phosphor Bronze Wire (Telephone)				
Phosphor-bronze wire, basis	,,	1s. 2 1/16d.	—	—
Brass 60/40—				
Rod, basis	,,	0s. 7½d.	—	—
Sheet, basis	,,	0s. 9¼d.	—	—
Wire, basis.....	,,	0s. 10d.	—	—
Pig Iron—				
Cleveland Warrants .	per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 SWG	,,	£18 0 0	—	—
Lead Pig—				
English	,,	£25 5 0	£1 5s.	—
Foreign or Colonial ..	,,	£24 2 6	£1 7s. 6d.	—
Tin—				
Ingot	,,	£153 10 0	£1 15s.	—
Wire, basis	per lb.	2s. 0¼d.	—	¼d.
Aluminium Ingots	per ton	£120 0 0	—	—
Spelter	per ton	£27 5 0	12s. 6d.	—
Mercury	per bottle	£11 0 0	—	—

Salammoniac.—Per cwt. 65s.-60s.
Sulphur (Flowers).—Ton £10 15s.
,, (Roll-Brimstone).—Per ton £10 15s.
Sodium Bichromate.—Per lb. 5½d.
Sodium Chlorate.—Per lb. 3½d.
Sulphuric Acid (Pyrites, 168°).—Per ton £9 10s.
Copper Sulphate.—Per ton £26 10s.
Boric Acid (Crystals).—Per ton £60
Rubber.—Para fine, 10½d.; plantation 1st latex, 8¾d

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

New Companies.

Bideford and District Electric Supply.

BIDEFORD AND DISTRICT ELECTRIC SUPPLY COMPANY, LTD. (181 201). Reg. April 19. Capital, £25 000 in £1 shares (7 500 preference and 17 500 ordinary). To acquire from S. I. Knill the rights, benefits, and interests referred to in three agreements, and to adopt three agreements with the said S. I. Knill, Crompton & Company, Ltd., and Bartlett, Bayliss & Company, Ltd., and to carry on the business of suppliers of electricity in Bideford and elsewhere. First directors: Major W. Ascott, E. W. S. Bartlett, J. U. Fulford, J. N. A. Houblon, Sir Robert M. Hyslop, H. N. G. Stuckley, and G. C. Smyth-Richards. Secretaries: R. and R. B. Blackmore. Registered office: Alexandra House, The Quay, Bideford, Devon.

James Gordon & Company.

JAMES GORDON & COMPANY, LTD. (181 247). Private company. Reg. April 21. Capital, £15 000 in 8 000 7½ per cent. preference shares of £1 each and 14 000 ordinary shares of 10s. each. To adopt agreements with J. Gordon and J. J. Lassen, and to carry on the business of founders, mechanical, electrical, and marine engineers, manufacturers of water turbines, governors, pipe lines, and other water-power machinery, &c. Subscribers: S. Pennells and B. H. Gower. Life directors: J. Gordon (chairman) and J. J. Lassen. Registered office: Windsor House, Kingsway, W.C. 2.

Instrument Screw.

INSTRUMENT SCREW COMPANY, LTD. (181 233). Private company. Reg. April 20. Capital, £3 000 in £1 shares. Manufacturers of screws and parts for electric and scientific instruments, and small engineering and scientific apparatus, &c., in the United Kingdom or elsewhere. First directors: E. Homberger (managing director and chairman), H. Booty. Secretary: H. C. Booty. Registered office: Stanley-road, South Harrow.

Kohler.

KOHLER COMPANY, LTD. Private company. Regd. April 20 by H. C. Davies & Son, 222, Strand, W.C. 2. Nominal capital, £10 000 in £1 shares. To act as agents, importers and exporters of goods manufactured or sold by the Kohler Company, of Kohler, Wisconsin, U.S.A.; to manufacture and deal in Kohler automatic power and light machines, plant and accessories, electrical and other machinery, internal combustion, gas, and other engines and dynamos, &c. First directors: W. J. Kohler, W. B. Clark, and J. Peacock. Registered office is at 329, High Holborn, W.C. File number, 181 235.

Level-Protractor Engineering.

LEVEL-PROTRACTOR ENGINEERING COMPANY, LTD. (180 100). Private company. Reg. April 12. Capital, £2 000 in £1 shares. Scientific instrument makers, mechanical, civil, and electrical engineers, &c. First directors: J. Sutter, E. H. Newton, and W. C. J. Schlie. Registered office: 3, St. Georges-terrace, Brearley-street, Birmingham.

Peacehaven Electric Light and Power.

PEACEHAVEN ELECTRIC LIGHT AND POWER COMPANY, LTD. Public company. Reg. April 21. Nominal capital, £20 000 in 15 000 10 per cent. preference shares of £1 each and 20 000 ordinary shares of 5s. each. To acquire certain plant and machinery and the right to supply electric light and power to owners, leaseholders, and tenants on the "Peacehaven" Estates and elsewhere, and to adopt an agreement with the South Coast Land and Resort Company, Ltd. First directors: Rt. Hon. Lord Teynham, C. W. Neville, and C. F. Gold. Registered office: 4, Vernon-place, W.C. 1. File number: 181 255.

Power and Traction Finance.

POWER AND TRACTION FINANCE COMPANY, LTD. Reg. April 20. Private company. Nominal Capital, £250 000 in £1 shares. To seek and secure openings for the employment of capital in any part of the world; to apply for and turn to account any Act of Parliament, decree, concession, right, or privilege; to carry on, finance, assist, or participate in trading, financial, commercial, industrial, manufacturing, mining, and other businesses, works, contracts, and undertakings, and to carry on business as exporters and importers of any articles, and as general engineers and contractors, and any business usually carried on by trust, finance, land, mortgage, and agency companies and bankers; to promote companies, to deal in investments and securities, and to acquire, construct, equip, administer, and control public works of all kinds. First directors: Wm. L. Hichens, Sir John Hunter, the Rt. Hon. Lord Meston, P. J. Pybus, Sir Hugh Read, Bt., and J. Sampson File number: 181 220.

Exhibition Notes.

The FOREIGN SAMPLES EXHIBITION, organised by the Department of Overseas Trade, is now held at 7-11, Old Bailey (first floor), E.C. 4 (Tel.: 1 866 City), where 13 500 sq. ft. of exhibiting space are available. It is open to British manufacturers only from 10 a.m. to 5 p.m. daily and 10 a.m. to 1 p.m. on Saturday.

An Exhibition of National Industries is to be opened in SANTIAGO on Sept. 16, under the auspices of the "Sociedad de Fomento Fabril" (Society for the Development of National Industries), and will remain open for two months. Exhibitors of machinery will be permitted to show samples of foreign manufacture, which will remain out of competition. British firms desiring to exhibit industrial or other machinery should communicate with their local agents, instructing them to make the necessary arrangements.

Arrangements for the Week.

FRIDAY, April 28th (to-day).

PHYSICAL SOCIETY OF LONDON.

5 p.m. At the Imperial College of Science, South Kensington, London. Papers will be read on :—

1. "The Position of Best Focus in the Presence of Spherical Aberration," by Mr. T. Smith, B.A.
2. "The Determination of the Absolute Stress-variation of Refractive Index," by Mr. F. Twyman and Mr. J. Perry.
3. "An Experimental Comparison of the Viscous Properties of (*a*) Carbon Dioxide and Nitrous Oxide, and (*b*) Nitrogen and Carbon Monoxide," by Mr. C. J. Smith.
4. Demonstration of the Optical Sonometer. by Mr. F. Twyman.

INSTITUTION OF MECHANICAL ENGINEERS.

6 p.m. At the Institution, Storey's-gate, St. James's-park. London, S.W. Paper entitled "An Account of some experiments on the Action of Cutting Tools," by Prof. E. G. Coker and Mr. K. C. Chakko.

ELECTRICAL POWER ENGINEERS' ASSOCIATION.

7 p.m. At the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London. Lecture entitled "Some Notes on the Design of Generating Plant," by Mr. C. F. Hewitt.

INSTITUTION OF ELECTRICAL ENGINEERS. (NORTH-WESTERN CENTRE.)

7.30 p.m. At the College of Technology, Manchester. Public Lecture on "Recent Developments in Atomic Research," by Prof. W. L. Bragg.

INSTITUTION OF ELECTRICAL ENGINEERS. (SCOTTISH CENTRE.)

7.30 p.m. At Technical Institute, Dundee. Paper entitled "Single and Three-Phase Alternating Current Commutator Motors with Series and Shunt Characteristics," by Prof. S. Parker Smith.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (NEWCASTLE-ON-TYNE).

7.30 p.m. In the Lecture Theatre of the Literary and Philosophical Society, Newcastle-on-Tyne. Paper entitled, "Corrosion—with Special Reference to the Ferrous Metals and the Deterioration of Ships," by Mr. A. Pickworth.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Lecturette. "Some Notes on the Utilisation of Water Power," by Capt. H. Whittaker.

MONDAY, May 1st.

SOCIETY OF ENGINEERS.

5.30 p.m. At the Geological Society, Burlington House, London, W. Part II. of Paper on "The Testing of Small Electrical Plant," by Dr. C. V. Drysdale.

INSTITUTION OF ELECTRICAL ENGINEERS. (WESTERN CENTRE.)

6 p.m. At South Wales Institute of Engineers, Park-place, Cardiff. Paper on "Electric Motor Starters." by Mr. James Anderson.

TUESDAY, May 2nd.

INSTITUTION OF CIVIL ENGINEERS.

6 p.m. At the Institution, Gt. George-street, London, S.W. 1. James Forrest. Lecture entitled, "Some Post-War Problems of Transport." by Sir John Aspinall.

WEDNESDAY, May 3rd.

INSTITUTION OF ELECTRICAL ENGINEERS. (WIRELESS SECTION.)

6 p.m. At the Institution, Savoy-place, London, W.C. 2. Lecture on "Short Wave Directional Wireless." by Mr. C. S. Franklin.

THE INSTITUTION OF METALS.

8 p.m. At the Institution of Mechanical Engineers, Storey's-gate, London, S.W. 1. Lecture on "The Relation of the Elements," by Sir Ernest Rutherford. F.R.S.

THURSDAY, May 4th.

THE IRON AND STEEL INSTITUTE.

10 a.m. At the Institution of Civil Engineers, Great George-street, London, S.W. 1. Annual meeting.

FRIDAY, May 5th.

ROYAL SOCIETY OF ARTS.

4.30 p.m. At John-street, London, W.C. 2. Lecture on "Imperial Wireless Communication," by Prof. W. H. Eccles, D.Sc., F.R.S.

THE IRON AND STEEL INSTITUTE.

10 a.m. At the Institution of Civil Engineers, Great George-street, London, S.W. 1. Annual meeting.

INSTITUTION OF ELECTRICAL ENGINEERS. (LONDON STUDENTS' SECTION.)

7 p.m. At the Institution, Savoy-place, London, W.C. 2. Lecture on "Electrically Oscillatory Discharges." by Mr. R. P. Howgrave-Graham.

THE JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Lecturette on "Gold Casting under Steam Pressure." by Mr. E. N. Ching.

EDINBURGH ELECTRICAL SOCIETY.

8 p.m. At Philosophical Institute, 4, Queen-street, Edinburgh. Annual meeting.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MEWBURN, ELLIS & CO., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

COMPLETE SPECIFICATIONS.

142 126 DICTOGRAPH PRODUCTS CORPORATION. Telephone sets. (21/8/17.)
142 845 SIEMENS-SCHUCKERTWERKE GES. Reversing of alternating-current shunt motors. (8/4/14.) (Addition to 2 409/14.)
145 400 FILIPPO, H., LELY, JUN., D., & NAAMLOOZE VENOOTSCHAP PHILIPS' GLOEILAMPENFABRIKEN. Electric glow discharge lamps. (20/6/19.)
145 421 SIEMENS & HALSKE AKT.-GES. Vacuum electric discharge apparatus having an incandescent cathode. (31/5/16.)
145 468 SIEMENS-SCHUCKERTWERKE GES. Dynamo electric machines. (10/11/14.)
145 528 BOSCH AKT.-GES. R. Construction of commutators. (29/4/19.)
145 587 MARSOLLIER, C. J. Electrical connecting devices and lamp-holders. (8/2/16.)
145 741 CORADI, O., & BUCHLER, H. GRAF-. Magnetic work-holders. (19/6/19.)
146 241 SIEMENS-SCHUCKERTWERKE GES. Totally enclosed dynamo-electric machines. (7/10/14.)
146 311 KRUPP AKT.-GES. F. Arrangement for the excitation of continuous current generators in Ward-Leonard systems. (6/1/15.)
146 425 WESTERN ELECTRIC CO., LTD. Telephone exchange systems. (29/12/16.)
148 313 HUTH GES. DR. E. F., & LOEWE, S. Methods of and apparatus for wireless telephony. (28/11/16.) (Addition to 148 312.)
148 316 HUTH GES., DR. E. F. Device for checking and recording at the sending station messages transmitted by wireless telegraphy. (21/10/14.)
148 323 HUTH GES., DR. E. F. Vehicle stations for wireless telegraphy. (4/12/14.)
148 415 SIGNAL GES. Electro-magnetic subaqueous sound producer or receiver. (11/7/18.) (Addition to 147 935, modified by 148 411 and 148 413.)
148 528 CONRADTY, C. (Firm of). Bow collectors for electric vehicles. (17/6/18.)
148 531 CONRADTY, C. (Firm of). Bow collectors for electric railways in which the slip-piece is adapted to turn upon its longitudinal axis. (28/4/16.)
149 282 MARCONI'S WIRELESS TELEGRAPH CO., LTD. Reception of wireless signals. (28/7/19.)
149 351 ALBER, E. Electric batteries. (26/7/19.)
149 975 MASCHINENFABRIK OERLIKON. Synchronous motor for polyphase current. (26/8/19.)
151 253 TROST, S. O. E. T. Wireless telegraphy. (18/7/19.)
151 609 LAFEUILLE, J. L. Electrical resistances. (22/9/19.)
151 613 LA PICHARDAIS, D. M. G. R. DE. Electric switches. (23/9/19.)
152 345 ROHDE, F. Suspension insulators for electric wires and cables. (12/10/20.) (Convention date not granted.)
152 658 VOLET, R. A. L. Dynamo-electric machine commutators and similar electrical apparatus. (13/10/19.)
153 908 MASCHINENFABRIK OERLIKON. Electrical heating device. (13/11/19.)
154 908 SOC. FRANCAISE RADIO ELECTRIQUE. Means for regulating the frequency of alternating currents. (6/12/19.)
155 297 GES FÜR TEERVERWERTUNG. Process for the manufacture of furnaces electrodes of large cross-section. (27/11/19.)
156 673 BERGMANN ELEKTRICITÄTS WERKE AKT.-GES. Construction of conductors for electrical machines. (26/11/17.)
157 103 WEDERSTAND AKT.-GES. FÜR ELEKTRO-WAERME-TECKNIK. Frames for the windings of electric resistances or heating elements. (12/9/18.)
157 438 SOC. ANON. DES ATELIERS BRILLÉ FRÈRES. Relays and synchronised clocks or other apparatus actuated thereby. (26/9/19.)
160 799 LEVY, L. Electric oscillation generator. (29/3/20.)
160 813 COHN, SEN. A. (Firm of). Electric switching or like devices. (23/4/19.) (Divided Application on 147 949.)
161 954 ALLMÄNNA SVENSKA ELEKTRISKA AKTIEBOLAGET. Means for reducing the ground current in electric high-tension transmission systems. (16/4/20.)
161 983 BAYERISCHE VEREINSBANK. Electric fire, burglar and like alarms. (20/4/20.)
163 288 ADAMS, A. H. Telephone exchange systems. (13/5/20.)
163 298 METROPOLITAN-VICKERS ELECTRICAL CO. LTD. Electrical controllers. (17/5/20.)
163 324 SIEMENS-SCHUCKERTWERKE GES. Process and apparatus for connecting additional transformers to a supply circuit. (14/5/20.)
164 725 SOC. D'ELECTRO-CHIMIE ET D'ELECTRO METALLURGIE. Process for obtaining deposits of iron by electrolysis. (9/6/20.)
165 072 METROPOLITAN-VICKERS ELECTRICAL CO., LTD. Control of alternating current electric motors. (17/6/20.)
166 878 METROPOLITAN-VICKERS ELECTRICAL CO., LTD. Control of alternating current electric motors. (19/7/20.)
167 496 AKT.-GES. BROWN, BOVERI, ET CIE. Oil-cooled transformer boxes. (5/8/20.)
168 860 METROPOLITAN-VICKERS ELECTRICAL CO. LTD. Protective apparatus for electrical systems. (8/9/20.)
168 893 BRITISH THOMSON-HOUSTON CO., LTD. Electron discharge amplifiers. (29/10/13.) (Divided application on 147 148.)
169 936 RAPHAEL, F. C., & EDISON SWAN ELECTRIC CO., LTD. Means for fixing electric cables and wires. (22/11/20.) (Divided Application on 32 934/20.)
170 016 BROWNING, W. H. Electrically heated soldering irons. (16/7/20.)
170 021 MARKS, E. C. R. (Nagel Electric Co., W. G.) Electric measuring instrument. (7/4/20.)
170 039 HOLSLAG, J. Electrodes for electric arc welding and like operations. (4/6/20.)
170 043 MONNOT, J. F. Storage battery plates. (8/6/20.)
170 048 HACKETT, P. J. Signalling circuits, particularly applicable to telephony. (9/6/20.)
170 049 WALKER, C. L. Electric signalling or control systems. (10/6/20.) (Cognate Application, 15 692/20.)
170 052 BULLEN, A. G. & JENKINSON, R. L. Electric switch automatically operated by heat. (11/6/20.)
170 072 MACRORIE, A. K., AIREY, H., MORRIS-SHEARING, G., and MULLARD, S. R. Supports for filaments used in thermionic valves and similar apparatus. (7/7/20.)
170 094 SCHROEDER, F. H. Dynamo-electric machines. (10/7/20.)
170 096 MACRORIE, A. K., AIREY, H., MORRIS-SHEARING, G., & MULLARD, S. R. Thermionic valves. (10/7/20.)
170 097 MACRORIE, A. K., AIREY, H., MORRIS-SHEARING, G., & MULLARD, S. R. Use of multiple seals with silica thermionic valves and a method of attaching the conductors from the seals to a valve electrode. (10/7/20.)
170 106 SIEURIN, S. E. Manufacture of furnace electrodes. (12/7/20.)
170 112 GARDNER, E. R. Appliance or instrument for testing magnetos and sparking plugs in actual use. (14/7/20.)

APPLICATIONS FOR PATENTS

April 10, 1922.

10 117 A. C. BARTON & F. H. LEFFLER. Electric switch.
10 122 E. G. CRAVEN. Rheostat, &c.
10 137 W. MCGEE & SON & J. B. & T. WHITE. Enclosed electric machines.
10 142 J. H. REEVES & J. TAYLOR. Method of locking lamps to holders.
10 143 & 10 144 C. E. WOOD, H. R. JONES, & W. E. LAWTON. Lifting magnets.
10 146 F. RICHARDSON. Drying paper on fibre insulated cables.
10 188 W. G. TURNER. Instrument for indicating simultaneously values of two variable readings.
10 207 B. T.-H. Co., H. C. WHEAT, & W. MILLNER. Electric lamp fittings.
10 214 RELAY AUTO. TELEPH. CO. & B. B. JOHNSON. Automatic, &c., telephone systems.
10 215 SOC. D'ETUDES POUR LIASONS TELEPHONIQUES ET TELEGRAPHIQUES À LONGUE DISTANCE. Long distance telephone installations. (8/7/21, France.)
10 220 RANSOMES, SIMS, & JEFFERIES, & MOSSAY & Co. Controlling mechanism of electric vehicles.
10 224 SIEMENS & HALSKE AKT.-GES. Telephone systems. (9/4/21, Germany.)
10 234 W. H. CHRISTIE & F. N. DENISON. Electric recording and sounding device.

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10 243 W. P. DURTNALL. Electric locomotives, tramcars, road vehicles, &c.
10 245 A. C. BARTON & F. H. LEFFLER. Automatic switch.
10 246 C. H.-W. BROWN. Electrically heated treeing iron for boot manufacture.
10 257 F. A. MILWARD. Rotating contact switch for bayonet holder fitting.
10 282 A. J. GREGORY & J. NICOL. Electrically controlled indicating device.
10 300 J. K. CATTERSON-SMITH. Alternating current circuit models for educational purposes.
10 311 M. A. RENISON. Diaphragm for sound recording telephone instruments, &c.
10 343 A. H. MAITRE & V. H. G. MARTIN. Damping device for switch contacts for electro-magnetic vibrating members. (18/4/21, France.)
10 348 LANDIS & GYR AKT.-GES. Prepayment meters for electricity, &c. (12/4/21, Switzerland.)
10 371 CHLORIDE ELECTRICAL STORAGE CO. (Kershaw). Storage batteries.
10 373 A. MELOTTE. Electric brush holders, &c.
10 382 C. C. GARRARD, M. J. RAILING, & W. WILSON. Charging accumulators.
10 393 B. T.-H. Co. (G. E. Co.). Regulators for electron discharge devices.
10 397 E. F. WIEDERHOLDT. Means for connecting conductors to sparking plugs.
10 401 A. H. PEHRSON. Rotating or oscillating electric furnace plants. (12/4/21, Sweden.)
10 402 C. B. KERSTING. Holders and adapters for radio telephonic and telegraphic apparatus.

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10 421 FULLERS' UNITED ELECK WORKS & L. FULLER. Galvanic batteries.
10 427 J. A. DAVIES. Device for application of electric power to agricultural machinery.
10 462 G. H. MOODY. Thermionic valve holders.
10 469 SIEMENS BROS. & Co., H. T. BODY, & W. H. GRINSTED. Automatic telephone systems.
10 471 W. PRIOR & C. E. RILEY. Selenium cells.
10 472 W. SANDFORD. Battery lamp.
10 474 F. KRUPP AKT.-GES. Time switches. (23/5/21, Germany.)
10 480 AUTOMATIC TELEPHONE MFG. CO. & H. H. HARRISON. Transmission of telephone numbers, &c.
10 486 EDISON SWAN ELECTRIC CO. Advertising device.
10 498 & 10 499 J. B. TUCKER. Electric switches.
10 507 GENERAL ELECTRIC CO., LTD., & G. C. MARRIS. Telephone repeater circuits.
10 510 STERLING TELEPHONE & ELECTRICAL CO. Indicators for lifts, &c.
10 512 E. P. BARFIELD & L. W. WILD. Electric furnaces.
10 513 M. MORRISON. Rectifiers for electric currents. (12/4/21, U.S.)
10 518 H. PARODI. Contact rail for electric traction.
10 520 H. L. DOWN & W. A. HOLE. Electric discharge tubes.
10 525 F. HERNAMAN-JOHNSON. Single-flash radiography.
10 527 C. A. VANDERVELL. Electric installations on motor cars.
10 538 G. W. HUMPHRY. Devices for connecting electric wires, &c.
10 539 G. W. HUMPHRY. Electric wiring systems for lead-sheathed cables, &c.
10 548 A. HELFENSTEIN. Closed electric furnace. (12/4/21, Austria.)

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10 572 T. G. P. HEALEY. Electric horns.
10 580 J. CLEMENT & L. GILLARD. Electric switches.
10 585 & 10 586 J. A. CRABTREE. Electric switches.
10 598 J. F. SCHLEPER. Jointing electric conductors.
10 612 A. G. BULLEN & R. L. JENKINSON. Adjustable clips for electric wiring.
10 628 F. KRUPP AKT.-GES. Permanent magnets. (29/6/21, Germany.)
10 629 F. KRUPP AKT.-GES. Electric overload protective systems. (28/5/21, Germany.)
10 649 BUREAU D'ORGANISATION ECONOMIQUE. Cooling of electrical apparatus. (13/4/21, Germany.)
10 650 R. PECHKRANZ. Electrolysis of water.
10 656 N. TOGAMI. Distributing systems.
10 660 S. M. TOWNSEND. Electric cooking devices.
10 666 VICKERS, LTD., & J. ETCHELLS. Electro-magnetic regulating devices for dynamo electric machines.
10 671 FERRANTI, LTD., & A. H. HIGGS. Alternating current distributing systems.
10 674 CHLORIDE ELECTRICAL STORAGE CO. (Ford). Storage batteries.
10 677 SCINTILLA. Apparatus for preventing operation of electric appliances on motor vehicles (20/5/21, Switzerland.)
10 678 S. J. FROST. Incandescent lamps &c.
10 700 W. S. GRAFF-BAKER & E. T. BAOCK. Electric apparatus for producing Ozone.
10 704 B. T.-H. Co. & E. F. W. ALEXANDERSON. Radio transmitting systems.
10 714 H. R. WRIGHT. Circuit arrangements for electric relays.

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CONTENTS.

Notes of the Week.

The Budget.

Now that the first enthusiasm at the reduction of taxation has died down, the Budget is being criticised from a more sober point of view than was possible in the atmosphere of rumour and petition of a few days ago. A lower income tax and the postal and telephone concessions will mean a direct saving in industrial as well as private circles, and will, therefore, be all to the good, and the customs reductions, by lightening domestic expenditure, may assist in the revival of other branches of trade. The taxpayers of the country ought therefore to be thankful for what they have been given, but the fact remains that they are not thankful, and are eager for still further reductions. There is justice in the claim. For it will be agreed that after nearly four years of peace the burden of taxation is much too heavy. Even now the income tax is at the very high figure of 5s., and for traders there is still that inequitable charge, the Corporation Tax, except in the case of public utility companies, who are, we are glad to see, exempted for another three years, though we hope it will have disappeared long before that. Postal and telephone rates ought to be still lower, and many of the other taxes are unjustly heavy and are becoming increasingly difficult of collection. Even the concessions have only been possible by the adoption of methods which are not too sound, and it is a gamble whether details on both sides of the balance-sheet will come out at anything like the figures estimated. The cure of all these ills is, of course, reduced expenditure, but this is a policy which the Government are as unwilling as ever to adopt. It is not surprising then that the Federation of British Industries are demanding another "Axe" Committee, or that Mr. Bonar Law should say: "The main duty of the Government is to realise that the revenue will fall, and that everything that human energy can do should be done to keep our expenditure at the lowest level."

D

The Protection of Turbo-Alternators.

The Paper on "Protective Apparatus for Turbo-Alternators," by Mr. J. A. Kuyser, which has been read and discussed before various centres of the Institution of Electrical Engineers during the past few weeks, deals with a subject which is not only important in itself, but upon which most electrical engineers have decided views. It is not, therefore, surprising that the discussions generally were interesting, critical, and well sustained. Mr. Kuyser argues that, for economic and operating reasons, turbo-alternators must be protected, and that it only remains to determine what system of protection to use. Most of the existing systems have their drawbacks, and he, therefore, proposes a new method for overcoming these. Coupled up with this is a consideration of the phenomena which occur when the field system is opened, and the different methods at present in use also come in for criticism. A great part of the discussion was influenced by a natural desire to controvert these arguments, and we are led to the opinion that while no doubt turbo-alternators can be protected, there is no general agreement as to how it can best be done.

Why Protection at All?

The most interesting part of the discussion dealt, however, with another phase of the subject. Why, said more than one speaker, have protection at all? Design your machine, both mechanically and electrically, to withstand all conditions, and then discard all external aids to safety. To do otherwise is a confession of failure. In any event, it is a bad policy to hang about your turbo-generator, which is, after all, a more or less engineering job, all sorts of flimsy apparatus, which will probably fail when they are most required. The operating engineer is particularly insistent on this argument, which must not be considered simply as a survival from the days when circuit-breakers were tied-up with string.

Insurance Not Engineering

The question is one rather of insurance than engineering. If at the present time we know all there is to be known about the vagaries and effects of short-circuit phenomena, then it is surely better to design self-contained plant to withstand those conditions. If we do not it is better to insure expensive plant by providing it with protective apparatus. But as time goes on the progress of both these schools must be toward each other, and when they meet protective apparatus will have become very simple, if it is not unnecessary altogether.

Education Estimates.

The discussion on the vote for the Board of Education, which took place in the House of Commons last week, brought out the fact that the total amount allocated for education in the current year is £6 104 653 less than in 1921-22, but this saving is unfairly distributed over elementary and higher education and research. It is unfortunate that the financial condition of the country necessitates drastic cuts in the amounts allocated for the education services, but, in our opinion, these economies should be effected in such a manner as to cause the least damage to educational progress and efficiency. On the ordinary services of the Board of Education it is proposed to spend about £4 900 000 less than in the past year. This represents a cut of about 10 per cent.; but the grant to universities and university colleges is down by £300 000, or a reduction of 20 per cent., and there is a similar cut in the grants for technical colleges. There is to be a further saving of £118 486 on scientific and industrial research, or a cut of 28 per cent., and as there was a substantial reduction in the amount allocated for research last year, it looks as if it were intended that this imporant work should be left to private initiative and enterprise, and therefore we shall soon be again enjoying easy-going pre-war conditions. The lessons taught by the War are in danger of being lost, and higher education, technical training, and research are to be sacrificed for the sake of economies which do not in the aggregate amount to a half-million! In our opinion, this is not economy; it is a reckless disregard of the best interests of the nation and of the Empire.

Hot and Cold.

We have indicated above the attitude of the Government towards technical education as evidenced by the tightening of the national purse strings. But this apparently is not the attitude of Mr. Herbert Fisher, the Minister for Education. Speaking at the first of a series of lectures on "Physics and Engineering Science," which are being delivered before the Institute of Physics by Prof. A. Barr, Mr. Fisher said "the industrial progress of the country was insecure unless it was based on a wide knowledge of science. . . . Science, and science alone, could enable us to maintain and extend our industrial progress." We suppose that to the educationist turned politician this is an excellent argument for reducing the support given to technical education. But if Mr. Fisher really feels like that, and the education estimates are passed as they stand, he ought to resign.

Foreign Engineering Contracts.

Any organisation which helps to develop the export trade of the country deserves encouragement and support, and therefore we welcome the formation of the British Power and Transport Finance Company, which is primarily intended to obtain and execute comprehensive engineering contracts, involving civil, mechanical and electrical work. There are a number of large railway, hydro-electric, and harbour schemes in prospect, but contracts for these are usually let subject to conditions as to finance and date of completion, which preclude individual firms from undertaking them. The new company has been formed in order to overcome these difficulties, and it proposes to concentrate the experience and financial power of a number of engineering firms and financial organisations into one association. It will thus be in a position to undertake and carry out the largest contracts and projects. The directors of the new company are Mr. W. L. Hichens (chairman of Cammell, Laird & Company), Sir John Hunter (managing director of Sir William Arrol & Company), Sir George May (Prudential Assurance Company), Sir Hugh Reid (managing director of the North British Locomotive Company), Mr. John Sampson (director of John Brown & Company), Lord Meston (a director), and Mr. P. J. Pybus (managing director of the English Electric Company). It will be seen that the manufacturing resources of the companies concerned will be equal to any calls that may be made upon them, and the co-operation of engineering and finance, which is foreshadowed, should be capable of meeting the competition of any foreign amalgamation or combination.

The Lighting of Hospitals.

Advances in technical equipment and method in hospitals during recent years have no doubt been considerable, but it would appear, from a discussion before a joint meeting of the Illuminating Engineering Society and the Royal Society of Medicine on April 27, that the methods of lighting employed in these institutions are not always ideal. Mr. John Darch, who read an introductory paper, even warned the audience of Florence Nightingale's trenchant observation that "the very first requirement of a hospital is that it should do the sick no harm!" One of the commonest faults, according to Mr. Darch, in the lighting of hospital wards is the liability of the lights to distract the eyes of patients, owing to the glare from imperfectly shaded filaments within the range of vision. We have no doubt, however, that the problems only need to be clearly stated to receive attention, and the intention of the Illuminating Engineering Society to form a small joint committee to deal with them should have good results.

Illumination of Operating Tables.

Methods used in operating theatres show great variety, some being extremely elaborate, others rather makeshift. The lighting of the operating-table is a difficult problem. A relatively high illumination, not less than 25 foot-candles, is needed. The lights should be so arranged that the surgeon, bending over the table, is not hampered by inconvenient shadows from his head or arms. Scrupulous care must, of course, be taken to avoid dust falling on the table, and accordingly some believe that lighting fittings should not be immediately overhead. Further, the use of lamps of high candle-power is apt to engender an amount of heat, which is trying to the surgeon and possibly harmful to the patient. One interesting possibility mentioned in the discussion is the use of "artificial daylight" in cases where the correct judgment of colours is important. This occurs, for instance, in certain operations, in examining affections of the skin, and in bacteriological work. The lighting of microscopes, touched upon by Mr. Conrad Beck, is again a special problem to which alone an evening's discussion might be devoted. Another feature of hospital lighting is the necessity for providing

plug outlets for inspection lamps, the design of which also presents interesting optical problems. It is not easy to get a sufficiently intense and even illumination from a lamp capable of being run on an ordinary supply voltage, but some new forms of compact lamps shown at the meeting suggest that considerable progress has been made in this direction. The discusssion raised many interesting points, and should form a useful basis for further research.

The Engineering Dispute.

Two important events in the history of the engineering dispute have occurred during the past week. The Government have at last appointed Sir. Wm. Mackenzie to hold a Court of Inquiry under Part II. of the Industrial Courts Act, and the employers announced that the shops were to be opened from Wednesday to those men who undertake to conform to certain instructions. It is too early to say what will be the result of these moves, but we hope they will both bring nearer the settlement which is urgently necessary. We are glad that the inquiry will be open to the Press and to the public, so that as much light as possible may be thrown on the arguments of both parties. There is not wanting the feeling that something is being kept back, that selfish interests are being used to prevent agreement, and that politics are being allowed to prevent production. At a time when trade revival is necessary and possible this should not be allowed.

The Institution Council.

The general body of members having exercised their right to make further nominations to some purpose, the election of the Council of the Institution of Electrical Engineers this year promises to be hotly contested. In addition to the six official nominations for three vacancies among the members of the "Ordinary Members of Council," three unofficial nominations have been made, so that voters will have to erase no less than six names from the ballot-paper. The three additional nominations are Mr. R. A. Chattock, city electrical engineer, Birmingham, who is nominated by an influential Midland group, Mr. R. H. Fletcher, of Cardiff, who obtains similar support from South Wales, and Mr. A. M. Sillar, who receives recognition from both London and Manchester. If all these candidates are elected the local centres will have no right to complain of under representation. Mr. A. F. Harmer is also nominated for a vacancy among the associate members, but here no erasion is necessary. Mr. Harmer has done good work, both in public and private, in connection with the informal meetings, and we are glad his activities will now have wider scope. All that remains is to recommend members to show their interest in Institution affairs by voting, so that the Council, as elected, may truly represent the general body of the Institution.

Revision of Prices.

It is announced that the Electricity Commissioners have granted, and the Ministry of Transport proposes to confirm, the Special Order amending the Brechin and Montrose Provisional Orders. The announcement has aroused considerable feeling in the municipal circles of the affected burghs, and opposition to the Special Order will be continued, though, we hope, without success. The attitude of these Scotch municipal fathers is unreasonable, for they are really endeavouring to enforce rigid agreements entered into and orders issued in the year 1898. The maximum price was then fixed at 8d. a unit, but two years ago permission was obtained under the Statutory Undertakings (Temporary Increase of Charges) Act, 1918, to raise the charge to 1s. a unit for private supply. The company now desires to make permanent provision for the periodical revision of the charges, somewhat on the lines of the Electricity (Supply) Bill, and the Commissioners have, naturally, granted the application, which is quite a reasonable one, and will operate as much in favour of the consumers as the company.

Bumbledom à l'Ecosse.

The contention of the Brechin Council is that as they transferred the original Order to the company on special terms as to the charges for electricity, "they should have the absolute right to fix prices without the interference of the Electricity Commissioners," and they would, therefore, like to limit the company to the pre-war dividend, which was only about $1\frac{2}{3}$ per cent. We doubt if the Council could have made a greater success of the undertaking than the company, but if they think they can we feel sure they can obtain possession of it upon reasonable terms. Many of the old provincial provisional orders were transferred to or secured by companies upon harsh terms, and it is for the good of the industry as a whole that these should be now revised, so that a reasonable return may be earned on the capital invested.

The Indo-European Telegraph System.

There is now a good prospect of the telegraph service of the Indo-European Telegraph Company, which has been completely interrupted for nearly eight years, being restored, as the company has secured the necessary concessions from Germany, Poland, and the Soviet Republic of Russia, the latter having been signed on April 12. Substantial progress has also been made with the work of repairing and renewing the telegraph poles and lines. Parts of the system, especially in Poland, have had to be rebuilt, and the task of restoration has been difficult and costly. However, we congratulate the company upon the success of their long and delicate negotiations, and we hope that their telegraph service to the Near East and India will soon be available for commercial and business purposes. It will add greatly to the existing telegraph facilities, and, by giving an alternative route to India, will relieve the congestion on the Eastern Company's cables, and thus minimise the risk of delays to Indian and Eastern cablegrams. Though the company has not been earning anything since the outbreak of the War, dividends have been regularly paid, as a joint purse arrangement exists with the companies engaged in the Eastern business, and there was also a substantial dividend equalisation fund. The latter, however, is now exhausted, but as the current year should see the company again earning money from international traffic, the return to the shareholders may not suffer in consequence. We notice that the Odessa-Constantinople cable is in working order, and this is a good augury, for we believe it portends the extension of the service to Southern Russia, the Black Sea ports, and the adjacent territories.

"The Electrician" and the British Museum.

A pleasant task, which hardly a day passes but we are called upon to perform, is to advise readers of the whereabouts in ancient Electricians of some article whose contents will prove useful to them in their present work. This pleasant task is, however, not without its unpleasant corollary. For we are often unable to supply the particular copy demanded—a copy which may be dated ten years ago, fifteen years ago, or even in the early 'nineties. We are, therefore, grateful to a correspondent, well known in newspaper circles for his research work, for pointing out that

The Electrician has been regularly filed and bound at the British Museum since its issue of May 25, 1878, thus providing what can only be described as a wonderful budget of electrical history.

The Law and its Application.

To those who have anything to do with publishing this may not seem extraordinary, but although it has been the law since the early 'forties that a copy of every newspaper, book, or pamphlet publicly offered for sale should be forwarded to the British Museum, that statute until comparatively recent times was more honoured in the breach than the observance, so that there is but a small minority of periodicals of which anything like a complete file exists.

"There is no doubt," our correspondent continues, "that when the paper first came into existence it supplied, to use a hackneyed phrase, 'a long-felt want,' and a study of these priceless volumes shows that from 1878 The Electrician had its fair share of public support and advertising patronage, both of which, as the years have gone on, have continued to increase, until it has become a question, the war notwithstanding, whether at any time your periodical ever enjoyed so large a measure of popularity as it owns to-day."

Seekers after electrical truth, as mirrored in the columns of The Electrician, will, therefore, be glad to know where they may refer to a complete file of all our issues, always excepting those less than a year old, which, by the rules of the Museum, may not be inspected. It may be added that very complete files of The Electrician are also to be found in other places in London and the provinces, notably in the libraries of the Institutions of Electrical and Civil Engineers and at the Patent Office.

Switchgear Evolution.

The details of the evolution of switchgear design and construction form an interesting chapter in electrical history. In the early days, when low voltages were general, heavy currents were broken in air by means of hand-operated switches, which made connection on rubbing contacts of elemental simplicity. Conductors were festooned about these switches in a manner more artistic than safe, and the fires which naturally were not uncommon were extinguished by drastic, though effectual, means, which, however, carried wreckage in their train. The switchboards themselves were, of course, fixed in buildings to protect them from atmospheric influences, but in other ways protection, as it is understood to-day, was conspicuous by its absence.

First Steps Towards Safety.

As the operating voltages increased, a movement towards a safer condition of things was made in two ways. First the switches themselves were placed in separate compartments or cubicles and other live-metal work was protected from unauthorised contact by barriers of suitable design. Then with the coming of the oil switch the contacts at which the circuits were broken were themselves protected and the equipment itself was fixed in places remote from human contact under normal conditions. This stage in evolution was a step towards greater safety and certainty in operation, but at the same time was a step towards greater complication.

The Coming of the Ironclad Switch.

The ironclad switch, which may be said to form the next stage, was therefore a step in that cyclic change towards simplicity which is characteristic of all engineering advancement. This switch, by concentrating the protection afforded, at the same time eliminated many complications and allowed the production of a type of equipment which was not only electrically safe and mechanically sound, but was immune from atmospheric influences in a way which was not thought possible in the early days of the rubbing-contact switch. In other words the ironclad switch was a self-contained piece of apparatus which could be used anywhere and for any purpose.

A Courageous Step.

These conditions led quite naturally to a further step forward. It was a step which was taken with so much diffidence that Mr. Coates, in an article on the subject which we publish on another page of this issue, is quite correct in calling it courageous. It was in fact nothing less than placing oil-break switchgear out of doors and so saving not only the cost of sub-station buildings, but gaining advantages from better observation and greater security. This was indeed a great step forward. Twenty years ago it was a step which would have been regarded with horror, and even ten years ago it was considered a fit subject for comic treatment. At present it may be stated with truth that the outdoor sub-station has come to stay. For while not much progress has been made with its application in this country, that is more due to our conservatism and to other conditions that have more recently influenced electrical progress than to anything inherently wrong with the outdoor sub-station itself. For in the United States, where the climatic conditions are, if anything, worse than in this country, and on the Continent it has been largely developed with considerable success. This development has also been helped by an abatence of the restrictions we labour under in this country.

Insulation the Deciding Factor.

The details which Mr. Coates gives in his article make it easy to see why this should be so. The whole problem is insulation. And transmission lines at pressures exceeding anything we have considered for practical purposes in this country have long been used with success elsewhere, so that the insulation problem has been solved. That disposes of everything but the switches, and in them, as Mr. Coates points out, insulation is a mechanical rather than an electrical matter and in some ways becomes easier as the pressure is increased. Instrument transformers introduce some difficulties, but these can be overcome by the use of water-tight terminal boxes and careful workmanship, a remark we imagine which equally applies to the sealing off of the transmission cables where these are employed instead of overhead lines.

Even as regards the switches which introduce the only novelty into the situation, Mr. Coates points out that there is nothing to fear. As we have already stated the modern tendency is to place ironclad protection closely round the switches and to strip everything else away. From its design and construction, therefore, the standard oil switch seems quite applicable to outdoor work with the addition of larger clearances and a careful attention to such minor points as erection and painting. This attention is made easier by the fact that a greater generosity in space is generally permissible, though the total ground area of the two types of sub-station does not usually vary greatly.

An Idea Worth Consideration.

Economically, as Mr. Coates shows, in the details he gives of a 33 kV scheme, the idea is well worth close consideration. A number of alternative designs are of course possible, but in every case a saving amounting to about 25 per cent. of the total can be obtained by adopting outdoor methods. This saving is, of course, obtained on the buildings alone, the cost of switchgear for outdoor work generally being rather more than for indoors owing to the reasons mentioned above. The difference is not, however,

important. These figures have recently been confirmed independently from the results of Swiss practice and indicate therefore that the question is one which, in these days of high voltages and linking up, should be closely considered by our electricity supply engineers.

It is also a question which should be closely considered by designers and manufacturers. For like many other branches of electrical progress the evolution of outdoor switchgear has largely been in the hands of American and Continental engineers. Conditions over here are not, however, the same as in these two countries, and it will be necessary to strike out a line for ourselves. We are glad to think that this is being done.

Transport Problems.

"Michael Angelo," remarked Sir John Aspinall in the James Forrest Lecture which he delivered before the Institution of Civil Engineers on Tuesday, "once said: 'Little things make perfection, little things mar perfection, and little things are the greatest part of perfection.'" The lecture dealt with "Some Post-War Problems of Transport," and ranged big and large over the many phases of this important question, which, as the lecturer pointed out, has been tackled with enthusiasm, vision and wrongheadedness at various times since 1855. All these attempts at solution are, however, alike in two things: they all envisage the enormity of the work and the great costliness which any scheme of improvement will involve, and they have all been pigeonholed in somebody or other's desk. And still the London traffic problem grows like an abnormal infant, gaining power and strength every day, and still optimists and lecturers, at loss for a subject, put forward schemes for its solution. But nothing is done, and it does not look as if anything ever will be.

Herculean Qualities Required.

This is not to say that Sir John Aspinall's address is not worth study. It is very much the reverse. It is worth study because it brings out so clearly how Herculean must be the qualities of the man who undertakes to summon order out of the chaos of London traffic, and how little the much-vaunted increased facilities have contributed to bring about any improvement. It might indeed be said that these facilities have made matters worse. They have encouraged travelling and increased the flow of traffic at a greater rate than the means provided for dealing with that flow. This, of course, is not the whole story. For the conversion of London into a workshop with its dormitories outside has not been entirely caused by the larger number of trains (not the greater ease) provided for travelling to and fro, though the two movements are inseparably bound up. Both have increased the difficulties which were so obvious in 1855, and even earlier, that suggestions for their improvement were already being made. And it is a little difficult to see how matters can be improved.

Cold Comfort for the Suburbs.

For, preaching on the text we have already quoted, Sir John Aspinall has but cold comfort for the suburban passenger. Matters might be bettered, he thinks, by more attention to the methods of platform approach, by the use of plain, well-lighted direction signs, by the better design of rolling stock, by thinking out other methods than those employed for supporting standing passengers, by constructing separate platforms for entrance and exit, and so forth, and so on. But he says: "It is a mere utopian vision to hope that seating room can ever be so ample that straphanging will be abolished in rush hours," and those whose daily travel is by means of that suspensory and uncomfortable method, while thanking Sir John for making their treadmill more scientific and luxurious, may well think modern engineering barren if this is the best it can do for them.

New Lines Wanted.

The difficulties, which Sir John suggests might be solved by the above methods, are nevertheless very real and are becoming every day harder to solve. As we have already pointed out, the schemes for linking up existing suburban systems, though good in themselves, will only mean greater congestion on the central lines, and will therefore tend to make travel more crowded, more troublesome, and less speedy than it is at present. The only real solution for this is the construction of relief lines designed, not for the present-day traffic but for future traffic, and built in the light of experience to include all the time-saving devices which we now know to be necessary. Especially might an outer-circle railway be built on which goods and passengers between two outlying districts could be carried without coming into the central area. To undertake such relief work will require courage and money, but it will in the long run provide a truer solution of the difficulty than any attempt to improve existing methods.

In a greater or lesser degree the same problem is present wherever suburban traffic is handled, and the two most promising solutions are electrification and well-thought-out methods of handling the traffic with all that the phrase implies. Electrification, as Sir John rightly points out, is, for economic reasons, also the best way of handling the main line traffic problem.

Another Solution.

There is one aspect of the traffic problem, which Sir John touches upon by inference, which may in due time prove to be the right road for escaping from many of our present difficulties. A large amount of our railway and road traffic is indispensable in order that the government and industry of the country may be properly carried on. But were our life ordered differently the traffic problem would also assume a different shape. At present a vast amount of train mileage is expended in taking passengers from their homes to their work and back again, in carrying goods from factories to distributing centres and then to the places where they are consumed. All this means a waste of time, rolling stock and energy, which has to be put down in plain figures to be believed. If this could be prevented, or at any rate reduced, one great section of the traffic problem would be solved almost by a stroke of the pen. In a word, if men and women lived where they worked we could reduce what are in reality unnecessary movements and give our present railway system a margin for useful expansion.

The Garden City Idea.

Sir John rather hints at some such solution in his remarks on the supply of electric current, and the idea is, of course, the essence of the garden city movement. If by the help of the Electricity Commissioners and the railway companies cheap electricity can be supplied along the length of our existing lines of communication the establishment of factories and dwellings under better conditions than we know at present would be easily possible. We should have a movement of divergence rather than concentration, a movement which should solve the traffic problem in the best possible way. Failing that it is a little difficult to see what can be done, especially in view of the reluctance of those most concerned to do anything but drift.

High Voltage Switchgear Design.

By W. A. COATES.

The problem of building electrical equipment for the high voltages which are now becoming common is mainly one of insulation. Two main types of insulation are required, that which merely supports the conductor and that which insulates the conductor where it passes through an earthed body. In high voltage work the limitations in design are mechanical rather than electrical, and in other ways greater simplicity is possible than at lower pressures. Though high voltage gear was at first contained in cubicles, it was soon found that this was unnecessary, while in 1908 the advantages of placing the gear out of doors was discovered. Mr. Coates discusses at length the details of modern outdoor switchgear compared with indoor equipment, and points out its economic and engineering advantages.

We have reached the stage in this country where it is necessary to reconsider the nomenclature applied to system pressures. This need is accentuated by the large Colonial developments and by the fact that certain British concerns are actively catering for this specialised market. The British Home Office rules have established the terms:

"Low Pressure" for systems not exceeding 250 V,
"Medium Pressure" for systems between 250 and 650 V,
"High Pressure" for systems between 650 and 3 000 V, and
"Extra-High Pressure" for anything over 3 000 V at the receiving point.

What, then, are we to call a system working at 66 000 V? Confusion has already arisen, due to the use of present phraseology, on systems which include high-voltage transmission, and it is suggested that the time is ripe for the adoption of some new term to meet the occasion. But superlatives in technical phraseology are undesirable, and in the title for this article the simple description "High Voltage" is applied to systems above the generating voltage. An adequate alternative term would be "super-generating pressure." This has the advantage of being self-explanatory, although it may perhaps be a trifle indefinite. There are systems which generate at 650 V or 2 200 V, and then step-up to 6 600 V for transmission.

The great majority of the world's high-voltage transmission systems are in North America, and it is a natural consequence that the two great American manufacturing concerns have led the way in the construction of suitable transforming and switching apparatus. Between them they have probably built 75 per cent. of the high-voltage equipment in the world, the balance having been supplied by some half-dozen Continental manufacturers. Within the past year at least one British concern (that with which the writer is connected) has entered the market and has laid down equipment enabling it to build apparatus for the highest commercial voltages.

Insulation and Switchgear.

Since high-voltage design problems are, in the main, insulation problems, a brief review of the position from that point of view is justifiable. Two main types of insulation are required: that which merely supports a conductor and that which insulates a conductor where it passes through an earthed body.

For indoor work, supporting insulators are comparatively simple to design and construct. The ordinary porcelain post insulator, proportionately enlarged, is customarily employed. Great mechanical strength is not of so much importance as on lower voltages, since the mutual repulsion between the conductors on short-circuit varies directly with the square of the current, and inversely as the distance between conductors. These tall porcelains can, therefore, be made hollow, with walls sufficiently thin to be thoroughly vitrified during the firing process. The longer insulators are usually thrown and turned in two parts, and are then jointed before fixing. To this there is no objection, since puncture-resisting qualities are not required.

Insulator Dimensions.

Full standards for insulator dimensions do not exist. In general, it will be found that for a given system voltage Continental insulators are appreciably shorter than those of British or American manufacturers. The following table gives usual values for the axial length of indoor post insulators:

Table I.

System kV.	Axial Length, inches.	
	British or American.	Continental.
22	9¼	7½
33	13	10
44	16	12
55	19½	14½
66	23	17
88	29	22
110	36	27

Profiles Adopted.

The profiles adopted for insulators of this type vary considerably, although irregularities are usually a matter of taste rather than scientific design. In fact, it is not infrequent for the addition of flanges or ornamental projecting rings to reduce the flash-over voltage of an insulator by providing points for stress concentration. The question of smooth versus corrugated surfaces has been thrashed out to a conclusion in favour of the former long ago. In their somewhat rare indoor installations, American designers still use corrugated high-voltage insulators, apparently because they do not consider the advantage gained sufficient to make it worth changing existing standards.

Insulators and Outdoor Work.

For outdoor work the problem is practically the same as for supporting the transmission line. The ordinary pin-type insulator ceases to be a commercial proposition on systems over 66 kV, as the size and weight of porcelain increase out of all proportion to the voltage. The unit construction—wherein several porcelain discs or sheds, separated by jointed metallic fittings, are used in series—is almost universal above that pressure, and is often employed for lower pressures.

Limitations Mechanical Rather than Electrical.

Where the busbars or connections can be suspended, the ordinary flexible string of line-insulators is employed. For holding the contacts of isolating switches, or other apparatus, rigid constructions on similar lines have been adopted. With these the limitations of design, so far, have been mechanical rather than electrical, although when working at 220 kV changes in the electrical design also may become necessary. In general, these tall, unit-type, post insulators should not be subjected to bending loads of any magnitude, but should rather be worked in compression, tension or torsion. Operated in this way no trouble is experienced.

Bushing Insulators.

Bushing insulators for high voltages are of three general types: (1) Compound-filled porcelain shells; (2) oil-filled porcelain shells; (3) condensers built of concentric layers of micarta, with metal-foil plates at intervals. To some extent bulk bushings made of bakelised micarta are employed also.

All three forms have been successfully applied to both indoor and outdoor working, the vast majority being of the oil-filled or condenser type. The former has the disadvantage of being somewhat delicate to handle, since at least one (usually three) oil-tight joint must be maintained, and, in the nature of things, the potential distribution across its surface is inferior to that of the condenser terminal. Against this, the porcelain shell can readily be moulded so as to incorporate rain-sheds for outdoor work, whereas separate sheds must be fitted over the condenser type.

For a given working voltage, the radial thickness necessary at the ground band is a maximum with the compound filled or bulk bushings, and a minimum with the condenser types. Ring-type transformers will thus be more accurate when used over a condenser than on any other type of terminal.

Apparatus Design.

Apart from the special design of terminal, to which reference has been made, and from the fact that greater clearances to earth must be allowed, there is little difference between the apparatus used on the highest pressures and that employed on our usual British voltages. The probable gas pressures developed in a high-voltage oil switch are less than with one on low voltage, so that the tanks, although much bigger, do not have to be stronger in proportion. When they are placed out of doors, the bottoms of all tanks should be raised sufficiently from the ground to permit the under-surface to be painted. This, of course, applies equally to power and instrument transformers.

Cost considerations prohibit the use of potential transformers on pressures over 66 kV. Metering can usually be done equally well on the low-tension side of a transformer bank. Some very desirable systems of automatic protection necessitate potential connections, but these must be put on one side in favour of protective systems, not quite so perfect, which can be worked from series transformers only.

Where the secondary load on series transformers is small, and the normal full load H.-T. current is of the order of 100 A, ring-type transformers round a condenser or oil-filled terminal can be used. The ring transformer is housed on the under-side of a switch or power-transformer cover, and thus takes up no extra space.

If conditions make wound primary series transformers essential, they are built as separate units, the two high-tension leads, lightly insulated from one another, being taken through the tank-cover in a single bushing. To avoid trouble, due to the inductance of the primary winding, when high-frequency surges occur, a shunt resistance is commonly bridged across the high-tension leads.

On all apparatus placed out of doors, to which small wiring is run, a watertight terminal box must be provided, with a downward outlet for screwed conduit. Plenty of space is desirable in such boxes, since connections may have to be changed or made with cold fingers.

Lightning Arresters Questions.

Lightning arresters for high-voltage work are a fit subject for a separate article, or indeed a book. It may be noted, however, that on pressures over about 50 kV neither the Wurts (multi-gap) type nor the condenser type are practical. The arresters in use are all either of the electrolytic type, or else a more or less elaborate modification of the original horn arrester. The chief point to be watched in installation is consequently the provision of adequate clearance above and around the horn gaps, since the arcs may rise to considerable heights.

There is a growing tendency to omit lightning arresters altogether on lines of 80 kV or more, and to rely solely on the protection of a ground wire run above the transmission lines. This is quite a logical proceeding, and has apparently been quite satisfactory on those systems treated in this way. Probably the majority of engineers will continue to instal the most efficient protective apparatus available, however.

Layouts.

In the layout of switching equipments marked variations occur in the practice followed in different countries. For apparatus working at generating voltage, some form of cellular construction is provided almost universally. In most large power-stations the fact of cubicle work being present does not materially increase the space occupied by the switchgear, since circuit centres are determined rather by the dimensions of the oil-switch. This does not hold good at super-generating voltages.

It is unsound to consider as an insulator the material of which cubicles are built, since in nearly every case such material is hygroscopic. It follows, then, that the clearance from live metal to cubicle wall must be as great as to earth. If the system be insulated, or have the neutral earthed through a resistance, it is necessary to reckon on the possible voltage to earth being the same as from phase to phase. The distance between conductors in different phases will thus be the thickness of the barrier which separates them, plus twice the air distance which would be safe were no barrier present.

Cubicle Design.

Cubicle work is intended (*a*) to limit the fire hazard; (*b*) to protect from adjacent live conductors men working on a dead circuit; and (*c*) where phase barriers are used to protect from accidental phase-to-phase short circuits.

The increased spacings essential with high voltages automatically reduce the risks under (*c*), and, to a degree, those under (*b*) also, leaving only the fire risk. Complete subdivision of phases is very rarely adopted on high voltages. Most Continental designers employ some cubicle work, applied like the flavouring in a cooking recipe, " to taste." There is no uniform practice. " A " employs full circuit barriers and also phase barriers between busbars. " B " does the same thing, but forgetting that fire control is the primary object of cubicle work, saves money by taking conductors through large holes in the cell walls, instead of through insulators which close the orifice. " C " encloses all the gear for a single circuit in a fire-proof room which is not subdivided in any way.

Safety Without Cubicles.

When American designers first approached this problem they took the bold step, and omitted all cubicle work. Safety was secured by guard-rails round the equipment for each circuit. The fire hazard was accounted negligible, for not only are accidental short-circuits less probable, but also

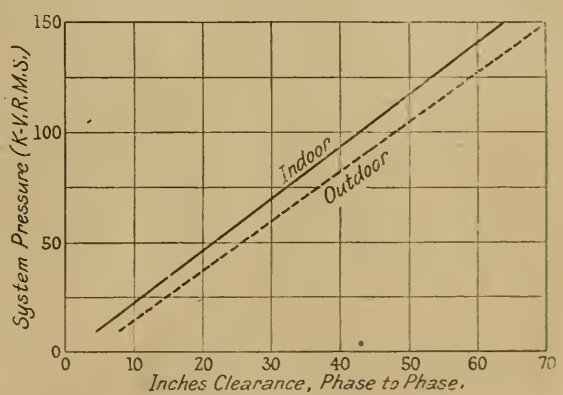


Fig. 1.

high-voltage oil-circuit breakers are less likely to burst when opening on short-circuit than those on lower voltages.

Experience has shown their action to be fully justified, as on these open structures very few accidents have happened which would have been avoided or minimised by cubicles. So far as the writer is aware, the sending and receiving stations on the Shawinigan system constitute the only outstanding exception to this practice. Here each circuit has its equipment in a separate fire-proof room.

Some of the most recent Continental installations have been planned to omit all cubicle work, and it seems reasonable to expect that in the comparatively near future cubicles will be confined to generating voltages only.

The Beginning of Outdoor Work.

In 1908 another courageous step was taken, when for the first time, oil-break switchgear was placed out of doors. The first large installation of this type was erected near Hamilton, Ont., Canada, in 1909. As an extra precaution, snow-sheds were erected above the oil-circuit breakers, but the first winter demonstrated conclusively, first, that the sheds did not protect the switch terminals from the snow, and second, that there was no need to do so, since they functioned just as well when buried in snow as when clean.

For outdoor work it is preferable to use rather larger clearances between phases and to earth than indoors. In Fig. 1 are indicated desirable standard clearances for the

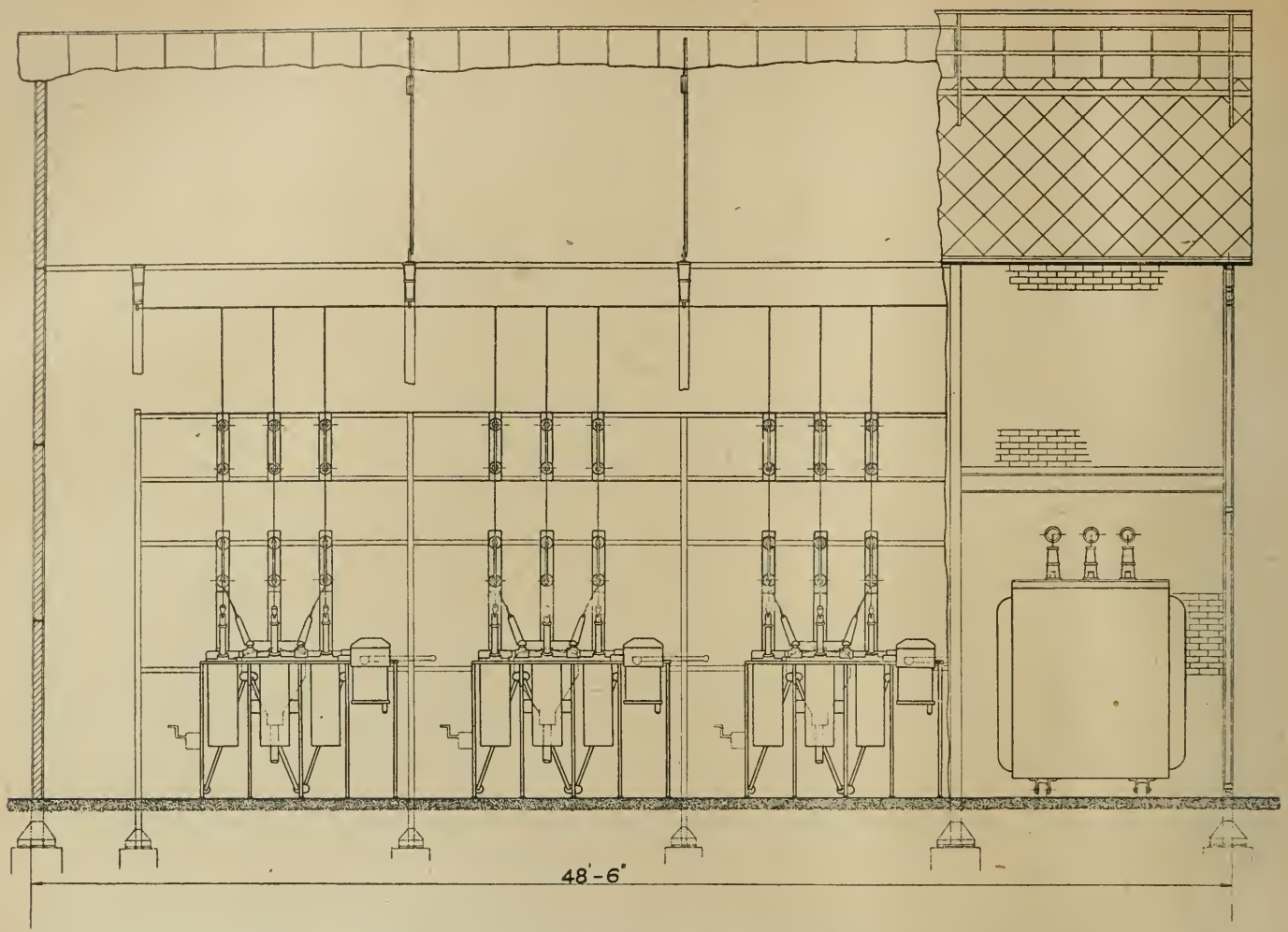


Fig. 2.—Exterior Elevation of Typical Indoor Sub-station, shewing Transformer in Cubicle, with Shutter of Latter Removed. Section "AA" shewing Feeder Switches.

two conditions. These are given for normally located installations at or near sea-level. Where the plant is at a high altitude the spacing should be varied inversely as the air density. For instance, at an altitude of 10 000 ft. the air density is 0·68, and the spacing should be increased by 47 per cent.

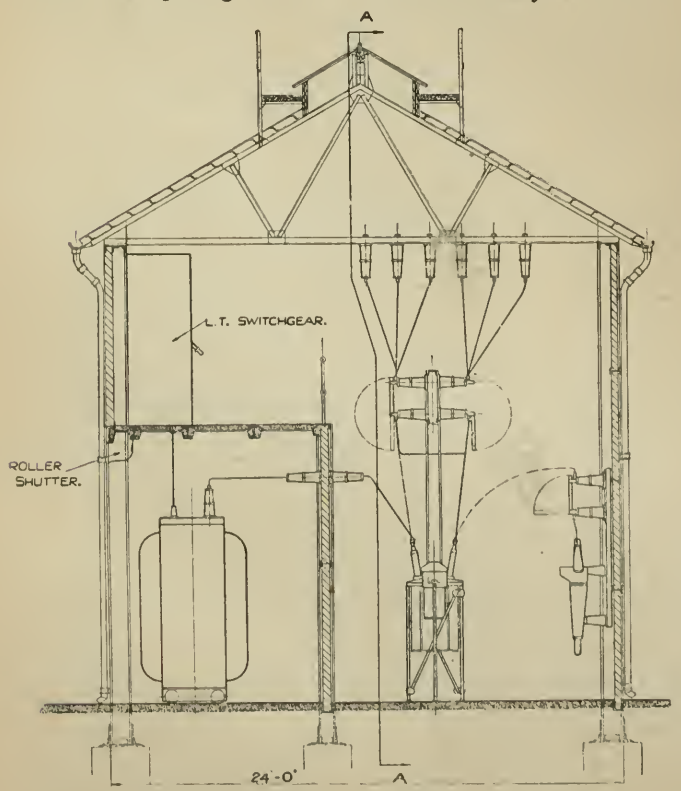


Fig. 3.—End Elevation of Typical 33 kV Transformer Sub-station.

As witness to the foregoing comments on the various types of layout, a large number of typical cases were studied recently, and the following approximate relationships determined for plants of pressures from 30 kV to 110 kV:

Type of Layout.	Per cent. Space Occupied.
Single bus, Continental cubicle layout ..	100
Double „ „ „ „ ...	115
Single „ American indoor „ ..	65
Double „ „ „ „ ...	65
Single „ „ outdoor „ ...	85
Double „ „ „ „ ...	140

Since cubicle structures for super-generating voltages may be regarded as obsolescent practice, it is proposed to discuss more fully the open indoor equipment as against the outdoor station.

The Space Question.

In the first case it will have been noted in the above table that the outdoor equipments occupy more space than those indoors. Primarily, this was not due to necessarily increased conductor spacing, but rather because, in the majority of instances, plenty of cheap ground was available. The whole outfit has been spread out for better and safer handling of equipment, and because so doing has not materially increased the total cost. As a rule, it is possible to get an outdoor switching equipment on to practically the same ground area as the corresponding indoor gear. This is demonstrated hereafter.

As regards cost, the equipment itself—*i.e.*, power transformers, oil switches, instrument transformers, and isolating switches—when built for outdoor service, will cost about 7 per cent. to 10 per cent. more than the corresponding

indoor types. This ratio being approximately fixed, in the typical cases following only the costs of buildings or steel-work structures are separately estimated.

Outdoor equipments at generating voltages are not usually feasible, since the space occupied is greater than with indoor equipment. In two cases recently studied, where the pressure was 11 kV, the outdoor scheme required two or three times the space of an indoor equipment, although there was an appreciable price advantage in favour of the former.

A further point is that on the L.-T. side quite an array of instruments is required which needs adequate weather protection. In small sub-stations these may be housed in a small, sheet-steel, lock-up cubicle, carried from the framework provided for the high-voltage gear if there is no actual switchgear required on the L.-T. side.

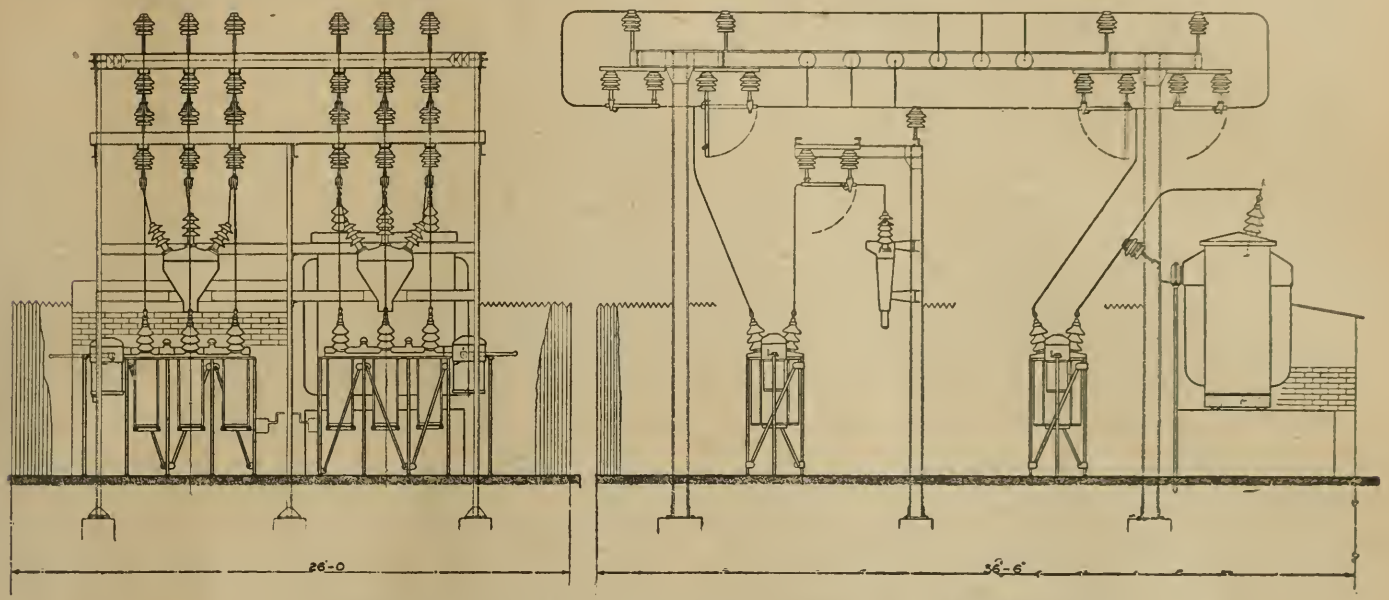


Fig. 4.—End Elevation and Section through One Feeder and Transformer Circuit.

The writer is of opinion that this voltage limitation is not insuperable, but, for the time being, we may confine our attention to those outdoor stations where the pressure is above that of generation.

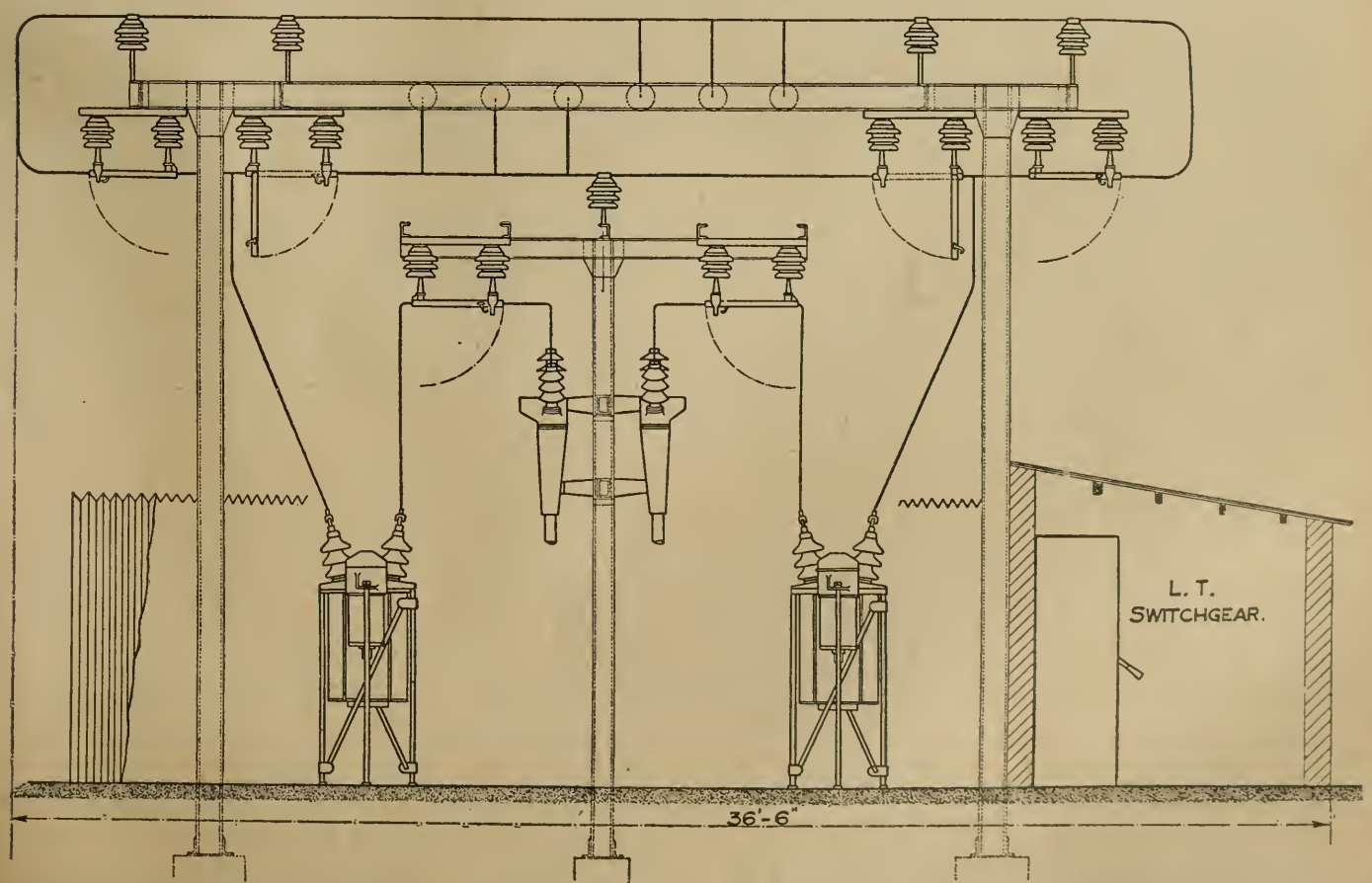


Fig. 5.—Section through Feeder Circuits and L.T. Switch-House.

Protection Against Rust.

A matter of prime importance is the means to be adopted to prevent rust on steel structures exposed to the weather. One solution is to galvanise the steel and assemble with

sherardised bolts. Unless the work be done really well, however, and no drilling or reaming of holes on site be necessary, deterioration will occur in time. Those parts adjacent to live conductors are probably best treated in this way. Ordinary paints are generally useless, because in time they dry hard and crack or flake off, particularly at the vulnerable joints.

The most satisfactory protection for surfaces readily accessible is to apply two or three coats of a paint having a bitumen or graphite base. These do not dry dead hard, but always remain flexible to a degree, permitting slight movements without injury to their surfaces.

It has been suggested that ferro-concrete should be used for supporting structures to avoid this anticipated trouble due to rust. The construction generally necessary does not lend itself to this class of work, which would be extremely heavy and costly. In fact, the design would probably end as a steel structure, encased in a concrete shell, which also would crack and admit moisture if there is any " working " under wind pressure.

To give a clear idea of the possibilities in high-voltage switchgear design two schemes are presented.

Details of a 33 kV Scheme.

In Figs. 2, 3, 4, and 5 are shown 33 kV transformer sub-stations, such as may become common requirements in this country when our super-station schemes are developed. Since in most cases (at least, at the urban terminal end) cable transmission will be essential, it has been assumed that the 33 kV line is brought underground to the sub-station.

Considering first the indoor sub-station, Figs. 2 and 3, a single three-phase O.I.S.C. transformer is housed in an isolated cubicle, which is accessible from outside the building only. Such a construction serves to limit the spread of fire, should one occur.

The L.-T. switchgear might be accommodated on the main floor, adjacent to the transformer cubicle, or if this space can be employed advantageously for stores or offices, advantage may be taken of the height of building by placing the H.-T. switchgear and control panels on top of the transformer cubicle. In an alternative arrangement the door to the transformer cubicle could open into the building, so that for repair work the transformer can be run from its cell into the main building.

The H.-T. switchgear is shown arranged entirely without cubicle work, a rolled-steel or pipe-work structure being employed to carry the selector switches. The space allowed for the operation of the selectors is unusually small, and might with advantage be increased, since it is not easy to withdraw a link from a position almost immediately below it.

In the particular case studied there were two incoming feeders and one outgoing feeder on the H.-T. side, in addition to the transformer circuit.

Floor Space.

The floor space occupied by the complete sub-station is 24 ft. by 48 ft. 6 in. (1 160 sq. ft.), and the cost of building may be put at £1 280. The cost of switchgear and transformer of indoor type erected would be approximately £3 570, giving a total cost for the indoor station of £4 850.

The corresponding outdoor arrangement is practically self-explanatory. The H.-T. circuits are arranged back to back. On one side of the structure the outdoor transformer is mounted on a concrete plinth of such height that, when necessary, the transformer can be skidded direct on to a lorry for removal. Beside this plinth is provided a small, lean-to building to house the L.-T. switchgear and control instruments. To prevent the access of unauthorised persons a corrugated-iron fence surrounds the whole structure.

In this case the ground space occupied is 36 ft. 6 in. by 26 ft. (946 sq. ft.). The cost of steel structure, concrete plinth, lean-to, concrete flooring, and fencing would be approximately £225, and the switch and transformer gear £3 900, giving a total for the outdoor scheme of £4 125—*i.e.*, an economy of 15 per cent.

(To be concluded.)

Reviews.

Thermionic Tubes in Radio Telegraphy and Telephony. By J. Scott-Taggart. (London: The Wireless Press, Ltd.) Pp. xxiii+424. 25s. net.

The volume under consideration appears to be a record of the development of the use of thermionic valves in radio telegraphy and telephony.

A short section at the beginning is devoted to a descriptive explanation of the phenomena occurring in thermionic valves and is followed by descriptions of the two electrode and three electrode valves. The use of these valves is described in following chapters as detectors, as amplifiers, as retroactive amplifiers and as high frequency and low frequency single and multistage amplifiers. Succeeding portions of the book deal with reception of continuous waves, the transmission of continuous waves, the use of valves in oscillators and wavemeters, and in wireless telephony. The two final chapters deal with the dynatron and with miscellaneous vacuum tube devices.

The author appears to have obtained much of his information from patent specifications. Much useful information can be obtained from this source both from the complete patent specifications and also from the volumes of abridgements published by the Patent Office. Though it is necessary to bear in mind that the granting of a patent does not insure its validity, nor does it imply that it will work. On p. 57 the author refers to an appendix giving a list of vacuum tube patents and original papers, unfortunately this appendix has been omitted.

It is thought that the book will be of greatest interest to the wireless amateur as it is couched in simple language and the majority of its statements and explanations are neither supported nor encumbered by any mathematical reasoning. The book is provided with circuit diagrams to an extent almost bewildering and we consider that much unnecessary repetition occurs both in the diagrams and in the text. As an example of the latter we notice that heterodyne reception is fully described on p. 252, it is again described on p. 339 in connection with wavemeter measurements, and once again on p. 348 in connection with measurement of capacity.

A defect in the book is the loose wording which frequently occurs. For example, on p. 150 we are introduced to a " step up " transformer, the resistance of whose primary winding " should be as high as possible." Resistance is not an advantage in a transformer it is an unfortunate accompaniment to a winding with a large number of turns, and statements like this have in the past inspired enthusiastic amateurs to rewind their apparatus with eureka wire. Again, on p. 244, an aperiodic anode circuit shown in Fig. 208 is described as oscillatory. Another instance, on p. 292, " It is unnecessary to have a separate aerial circuit loosely coupled to the *anode oscillatory circuit*. The reasons which necessitate this latter arrangement in an ordinary spark set do not apply."

In dealing with the methods of keying with valve transmitters Mr. Scott-Taggart falls into a common error in describing the marking and spacing wave method as " most undesirable since two wavelengths are being emitted and cause considerable interference with other stations." As a matter of fact this system will usually cause less interference than any other, since it is the only system by which undamped waves are radiated.

Costing for Manufacturers. By W. H. Hazell. (Nisbet & Company, Ltd.) 12s. 6d.

The war has given us quite a literature of costing. The Ministry of Munitions set up the most elaborate machinery for arriving at the cost of the products that it needed, and, at the same time, created a large class of costing experts, several of whom have since the war put their experiences into print, and given to the world their ideas on the science of costing. The volume now published from the pen of Mr. W. Howard Hazell, under the above title, will, therefore, be the more welcome because the author can speak on these matters with an authority greater than that of most writers. Mr. Hazell discusses very briefly the general principles underlying a true costing system, and then dives into detail. The essential features of costing are discussed one by one, and practical advice on the ascertaining, collecting, and application, of costing figures is given under appropriate headings. The matter is copiously supported with diagrams, and specimen accounts, while models for seventeen different forms appear as appendices.

Mr. Hazell fails, however, in a curious and remarkable way to understand the true purpose of the art which he is teaching. He thinks a business is carried on with the intention of charging to the customers the total cost of producing the goods, to which should be added a reasonable profit. The fact is, of course, that a business is carried on with the object of producing goods at a price which the public will readily pay. The latter definition makes a costing system far more important, and puts it on to a higher plane than Mr. Hazell appears to understand.

Protective Apparatus for Turbo-Generators.*

By J. A. KUYSER.

The author details the causes of electrical breakdowns on turbo-alternators, and discusses several well-known methods of preventing damage to the equipment when trouble occurs. He also describes a new system which aims at eliminating some of the shortcomings of existing methods. The need for, and points in the design of, automatic field switches are discussed at some length, and a means of localising fires is given.

The increase in size of distribution systems, power plants and generating units involves new problems in protection. Many improvements have been made in oil switches, automatic tripping devices and in the arrangement of protective reactances to control and limit large amounts of power. So far as the distribution system is concerned, satisfactory protection can now be obtained. Formerly it was not possible to secure the same degree of protection on turbo-generators and supply apparatus, but great advances have recently been made. Electrical breakdowns have frequently occurred on large turbo-generators where the resulting arc has ignited combustible material on the end windings; or, if in the slot portion have burnt the laminations, rendering a complete rewinding and even core rebuilding necessary, and resulting in a prolonged interruption of the supply.

Electrical Breakdowns in Alternators.

The majority of breakdowns in turbo-alternators are due to: (1) Faults between turns in the stator end-connections, or between conductors in the slot; (2) faults between phases on the stator end-connections; (3) faults to earth on the stator end-connections; (4) faults to earth in the stator slot conductors; (5) short-circuits or earths in the rotor winding..

Most serious breakdowns occur on the end-connections of turbo-stators, which are exposed to various prejudicial effects from the cooling air, even though the latter may be cleaned by wet-washing apparatus. Dirt may deposit, free moisture may be carried over due to defective action or freezing of air washers, and condensation of atmospheric moisture may also give trouble. Owing to the complicated shape of core windings the same high grade insulation as on end-connections may be impracticable, and faulty connectors cannot be eliminated by a high-flash test of 50 to 100 times operating voltage when the machine is completely wound. Earths inside slots are rare when mica wrapping has been used, but may occur on older machines and cases of deterioration or slot insulation owing to vibration have been recorded. Faults in rotor windings are usually due to broken connections, displacement of end-windings through centrifugal force, or to the use of combustible material in slots. Such faults, however, do not jeopardise the whole machine.

Precautions for preventing stator breakdowns include (1) care in design and manufacture, (2) installation of suitable air-cleaning apparatus, (3) care in operation, and (4) protective reactances. In dealing successively with these items the author emphasises the necessity of using insulation capable of withstanding the temperature met with, and the dielectric and mechanical stresses. Very few cases of breakdown due to temperature rise have been noted. Bracing the stator winding, especially the end-connectors, and efficient lamination of conductors in large machines are of great importance. Interchangeability of individual coils is sometimes specified, but this feature is of no avail unless protective gear, to localise damage, is provided.

The air-circulating system, which avoids the drawbacks of wet and dry-air filters, is mentioned with approval. The use of internal and external reactances for protective purposes greatly reduces shocks on generators, but nevertheless breakdowns occasionally occur, and in such cases the best that can be done is to isolate the machine and "kill" its field as soon as possible so as to limit the damage. Means for extinguishing fire should also be available.

Alternator Protective Devices.

Modern protective gear should operate on all possible faults in the generator or in the cables between the generators and busbars, but should be inoperative for faults and short-circuits external to the generator and cables. The gear should operate the main circuit breaker, interrupt the field current and reduce the generator voltage to a small value in the shortest time. Further, it should not introduce new weak points and so increase the risk of breakdowns.

The system most commonly used is the Merz-Price balanced protective gear, whose most serious drawback is that if a fault occurs between different turns of the same phase winding the fault currents are purely internal and will not cause unbalancing of the currents in the phase terminals. No protection is therefore obtained for such faults until they develop into an earth or into a short-circuit between phases; moreover, two current transformers seldom have identical magnetic characteristics, and perfect balance is therefore seldom obtained. A heavy magnetisation due to a short-circuit may upset the magnetic balance. This defect is evident on heavy overloads. The difficulty may be overcome by a coarse setting of the relay, but in this case the earthing resistance must have a low value. Hence with a fault to earth the fault current may not be sufficient to trip the gear.

Self-Balancing System.

The self-balancing system, proposed by Mr. J. R. Beard to overcome some of the defects in the Merz-Price system, has been adopted in several power stations. Current balance is obtained by a single transformer, thus eliminating the difficulties in obtaining a perfect balance mentioned above. But as regards faults between turns, the conditions are the same as in the Merz-Price gear.

Mid-Point Protective Gear.

A proposal (by the author and Mr. J. R. Beard) for a protective gear which will operate for all possible faults, including faults between turns, is illustrated in Fig. 1. The protected generator A, B, C, D is provided with tappings E, F, G from the mid-point of each phase. Reactance coils (or potential transformers) are connected in parallel with each phase and also provided with mid-point tappings M, N, O. The mid-point of the generator and that of the reactance coils are connected together. Current transformers are inserted in the mid-point connections and the secondaries of these transformers are connected to the relays.

When the machine is in normal operation the inter-connected points of generator and reactance are at the same potential and no

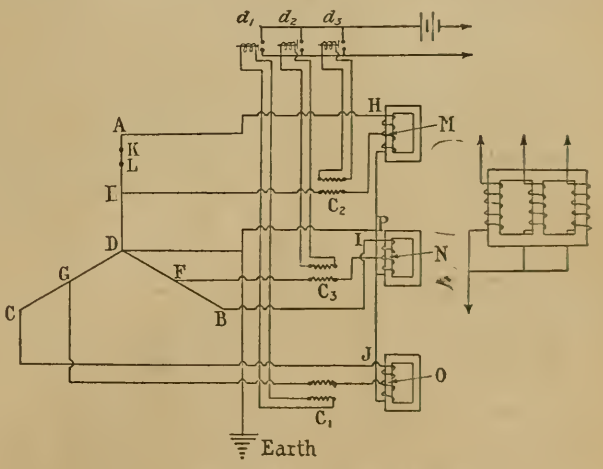


Fig. 1.—Mid-Point Protective Gear.

current will flow in the mid-point connections. If a fault occurs between turns, for example between points K and L (Fig. 1), the number of active turns between points A and E will be reduced and at the same time the flux will be weakened by the demagnetising action of the fault currents. Both actions will reduce the voltage between A and E and, to a smaller extent, the voltage in ED. The voltages in AE and DE will therefore be different, whereas the voltage of HM and NP will remain equal, being generated by the same flux. A current will therefore flow in the mid-point connection EM. The voltage and current induced in the mid-point connection is used to operate a tripping relay (by means of a transformer).

The unbalancing of the voltages in the phase halves or the shifting of the mid-point in the generator phase winding occurs not only on a fault between turns, but also when a fault occurs to earth or between phases.

The system will therefore deal with any fault in the generator winding, including faults between turns, and will give more complete protection than has hitherto been obtainable. A fault outside the generator, for instance, in the cables leading from the generator, will not cause unbalancing, and the generator leads would therefore not be protected. To include the leads in the protection, the cables can be provided with a conducting shield surrounding the central core and insulated for half the phase voltage from the core and from the armour. This shield is connected to the mid-point at the generator end. The reactance coils in this case are located at the switchboard and their mid-points connected to the shield. A fault from one of the cores to earth must be preceded by a fault from the

* Abstract of a Paper read before the Institution of Electrical Engineers.

core to the shield which forms the mid-point connection, and such a fault will operate the gear.

A Simplified Arrangement.

A simplification of the arrangement can be made in the case of a generator where the phases are wound in two parallel circuits. In this case the mid-points of the two parallel windings can be interconnected over the transformer which operates the relay. This system is, however, very limited in its application, as few generators are wound in two parallel circuits.

Automatic Field Switches.

As previously mentioned, a complete generator protective equipment should include an automatic field switch to interrupt the field circuit immediately the fault occurs. The automatic field switch may be located in different parts of the field circuit and may take the form of (1) a switch in the exciter field circuit, (2) a reversing switch in the exciter field circuit, (3) a circuit breaker in the main field circuit, (4) a switch to short-circuit the slip-rings and exciter.

Hitherto, in order to limit the voltage-rise on breaking the induction circuit, it has been standard practice to provide a non-inductive field-discharge resistance or " kicking coil " where a field circuit was to be opened. The normal operation of the field-discharge switch is to connect the field winding in parallel with the discharge resistance and subsequently to open the current supply from the exciter armature. Thus after the switching operation the field circuit is not interrupted, but the current circulating through the winding and the resistance is allowed to die out gradually. The ohmic value of the discharge resistance is, as a rule, roughly equal to the field resistance.

Time Required for Field Discharge.

An appreciable time elapses before the field current decreases to a reasonable value ; thus in the case of a 8 900 kVA 2-pole machine a current of 10 per cent. of no load value is attained in 11 secs. For a 23 500 kVA machine the time might be 30 secs. or even 1 min.

It is evidently necessary in the case of a stator breakdown that the voltage shall disappear as quickly as possible. The present arrangements appear unsatisfactory. The discharge is too slow and the voltage is maintained for a sufficient period to cause appreciable damage. The first remedy is to use a high discharge resistance, as the discharge time is inversely proportional to the total resistance in the discharge circuit. But the use of such high discharge resistances may lead to a high voltage-rise on the rotor winding during the switching If, as is usual, the discharge resistance is equal to the field resistance, the voltage-rise is equal to the excitation voltage, but if a high discharge resistance of, say, 19 times the field resistance is used, the voltage-rise would be theoretically 19 times the excitation voltage.

Influence of Damping Currents in Rotor Body.

The next factor to consider is the damping action of the closed circuits formed by the rotor slot-wedges and the rotor body. The effect of such currents is to reduce the high voltage-rise if a high discharge resistance is used, but to retain the sluggishness of the discharge. The damping circuit may be represented by a separate field winding short-circuited on itself, having the same number of turns as the field winding and lying in the same slots. If the resistance of the main field is equal to R_f, the ohmic value of the discharge resistance to R_r, and the equivalent resistance of the damping circuit to R_d, the equivalent resistance of the two circuits combined will fulfil the conditions

$$\frac{1}{R_e} = \frac{1}{R_f + R_r} + \frac{1}{R_d}$$

The equivalent resistance R_e determines the discharge current and voltage. R_d can be determined experimentally by making two discharges for different values of R_r and recording the current/time or voltage/time curves.

In a case where $R_r = 30\ R_f$ a damping effect equivalent to a discharge resistance of 38 times rotor resistance was recorded. An observed voltage rise of 25 times the excitation voltage on opening rotor circuit was recorded. This is less than the value derived from consideration of time-constants because the circuit was not opened absolutely simultaneously. The discharge resistance which has hitherto been used in conjunction with automatic field switches is therefore unnecessary, there being no danger of an insulation breakdown if the main field is opened by means of an ordinary circuit breaker. The elimination of the discharge resistance will greatly increase the value of the protection obtained, save the unnecessary expense of resistance units and special switches, and reduce the number of moving parts, thus increasing the reliability of the switch.

In the previous considerations the field switch has been assumed to be located in the main field circuit. Another method is to provide a small automatic switch in the exciter field circuit.

Switch in Exciter Field. A Suicide Connection.

A third method is to use a reversing field switch in the exciter field so that the field circuit is opened and subsequently reversed. The reversal of the field has the advantage that the remanence of the exciter is destroyed, and the remanent voltage on the a.c. terminals reduced. The discharge time depends only upon the total resistance in the discharge path, and in this respect there is no advantage over the simple exciter field switch.

An advantage could be obtained from the use of a reversing switch, by exciting the exciter field coils separately from an independent source and allowing the exciter to generate reversed voltage.

The main field switch produces a more rapid reduction of the current during the first period of the discharge, whereas the separately-excited reversed exciter would give a more rapid reduction for the final part of the discharge.

Slip-Ring Short-Circuiting Switch.

A fourth method of interrupting the field current is to establish a dead short-circuit between the two slip-rings. This will short-circuit the exciter armature, and some (though not excessive) sparking will therefore occur on the exciter commutator unless a preventive resistance is used. The method is quite practicable. The disadvantage lies in the fact that the resistance in the discharge path is smaller than in any other method, and the discharge time is correspondingly lengthened.

Method of Tripping Auto-Field Switch.

The field switch can be tripped in different ways, viz., (1) direct from the fault-current relays, (2) by means of an auxiliary switch on the main a.c. circuit breaker, (3) by means of a combination of methods (1) and (2), (4) a time-lag may be introduced after the tripping of the main switch.

If all apparatus in the protective system could be depended upon, that method (1) would doubtless be preferable, on account of the more rapid action. It happens sometimes, however, that the relays operate for a fault outside the generator ; or reverse-power relays may operate for a failure in the motive power. The field switch would then be tripped and, if the main breaker failed to operate due to a defect in the tripping mechanism, the sound machine will remain connected to the system with the field out of circuit. Even so, nothing serious usually happens if the field circuit of one of several parallel-running alternators is interrupted for a short time.

The next possibility is that in the case of faults occurring in the machine the main a.c. breaker fails to open. If the field is not interrupted the system will feed into the fault, as will also the defective generator itself. If the field is interrupted the faulty machine will not contribute to the fault currents. The energy flowing into the fault, and the damage, will therefore be appreciably reduced, particularly if the faulty machine is large compared with the other plant in parallel to it.

The object of method (4) is to prevent large voltages being induced in the rotor due to the inductive effect of the fault currents in the stator. For the same reason it has also been proposed to connect over-tension devices between the rotor slip-rings. Experiments carried out by the author on a machine with a solid rotor have shown that the voltages induced in the rotor in the case of a stator fault are of even smaller magnitude than those observed for a direct opening of the main field circuit under no-load conditions, and are therefore not of a dangerous nature.

The conclusion is, therefore, that operation directly from the fault-current relays is the most satisfactory method, although there would not be much to choose between methods (1), (2) or (3) if the main breaker is very quick-acting and is periodically tested to eliminate all possibility of " sticking."

Extinguishing of Fire.

Although the installation of electrical protective devices greatly reduces the possibility of fire in the windings, it is still advisable to provide means for extinguishing a fire in the extreme case of the protective gear failing and the winding becoming ignited. The usual method of extinguishing is to apply a hose or a fire extinguisher through the inspection covers in the stator end guards. This is a very drastic method and should be used only as a last resort ; also there is usually so long a delay in applying the extinguisher that the winding is ruined. If serious damage is to be prevented, extinguishing must be done *immediately* after the accident and preferably automatically by the action of the fault-current relays, and an extinguisher must be used which will not ruin the insulation. It is sound practice to provide air dampers in the air inlet and outlet, which are automatically closed by means of solenoids energised from the protective relays.

Another advantage of dampers in the air ducts is that the air circulation can be positively stopped while the generator is not in operation, thus preventing a condensation of humidity due to the natural draught in the building. Such condensation may also take place when a cold machine is started up and the air temperature is above the temperature of the machine. When this condition occurs it is therefore advisable not to open the dampers before starting up, but to leave the dampers closed until the generator has attained a temperature above that of the cooling air.

The Institution of Electrical Engineers.

At the meeting of the Institution of Electrical Engineers on Thursday, April 27, a Paper on "Protective Apparatus for Turbo-Generators" was read by Mr. J. A. Kuyser. An abstract of the Paper will be found on another page of this issue. We give below an account of the discussions which took place in London, Manchester and Newcastle.

DISCUSSION IN LONDON.

The PRESIDENT, in opening the discussion, said the Paper raised a subject of great interest. He was inclined to think that when they had Papers on protective gear it would be a useful thing to be given some idea of the cost of the gear, but far more important than that was an idea of the value of the property that the gear was to protect. In ordinary electrical installation work there must be many thousands of pounds' worth of gear put in to provide against faults that happened, he would not say once in a century, but once in a great many years. The protective gear described in the present Paper was not of that class; it was a gear providing protection against an enormous amount of possible damage that could be valued at thousands and thousands of pounds, and those who had to run big turbine plants knew the great amount of damage, loss, and annoyance that was caused because there was no really effective protective gear.

A Designer Unsympathetic.

Dr. S. PARKER SMITH said he had not very much sympathy with the Paper on general lines. He could sympathise with the station engineer who desired to protect his machinery against damage, but from the designer's point of view they should be a little more critical of their own work. They ought to be able to design turbo-alternators—in fact, he was sure it could be done—so that protection against external faults was unnecessary. It ought to be possible to have a short across the terminals without injuring the machine. If the machine would not stand that, then we had not reached perfection. This involved the question of how much we were prepared to pay for reliability. A good deal could be done to prevent the destruction of machines by paying greater attention to mechanical details. The bracing of the overhang, for instance, was now done very much better than it used to be. He mentioned this question of mechanical design because he had not very much faith in the idea of breaking the field rapidly. The effect of cutting off the field current was not to destroy the field, but it was the existence of the field that was going to cause the damage once the short circuit started. When they broke the field circuit the flux might continue for a considerable time; and it would be interesting to know how long the flux did persist inside the alternator. He felt it was wrong to rely on cutting off the field current as sufficient protection until we had more evidence of the time taken by the flux to die away.

Breaking by Relays.

Major K. EDGCUMBE said he was pleased to notice that the author strongly recommended the breaking of the field by the relays instead of by circuit breakers. His own feeling was that it was better to chance the remote possibility of having the machine left on the bars without its field, than to have the certainty that they were wasting valuable fractions of a second before they started breaking the field. The author seemed throughout to have assumed that he had done his job when he had reduced the voltage to zero, but that was not really so.

A Candid Admission.

Mr. H. W. CLOTHIER said the significant general feature of the Paper was the candid admission on the part of an alternator building expert that automatic protection could not be put on one side as an unwarranted appendage, and the user who was content to ignore the study of these automatic protective devices on the plea that they were more bother than they were worth was, to say the least, taking unnecessary risks. The author brought the weight of his experience to bear on three features: (1) The fault between turns; (2) the earth fault near to the neutral end; and (3) the extent to which an alternator would damage itself after the oil switch had isolated it unless the alternator field was suppressed. As regards the fault between the turns, hitherto with the balanced systems of protection we had been satisfied to allow such faults to develop to leakage faults to earth. This they must do, and thereby they disclosed their locality, and could be isolated without incurring much injury to the machine. As to the earth faults near to the neutral end, these might be so reduced in current by the neutral resistances that they were insufficient to operate the relays until they developed to faults between phases. Much depended upon the permissible setting of the relay and the amount of resistance inserted in the neutral. The proper way to shorten the unprotected part of the alternator winding was to use a larger neutral resistance, and so increase the amount of current which it would allow to pass. It was a mistaken practice for these to be installed to pass less than full load current; twice full load current would be better in most cases. With regard to the suppression of the field circuit, exciter field switches had been made to operate simultaneously with the Merz-Price balance protection for some years, but latterly it had been shown to be advantageous to operate by means of a circuit breaker in the main field. He submitted that no serious case had been proved against the fifteen-year-old Merz-Price balanced system or the five-year-old self-balanced system, but he agreed with the author that the mid-point or between turns system should be given a trial. The objections to the system were the introduction of the potential element in the protective gear transformers; the extra tapping on the stator coils; and the absence of protection for the alternator terminals. All these, however, could be overcome by careful design of the detail parts. The insulation of the transformers must be made very sound and with a much higher margin for safety than was usually allowed on potential transformer designs. He was assured by two alternator makers that there was no difficulty in finding a suitable place for the tapping on the alternator winding or for taking a well insulated conductor away from this place to a terminal. The author's proposal to screen the terminals and cable by a mid-point connection to the switchboard depended mainly for its success on a good design of terminal box mounted on the alternator frame which would combine high tension and mid-point screen conductors, preferably compound filled. An alternative method would be to use, in addition to the mid-point protection system, a balanced leakage protection. He felt it was most important on all such protective systems that there should be an ample margin in the sensitiveness of the relays between the test room results and that promised or put into use in actual practice. Just as we had a factor of safety in the strength of a structure, so should we have it in reliability of operation, and it was for this reason that he specially urged that the earth current should not be cut too fine for the sake of saving £100 or so on the cost of the earthing resistance.

Temporary Expedients.

Mr. A. D. SLOAN said that as a designer he was inclined to agree with Dr. Smith's remarks, but at the same time it had reluctantly to be admitted that breakdowns did occur, and that we were not absolutely immune. He understood the author's apparatus had only been tried in the factory, and he would like to know if it was sufficiently quick acting to isolate the machine and kill the field before the incipient fault developed into a fault. If it did not do that it was no use, and they might just as well rely on the Merz-Price gear. Endeavours must be made to secure sufficient reliability in the machines themselves to obviate the use of protective gear altogether.

Necessity for Simplicity.

Mr. H. BRAZIL said that what staggered him in connection with the author's new system of protection was the number of potential transformers which had to be used, things which we were always endeavouring to get away from. That was a very grave objection.

The Operating Engineer's View.

Mr. L. M. JOCKEL, speaking from the operating engineer's point of view, said the author's new system was exceedingly ingenious and was worthy of further research. At present it seemed to be exceedingly complicated, and would add considerably to the capital expense of the alternators in the case of very large machines. Moreover, he doubted whether many operating engineers would care to tackle the system until it had been further tested in practice. His own experience of faults between turns was that they were never evident, and they usually became a fault between phases or a fault to earth. It was, however, refreshing to have a Paper of this nature from an alternator builder. He did not think many operating engineers would tolerate the second arrangement suggested by the author. It seemed to be totally bad from the reliability point of view, and it had several theoretical disadvantages. Moreover, his experience had been that the less potential gear they had in a power station the safer they felt.

Mr. L. ANDREWS recalled that when he read a Paper before the Institution twenty-five years ago on protective devices for a.c. apparatus the topic of the criticism, particularly from the generator makers, was that the devices were very pretty, but if only generators were designed properly they would not be needed. That still seemed to be the criticism now, after that period of twenty-five years. What was wanted was generator makers and switchgear makers to work in parallel with the object of tackling this question, and it was gratifying to see a Paper from a designer treating the whole problem of the generator and the switchgear as one engineering proposition.

More Bother than Worth.

Mr. E. T. WILLIAMS said his experience was that in the majority of cases the troubles involved with the protective devices were

greater than those they were put in to protect. As had already been stated, what was wanted was greater simplicity because that would of necessity bring with it greater reliability, and if the advice of Dr. Parker Smith was followed by designers, and more attention given to the machines and less to the protective devices, we should be on the right lines.

DISCUSSION AT MANCHESTER.

Mr. J. A. Kuyser's Paper evoked a provocative discussion before the North-Western Centre on April 4. In general it was agreed that the Merz-Price system had proved its efficiency in spite of some disadvantages, although power engineers were inclined to be sceptical of protective systems. Those essential auxiliaries, potential and current transformers, were severely castigated and equally as warmly defended.

Improvements in Merz-Price Gear.

Mr. G. A. Cheetham said that Merz-Price gear could now be set to give 15 per cent. of full load without any danger of tripping under overload conditions. Increase in impedence of relay circuits had enabled current transformers to be worked higher up the magnetisation curve, balance then being more readily obtainable. The self-balance gear gave a definite current setting instead of a percentage of the full load current, as the lowest fault current operating the relays was the minimum fixed current which would flow through a bar primary transformer to provide voltage enough to overcome the relay impedance. Under normal conditions self-balancing gear gave lower fault setting than the Merz-Price gear, but an improved scheme recently introduced enabled designers to give Merz-Price gear protection at 7·5 per cent. instead of 15 per cent. with an earthing resistance passing full load current with a dead earth on one phase. The new mid-point protective gear gave protection between turns, but it needed potential transformers, and the generator terminals themselves were not protected.

A Power Engineer's Abhorrence.

Mr. H. C. Lamb said that the power engineer abhorred interruption of supply through automatic gear functioning without cause, and hence he fought shy of protective devices, automatically operated dampers and steam connections. The author had omitted mechanical faults on rotors as a possible cause of damage to high-tension windings. The closed air system had great advantages. The pressure of water in the cooler should be below that of the atmosphere. The system of mid-point protection had something to recommend it, but came rather late in the day, as in these days there should not be any faults between turns, even in end windings. In the author's scheme of connecting potential transformers a breakdown of the winding of one of the transformers or the blowing of one of the protective fuses would cause the relay to operate and cut out the generator. In the scheme for protecting two alternators in parallel two generators would be cut out, one a sound machine, because of a fault on one. The aim should be to kill the field instantaneously.

Mr. G. A. Juhlin said that very small faults frequently caused complete burn-outs due to fire, which would have been avoided had a system of protection been available. The author's remarks regarding the use of string for bracing end connections could not be endorsed. The system of mid-point protection was applicable to transformers needing protection between turns as well as machines.

Protection for Protective Gear!

Mr. H. A. Ratcliff criticised the minimum operating current taken by protective systems, due to the defective design of transformers and relays, and the erratic character of reverse power relays. The weak point of the mid-point system was the potential transformer. Since protective gear had to protect plant it had to be more reliable than the plant to be protected, and this was unlikely.

Mr. D. S. Paxton referred to an air-cleaning apparatus intermediate between the wet and dry filters, consisting of thin copper-plated steel tubes, the surface of which is covered by the cleaning medium, a high-flash, highly viscous oil.

Mr. S. Ferguson suggested that some generator breakdowns originated in surges on the cable system outside the generator itself, causing failure between end turns. This could be prevented by external reactance. The author had not mentioned the Ferranti field protection system, consisting of a core-balanced transformer slipped over the lead cover of the cable. He advocated the elimination of all relays and operating direct with the fault current. The mid-point system was too complicated to be of value, especially as a fault between turns would soon go to earth.

Potential and Current Transformers.

Mr. J. Frith referred to and underlined the criticism expressed about potential and current transformers. They were flimsy and were not engineering devices. He suggested eliminating oxygen from the closed air cooling system and using nitrogen or carbon dioxide to prevent fire spreading in the machine.

Mr. R. Townend asked for a definition of the term "quickly," if the field was to be killed. Was it ten seconds or sixty seconds? Short-circuiting the terminals after opening the main field circuit was the quickest way of killing the voltage practically instantaneously. Regarding short circuits between turns, voltages might be piled up between turns, especially end turns.

Mr. E. P. Hill gave some examples from practical experience of breakdowns and said that it was possible, in the author's mid-point system, to get two faults on even distance from the centre taps.

Mr. J. H. Buchanan defended the makers of potential and current transformers, especially in view of the difficulties created by slight increases in cost. Specifications varied so much that it was impossible to supply all varieties, and standardisation was thereby discouraged. It was true that potential transformers, which had more turns, were less dependable than current transformers, but great improvements had been made. Finally, the best results were obtained by not using the transformer for both protective gear and instruments.

DISCUSSION AT NEWCASTLE.

Mr. Kuyser's Paper was read and discussed in Newcastle on March 27. We give below a summary of the various speakers' remarks:

Mr. C. H. Davidson considered that a neutral switch should be provided as if this neutral switch could be opened sufficiently rapidly all damage to the generator would be prevented. If the generator air ducts were entirely within the station no trouble should be encountered due to condensation of moisture. With reference to the mid-point protective gear which was so arranged that it would trip out two machines when it operated, although one machine would be healthy, and as the author said, ready for synchronising again, how was it possible to ascertain which machine was all right and which was faulty? The arrangement of the slip-ring short-circuiting switch was open to objection, as the exciters were not usually so robust as the alternators and damage was more liable to result. It was necessary to kill the alternator field as quickly as possible and to do away with all damping circuits, but it was not desirable to break down the exciter insulation every time the field switch was opened.

An Unusual Procedure.

Mr. H. W. Clothier made the unusual statement that he had read the Paper—a proceeding apparently not followed by all the other speakers. He considered that the people responsible for the protection of alternators had not previously properly appreciated the necessity for such protection. The balanced systems of protection had been in use for some twelve to fifteen years, but it was only recently that generator manufacturers had realised the extent of the damage which could result to the machine through breakdowns and were beginning to pay more attention to the systems of protection which had been available so long, but had not received due consideration.

Temperature Rise and Damage.

Mr. J. Rosen did not agree that excessive temperature rise in the generators had little effect on the insulation. He considered that excessive temperature rises had caused a large number of breakdowns and was satisfied that the higher the temperature rises encountered, the shorter was the life of the alternator.

Mr. G. L. Porter said the "between-turns" protection was a great improvement on previous generator protective schemes, as the generator was really the only class of apparatus which was liable to breakdown between turns. A breakdown on the machine terminals could be taken care of by means of a screen connected to the mid-point of the gear, which was preferable to the installation of a separate protective system for this purpose. He considered it preferable to put the reactance coil at the generator terminals rather than at the switchgear terminals, as it was not usually possible to get the switchgear close to the generator, and the inductive drop on the cables would often cause a greater potential difference than that at which the gear would operate. The practice of interlocking the main and field switches was sound as, if the main switch did stick, the opening of the field switch would not matter as the damage to the generator would be done in any case.

A Complicated Arrangement.

Mr. J. W. J. Townley also objected to the author's statement that temperature rise did not appreciably affect breakdowns, as this was contrary to his experience. Operating engineers did not have much experience of generator breakdowns, but other machines were seen more often and indicate that the breakdown was frequently due to temperature rise. The breakdown of large generators was much more serious than the cost of repair would suggest. The suggestion of the combination of mid-point protection with ordinary Merz-Price protective gear would give a very complicated arrangement, in which the possibility of a wrong connection causing shut-down would be appreciably increased. Breakdowns were occasionally caused by the protective gear, particularly if proper attention was not available. In small stations, the operating staff might not properly understand the protective gear, and its treatment would suffer accordingly.

Physics and Engineering Science.

On Wednesday, April 26, the first of a series of lectures on "Physics in Industry," entitled "Physics and Engineering Science," was delivered by Prof. A. Barr, before the Institute of Physics. The Right Hon. H. A. L. Fisher (Minister for Education) presided.

In the course of some opening remarks the MINISTER for EDUCATION said that the Institute of Physics had been founded to draw the attention of the public to the importance of physical science as a factor in industrial progress. Appeal had first been made to the business man, but the call had also been addressed to schools and colleges and to the Board of Education. He was very glad that the Board of Education should be officially associated with the admirable purpose which the Institute of Physics was designed to perform. The industrial progress of the country was insecure unless it was based on a wide knowledge of science. We had built up our industrial position in the eighteenth century by the method of trial and error. We had been very fortunate in having cheap coal and cheap labour, and being first in the field with few competitors. Thus we had been able to travel fast and far with but a very slender equipment of scientific principle. But the world had greatly changed now. In every quarter we met with competitors; the old rough and ready methods of business no longer served. Cheap labour and cheap coal had gone; science and science alone could enable us to maintain and extend our industrial progress. A large proportion of our research associations were employing men trained as physicists or physical chemists; this was a welcome sign.

An Inexhaustible Subject.

Prof. BARR said his subject was one which could never be exhausted, but the exposition of the position in regard to one industry might throw almost as much light on the possibilities in another industry as a special treatment of the conditions of that industry would provide. The professor of applied science stood in relation to the physicist on the one hand and the practitioner of the arts on the other in the position of a go-between. He ought to know what were the points of contact and divergency between their fields of activity, to be able to appreciate the standpoints from which they respectively viewed any question bearing upon their intercourse and assist in constructing the lines of inter-communication.

The Relation of Theory and Practice.

There should be little need to-day to re-open the old discussion on the relative value of theory and practice in the arts of construction and production. The question of the relative values of the knowledge gained in the study of pure science and of that gained through long experience in the practice of a particular art could not be discussed in general terms, but we should arrive at no just views regarding the application of physics in industry unless we assigned full values to the mental equipment that might be derived from each of those scources. It appeared to him that in general the practitioner in the arts had sounder views regarding the aims of the men of science than the pure physicists had of the conditions under which industrial processes could be conducted and the limitations which those conditions imposed on men who would gladly avail themselves, as far as possible, of every advance made in the knowledge of the physical principles that underlay the arts they practised.

No Place for Engineering Science.

Coming more closely to his subject, the lecturer said that there had been physicists who held that there was no place for engineering science as a special and a distinct subject in any educational system, and that the study of mathematics and physics as branches of pure science, afforded sufficient systematic training for men preparing for the engineering profession; but there had been engineering chairs in our universities for more than sixty years, and their existence had been justified. The teaching offered by the engineering faculty in a university, was not purely, nor indeed mostly technical in the proper sense of the term; it was not so much so as in a medical school, which supplied the student with a training in the practice of his profession as well as in the science on which it was founded. The term, engineering science, might be usefully taken as embracing all the systematised knowledge that formed the special mental equipment of the engineer in practice from whatever source that knowledge had been derived; and if physics was taken to embrace all that was known of the properties of matter, and the transformation of energy, of course, engineering science, in any sense of the term, must be a branch of physics.

The problems with which the engineer had to deal were in their essence, almost infinitely more complex than those that the physical investigator set for himself. The more we studied the mechanical structure of plants and animals, the more we realised how complex were the functions to be performed, and the conditions to be complied with by each and every part; but if the investigation of the structure of an animal or plant, as bearing upon its functions, involved a complex and difficult problem, how much more difficult would it be to solve the reverse problem of devising the structure that would best meet the requirements in respect of all the functions that had to be performed.

Correspondence.

AMATEUR "WIRELESS."

To the Editor of THE ELECTRICIAN.

SIR,—I have noted with considerable interest various articles on the subject of Wireless Telegraphy and Telephony from the amateur's and experimenter's point of view recently published in the weekly journals, and can from a long experience dating back to Mr. Marconi's early experiments, concur with you in lamenting the irksome restrictions placed upon earnest research by British enthusiasts.

One hopes, however, that as a result of your publicity, coupled with the efforts of the Wireless Society of London, a greater latitude may be granted to those who, like myself, have matters wireless very much at heart.—I am, &c.

London, W., May 1. C. J. CLOSE.

Southend's Diesel Sets.

Mr. Robert Birkett, engineer and manager of the SOUTHEND LIGHT RAILWAYS AND ELECTRICITY DEPARTMENTS has long been of opinion that the salvation of the electricity department lies in the gradual substitution of Diesel engines for the old steam plant, which has always worked under difficult conditions owing to the high cost, and the unsatisfactory character of the Southend water, and, in recent years, also owing to the high cost of coal and coal carriage. The two 1 200 H.P. Diesel sets at Leigh saved the situation during the last coal strike, when the supply would have come to a standstill if they had not been available. Five Diesel sets ordered by the Corporation from Belliss and Morcom were disposed of at the request of the Local Government Board for war purposes, and in consequence of the difficulty of obtaining quick delivery of land type Diesels (with which, by the way, Mr. Birkett believes he could generate as cheaply as it could be done in the projected super-stations, having regard to capital and all other charges), the Corporation bought four 1 200 H.P. and two 600 H.P. Diesels, which were taken out of surrendered German submarines, and these are being used with their original generators, four A.E.G. and two Siemens-Schuckert. Two Heenan and Froude water coolers have been installed at each of the Diesel stations.

Visit to the Stations.

On Thursday of last week the Councillors and the Press inspected the six Diesels, of which two are at the main depot in London Road, two at Leigh, and two at Thorpe Bay, and also the battery and booster sub-station at Chalkwell Park. The first of the Diesels was put on load at the Leigh station on December 21, 1920, and by the time of last week's inspection it was expected that all the six engines would be ready for regular work. Mr. Birkett, however, admitted that one of the pair at the main depot still requires further adjustment, which is expected to be accomplished in the very near future. The working of the other five engines has been quite satisfactory. The six sets, which have been converted and installed by Belliss and Morcom, are now actually rated down to a total of 4 000 B.H.P. or 2 500 kW.

The Corporation at "Supper."

At a supper held after the opening ceremony, Mr. RADFORD, Chairman of the Electricity Committee, gave some figures with regard to coal consumption. He said the consumption at Southend was 3·9 lb. per unit, or only about ½ lb. more than at Brighton, where they had up-to-date turbine plant, but as he did not say whether the units generated by the Diesel sets were included in the calculation, the figures are not of much value as an indication of the comparative efficiency of the steam plant.

Mr. BIRKETT, in replying to the toast of his health, said the consumption per head of population at Southend was about the same as in Brighton and Blackpool—40 units per head—and the average price per unit at Southend was 4·24d. compared with 5·38d. at Brighton in 1921, and, according to the "Electrical Times" figures, about half the undertakings in the country charged more than was charged at Southend, and most of these places were in the north where coal was easier to get.

Electric Clocks.

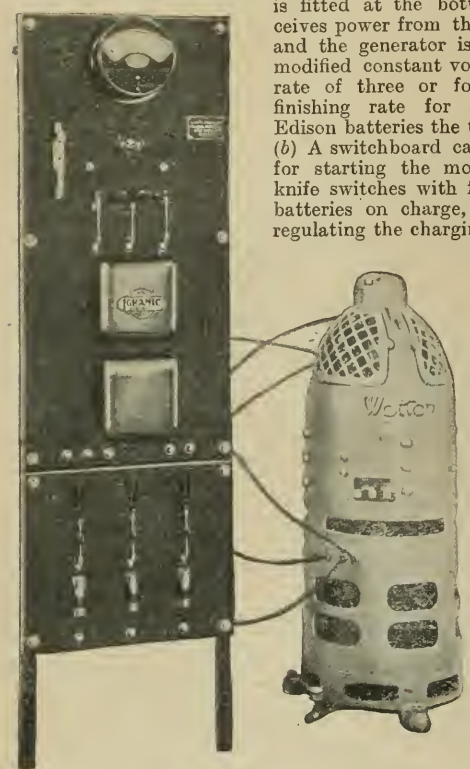
The Liverpool Overhead Railway have placed an order with GENT & COMPANY for a system of their pulsynetic electric clocks. Waterproof impulse clocks in cast-iron cases are being fitted at every station on the system, also in signal cabins, power stations, and administration departments, and all are controlled from a master clock or "transmitter" fixed at Dingle Station.

The installation is of more than ordinary interest, on account of the connecting wires which loop up the clocks being "broken" when the drawbridge at Clarence Dock swings. The timekeeping of the whole system is not affected, however, by the temporary disconnection. Further, the vibration of the steel structure, caused by passing trains, does not affect the timekeeping of the impulse clocks.

Automatic Battery-Charging Plant.

The efficient handling of materials and the uninterrupted operation of the transportation system in every industry where the storage battery, truck, tractor, or locomotive can be used, has always been the keynote in the design and construction of the various types of Wotton Battery Charging Plants manufactured by the Igranic Electric Company. Each type has been designed to meet the battery-charging requirements in connection with some one transportation problem, and they all embody perfections and refinements that are the result of many years' practical experience.

The Wotton vertical motor generator, which we illustrate, is associated with an automatic switchboard having equipment for distributing the charging current to one, two, or three batteries at once. It comprises :—(*a*) The Wotton motor-generator, consisting of an a.c. motor, mounted in the lower half of the frame, driving (through a one-piece shaft) the d.c. generator mounted above it. An annular self-aligning bearing with centrifugal pump oil circulation is provided at the top, while a combined thrust and annular bearing with splash lubrication is fitted at the bottom. The motor receives power from the line at full voltage, and the generator is wound to deliver a modified constant voltage, with a starting rate of three or four times the normal finishing rate for lead batteries. For Edison batteries the taper is not so steep ; (*b*) A switchboard carrying a knife switch for starting the motor, three single-pole knife switches with fuses for placing the batteries on charge, a field rheostat for regulating the charging rate, an automatic cut-off and reclosing circuit breaker and a combined voltmeter and ammeter.



A Wotton Vertical Motor Generator.

Twin Unit Plants.

Many factories are entirely dependent upon the industrial truck for all transportation of material and prefer to divide the charging equipment into two or more sections so that no combination of circumstances can reasonably put the trucks out of commission. Twin unit sets are manufactured to meet this demand. They are adapted to charge two batteries simultaneously at normal rate, or one battery at double normal rate, and at the same time provide a factor of safety against breakdown.

This arrangement includes two switchboards bolted together and two vertical generators. A double-pole switch, for paralleling the generators when boosting one battery, is carried on one of the panels. It is, of course, a simple matter to extend such an installation to charge any desired number of trucks simultaneously.

Assuming that two batteries are to be charged simultaneously, both motor generators are started by closing the motor switches and both charging switches are closed. The plant can then be left unattended. As soon as one battery is charged, two contacts close in the meter which is connected in the battery circuit, thus disconnecting the battery and causing the motor generator to stop. The second set is shut down in a similar manner when its battery is fully charged.

If, during the charging operations, there is a temporary failure of line voltage the set is automatically stopped and the charging circuit is opened. Immediately the supply is resumed the motor generators are automatically re-started and charging continues.

I.E.E. : North Midland Centre.

The Annual Meeting of the North Midland Centre of the Institution of Electrical Engineers was held at Leeds last week, about fifty members being present. In the absence of Mr. W. E. Burnand, Mr. W. B. Woodhouse took the chair, and the accounts were duly passed. The following officers have been elected for the ensuing year :—Chairman : Mr. W. B. Woodhouse ; Vice-Chairmen : Major H. Bell, Major E. A. Barker, Messrs W. Howard Brown, and S. Derwen Jones ; Hon. Secretary : J. D. Bailie ; Committee : T. Roles, T. B. Johnson, A. F. Carter.

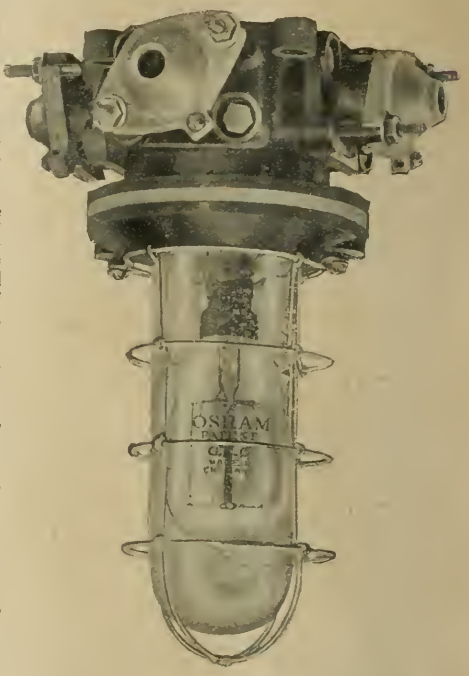
The summer meeting is to be revived, and notice of this will be given in due course.

Mr. W. H. Brown, the representative for the North Midland Centre of the Benevolent Fund, said a few words on behalf of the Fund, for which a collection was afterwards made.

A concert and wireless telephony demonstration then followed, which was thoroughly appreciated by all present.

Flame-Proof Mining Boxes.

The General Electric Company have recently developed a range of flame-proof lighting boxes for use with wire armoured V.I.R. cables in fiery mines, in which, by the use of only three standard forms of box and three types of glands, practically every lighting requirement in dangerous areas has been catered for. It will be seen from the illustration that these boxes are of robust construction. They comply in every respect with the regulations laid down in the Coal Mines Act, and among the important features in their design may be mentioned machined flanges of generous width on both box and cover, a simple locking device, and special attention to details of insulation. The armouring is clamped between two concentric cones, giving a large contact area and ensuring a firm connection and perfect continuity.



Universal Box with Detachable Glands and Well-Glass Fittings.

The Universal Junction box can be supplied as a one, two, three or four-way box with any one of three types of cover —(*a*) a solid front with central outlet tapped ½ in. gas and plugged ; (*b*) a cover for attaching a well-glass fitting ; and (*c*) a cover for attaching a bulkhead fitting. The solid front is supplied where the box is required merely as a junction box or where pendent lights are required. In the latter event, either a conduit drop with well-glass fitting or a cable gland with sealing chamber can be fitted. Two types of glands can be supplied, one forming an integral part of the box and the other detachable. The latter type can be removed, together with the sealing chamber by removing two bolts. In this manner connections or complete branch circuits can be prepared above ground and attached to boxes already erected. In the event of a failure renewals or repairs can be effected conveniently.

The third type of box is a split junction box for use with the mining-type lighting boxes when running cables are employed. By the use of split glands the cable may be tapped at any point and the branch circuit which can be made up complete, attached with the minimum interference with working.

I.E.E. : North-Western Centre.

At the Annual Meeting of the North-Western Centre of the Institution of Electrical Engineers last week the committee reported that eleven ordinary meetings and two special public meetings had been held, the average attendance at ordinary meetings being 115, and the average number of speakers at each discussion being nine. Four of the meetings were informal in character, and the committee felt amply justified in recommending their continuance during the next session. The membership was now 1343, an increase of 129 over the previous session. The following officers were elected :—Chairman : Mr. A. S. Barnard ; Vice-Chairmen : Mr. G. A. Juhlin, Mr. H. C. Lamb ; hon. secretary : Mr. W. A. Coates ; new members of committee : Messrs. A. G. Ellis, A. B. Mallinson, W. J. Medlyn, S. L. Pearce. Mr. Ellis had resigned the honorary secretaryship after three years of office, and Mr. W. A. Coates was elected to the post. The committee was gratified to record the election by the Institution of the assistant secretary, Mr. A. L. Green, as an Associate. Mr. Green had been connected with the North-Western Centre for twenty-one years. The Liverpool Sub-centre, founded in 1919, had a membership of 449, and the Students' Section had had a very active year. After the meeting Mr. J. W. Beauchamp, Director and Secretary of the E.D.A., gave a short lecture on Engineering Advertising, with special reference to the work of the E.D.A.

The Reform Club Kitchen.

The kitchen of the Reform Club, Pall Mall, is to be modernised and re-equipped this summer, and the contract for this work has been placed with Benham & Sons, Ltd., of Wigmore-street, W., who originally fitted up the kitchen in 1842, under the instructions of the famous chef, M. Alexis Soyer. Benham & Sons have in their possession a picture of the first equipment, and a few of the original fittings appear to be still in existence after eighty years. Mr. Stanley J. Benham, the present managing director, is the grandson of Mr. John Lee Benham, who carried out the contract in 1842.

Economic Conditions in Germany.

In the introduction to their report on the ECONOMICAL AND FINANCIAL CONDITIONS in Germany for the year to March, 1922, Messrs. J. W. F. Thelwall (Commercial Secretary to H.M. Embassy, Berlin) and C. J. Kavanagh (Commercial Secretary, Occupied Territories, &c., Cologne) state that there has been further progress towards order within the country; the more distressing features resulting from the war have almost completely disappeared; work has been plentiful and the resumption of overseas relations has taken place on a vast scale; but the bases of commercial life—stability of exchange and the granting of credit—are apparently as far from a satisfactory condition as ever.

Electrical Engineering.

The electrical trades were kept well employed on inland requirements, electricity supply and telephone extensions. The electrical transport developments have provided an appreciable amount of work, and the general activity in reconstruction throughout various industries resulted in a keen demand for plant and apparatus of all descriptions. The collapse of exchange in August led to a flood of orders for foreign account. The electrical groups of the Rhine-Elbe-Union concentration report that the community of interests agreement which they entered into with the steel producers has realised their expectations in greatly facilitating the supply of raw and semi-manufactured materials as regards quantity, quality, and regular delivery.

Research.

In the field of research and development in design the industry was as active as ever. Tests carried out on a gas turbine of a workable output are reported to have given satisfactory results, the development of the brown coalfield led to a stronger manufacturing capacity in specialised plant, and the overland h.t. transmission schemes gave a development to electrical apparatus required in this connection. The interest aroused by the low-temperature distillation of coal gave an impetus to the construction of plant, whereas the extension in the use of brown coal led to considerable attention to steam generators adapted to this class of fuel.

Electric Power.

The Rhineland-Westphalian industrial centre, together with its neighbouring districts, benefit from a very highly developed system of electric supply, and are calculated to receive an annual distribution from the supply stations of 13 milliard kWh, whereas the power generated on the mines and in the blast furnace and steelworks is estimated at 4 milliard kWh. The supply is chiefly in the hands of two large concerns, and augmented by the municipal stations of some of the larger towns, such as Duisburg, Dortmund, Oberhausen, Düsseldorf, Crefeld, Elberfeld, Barmen, and Cologne.

The chief private companies operating are the Rhenish-Westphalian Electricity Works, installed with 350 000 kW capacity, and the Communal Electricity Works Association, with 280 000 kW capacity. The former, which was originally formed with a capital of 2½ million marks, has now a share capital of over 100 million marks. In the initial stages its development was chiefly brought about by the absorption of various small supply stations, and more recently by the installation of new plant, of which the super-power station at Knapsack, operating on brown coal and having a turbo-generator capacity of 190 000 kW, represents its latest effort. An extension of the plant by a further 100 000 kW capacity has recently been decided upon, and it is proposed to install two 50 000 kW turbo-generators.

The impetus to its extension was given by the increased industrial demand for power and the development during the war of large electro-chemical factories. Its later development is interesting in point of view of the acquisition of certain coal interests, giving the company virtual control, and its extension into the field of gas supply, receiving coke-oven gas and distributing it throughout a length of 240 km. Hand-in-hand with the recent development, the company has assumed a new character by a majority participation of municipal interests, thus re-shaping it into a form of a mixed private and municipal enterprise. The Communal Electricity Works Association represents a merger of interests of ten different supply undertakings to promote economy in generating and distribution, to install new plant, to secure favourable deliveries of coal, and, while not encroaching upon the independence of the component companies, to consolidate their technical and financial interests.

Brown Coal.

An appendix to the report gives basic prices of coal in the Ruhr district and the price for Cologne brown coal. In spite of the low calorific value of the latter, the costs per potential heat unit delivered to the boiler bunkers is preponderatingly in favour of the lignite. These prices represent merely the official controlled prices to consumers, delivered at the pit mouth, whereas electricity undertakings having coal interests get their fuel considerably cheaper. The brown coalfields being adjacent to the power houses result in a considerable saving in handling charges, as the operation from mining to tipping into the bunker is completely mechanical. Carrying about 60 per cent. moisture, the transport of raw brown coal is not a commercial proposition, but when consumed on the spot, and the electrical energy transmitted by e.h.t. feeders, its importance as a cheap source of power is very appreciable. It is estimated that the power developed by brown coal and transmitted even into the Ruhr district from Cologne comes out very considerably cheaper than that generated at the Ruhr pit-head.

In the month of December, for example, Ruhr coal at the pit mouth was quoted at about M.500 per ton, as against brown coal at M.60, and, taking in an unfavourable case the calorific value of brown coal as one quarter that of steam coal, the price difference equals about 50 per cent. Having excellent briquetting qualities, it is possible for electricity works operating on lignite to develop a considerable turnover in briquettes both for industrial and domestic consumption, and so reduce the overhead charges. The problem of low-temperature distillation and recovery of by-products is the subject of active research.

Owing to the distance most of the large deposits are situated from centres of industry, it is possible that the future will see many extensions to the h.t. overland transmission schemes.

Rolling Stock.

Some tendency is apparent of the electrical firms engaged in locomotives to combine interests with manufacturers of rolling stock, and examples of this are to be found in the A.E.G.-Krupp, Rheinmetall, and Linke-Hofmann merger, and in the Rhine-Elbe-Union, which embraces the interests, amongst others, of the Siemens-Schuckert Works, the Bochumer Verein, and Dortmund Union. The reasons underlying these alliances might be found in a desire to concentrate upon plant for the electrification of railways, outside of the movement to secure a supply of raw materials.

P.O. Programme of Extensions.

ESTIMATES OF THE EXPENDITURE to be undertaken by the Post Office during the current financial year are given in a White Paper. It is proposed to spend £9 500 000 out of capital on the development of the telephone system. The sum of £2 230 000 is to be spent on trunk lines; £343 000 for extension of the overhead service; £3 500 000 for local works, the provision of subscriber circuits, junction lines, and public call offices; and £2 250 000 for new exchanges and the extension of existing exchanges, including sites and buildings.

The construction of two long underground routes will be put in hand, namely, from Leeds to Edinburgh, *viâ* Darlington, Newcastle, and Jedburgh, and from Worcester to Bristol *viâ* Gloucester. Among the shorter and more important extensions of the existing underground system which will be begun or completed are the following new routes:—London to Southend, Bristol to Bath, Manchester to Preston, Preston to Lancaster, Bradford to Dewsbury, Colchester to Ipswich, Pontypool to Abergavenny, Swansea to Pontardawe, Glasgow to Whitecraig, Kirkintilloch and Kilsyth and Edinburgh to Kirkcaldy. The new overhead trunk circuits will number about 200.

Local Developments.

In connection with the local development works, underground ducts and cables will be laid in various parts of London and in a large number of towns, including Colchester, Cambridge, Tunbridge Wells, Brighton, Nottingham, Derby, Birmingham, Liverpool, Manchester, Leeds, Halifax, Edinburgh, Glasgow, Aberdeen, and Falkirk. The scheme for new exchanges and the extension of existing exchanges includes the installation of equipment for about thirty new exchanges, and for the extension of some forty of the more important existing exchanges.

A new exchange is to be provided in Central London near the Monument, and the work is to be begun at once. In the outer suburbs exchanges will shortly be open at Tottenham and Barnet, and equipment is to be provided for new exchanges at Eltham, Kilburn, Southall, Nunhead, Woodford, Wallington, Addiscombe, Thornton Heath, and Hounslow. In the country the work will include new exchanges at Ramsgate, Eastbourne, Southampton, Swansea, Birmingham, Sheffield, Buxton, Liverpool, Inverness, and Dundee.

The Automatic System.

Provision is made for a considerable extension of the automatic telephone system in the working of the new exchanges at Southampton, Gloucester, Swansea, Sheffield, Shrewsbury, Fleetwood, Dundee, and Kirkcaldy, all of which will be equipped with automatic plant. The equipment will also be extended at the automatic exchanges already existing at Epsom, Newport (Mon.), Chepstow, Leeds, Accrington, and Darlington.

Expansion of Hydro-Electric Business.

In May, 1920, Sir W. G. Armstrong, Whitworth & Company initiated a hydro-electric section as a part of their civil engineering department to secure orders for water turbines, to be manufactured at their Elswick works to the designs of a well-known Norwegian firm. The business of this section has so expanded that the firm formed in January last a separate HYDRO-ELECTRIC DEPARTMENT, as a unit apart from the civil engineering department. The new department, like the old section, is dealing with complete water-power development schemes throughout all the various stages, in addition to the various component parts of such schemes, civil engineering, mechanical and electrical. Messrs. Armstrong now have survey parties out in many parts of the world looking into projects which have been brought before them. The offices of the hydro-electric department are at 8, Great George-street, Westminster, S.W. 1, and the department is under the management of Mr. Douglas Spencer, assisted by Mr. Robert P. Tod and Mr. V. Bataillard, and a large staff.

Factory Magazines.

More than sixty editors of works magazines or "factory newspapers" attended the second Conference of Editors of Works Magazines at the offices of the Industrial Welfare Society last Friday, Mr. Robert R. Hyde (Director of the Industrial Welfare Society) presiding. It is clear that magazines of this kind, if well edited and organised, will prove a valuable stabilising influence in industry. They form a common platform, where all sides can voice their views. Papers were read by Mr. Reginald Pugh (editor of "Industrial Welfare"), Capt. J. Robinson ("Smiths' Dock Monthly"), Mr. E. M. Wright (Sir Wm. Beardmore & Company), Mr. T. B. Rogers ("The Employees' Own Magazine"), and Mr. Oliver Sheldon ("Cocoa Works Staff Journal"). The general opinion was that the factory magazine should be non-political, and that it should contain no deliberate propaganda of any kind. Although the conference was mostly concerned with magazines for general circulation among the employees of large firms, an instructive paper was read on the subject of "An Administrative Staff Magazine" by Mr. Oliver Sheldon, who emphasised the importance of placing essential facts concerning their own firms and industry generally, not only before directors, managers, and departmental heads, but before foremen and others who come into more direct contact with the workers. One firm is publishing a magazine for this purpose.

At the luncheon, over which Mr. Sam Mavor (of Mavor & Coulson) presided, Sir Ernest Benn, who opened the first conference eighteen months ago, said, in the course of his speech, that he understood that the fashionable "axe" had had its effect on the works magazine, and that some of the magazines had been subjected to the operation of economy in the last twelve months. There was nothing he could conceive of as so foolish as the cutting down of that sort of work.

He referred to the deterioration which was now taking place in the general Press, and expressed the opinion that the time was not far distant when the trade and industrial Press would be the sole remanant of all that was worth having in the arts and practice of journalism. Works magazines should avoid politics, as the word was commonly understood, but they might be able to supply the facts to educate the people in the principles of commerce and industry, and thus obtain a greater influence than if they entered into politics as such. Through works magazines they might get at the rights of Communism. As an example of the methods of Communists, he related a true story of an occurrence in Russia during the first revolution, when one of the first proceedings of the workers who took over a factory was to go to the offices to collect the capital.

It was decided to hold the next Conference not later than a year hence.

Chester Electricity Inquiry.

On behalf of the Electricity Commissioners, a public inquiry was held last week at Chester into an application by Chester Corporation for a Special Order to authorise them to supply electricity within the urban district of Hoole, parts of the rural districts of Chester and Tarvin, and a part of the rural district of Hawarden.

On behalf of the Corporation, it was stated that they had plant with 7 396 kW capacity. The maximum demand for electricity during the winter of 1920-21 was 2 282 kW. The Corporation had expended on their undertaking £236 000, of which £193 380 had been provided by loans and £42 620 had been contributed out of the surplus revenue of the undertaking. At present they had 2 500 consumers taking 4 000 000 units per annum, from which an income of £48 000 was received. The electricity produced at the Hydro-Electric Works had a substantial bearing upon the cheapness at which the Corporation could give supply. The present charges were 5¼d. per unit for lighting, and from 2¼d. to 1½d. per unit for small power demands; but for large power consumers, taking not less than 25,000 units per annum, the charge was £6 per kW demanded per annum, plus 0·75d. per unit. There was also a special tariff for domestic purposes of 15 per cent. of the rateable value plus 1d. per unit. Mr. S. E. Britton, city electrical engineer, estimated the capital cost of the compulsory works scheduled in the Order for Hoole and Newton at £7 000, but to deal with the agricultural area £38 725 was required, making a total of £45 725. The charges would depend upon the demand. If the demand was not more than 200 000 units per annum the average per unit would be 11d.; for 250 000 units, 9d.; 355 000, 6d.; 550 000, 4d. He estimated that 500 000 units would be sold during the first year.

On behalf of Flintshire County Council, it was urged that Chester Corporation were attempting to poach on the preserves of the North Wales Power Company, whose scheme had been approved by the Commissioners, and to set up another authority.

Mr. Miller, for the North Wales Power Company, said that the whole trend of the present inquiry suggested a determination to reverse, if possible, the decision of the Commissioners that a big area should be developed by means of the hydro-electric power of North Wales. He contended that the present was not an application which deserved consideration on its merits.

Owing to the splendid response to the invitations issued for the Electrical Engineers' Ball on Feb. 10 last, the sum of 55 guineas has been handed over to the Institution of Electrical Engineers' Benevolent Fund and 55 guineas to the Electrical Trades Benevolent Fund.

Legal Intelligence.

An Electric Furnace Dispute.

The hearing was resumed on Monday, before Mr. Justice Sankey, of the action, the hearing of which was begun in February. The plaintiffs, Electro Metals, Ltd., sued the Malleable Steel Castings Company (1909), Ltd., to recover £1 239 4s. 7d., balance of purchase price of a 30 cwt. electric smelting furnace sold to defendants in May, 1918. Defendants' case was that the plant was unsatisfactory; they alleged plaintiffs failed to comply with certain conditions, and they counter-claimed for loss suffered by the alleged defects of the plant.

Mr. T. W. H. Inskip, K.C., and Mr. Wilfred Lewis were for plaintiffs; and Mr. T. Eastham, K.C., and Mr. R. Bennett represented defendants.

It was explained at the previous hearing that the price of the furnace was £3 300, and the sum now claimed was an instalment of £1 100 and the cost of certain materials required in connection with the furnace which had not been supplied under the contract between the parties, but which plaintiffs ordered at the request of defendants. The furnace had not been used since the moulders' strike in 1919, when the men working it were forcibly driven from the building by the moulders, and it was said that parts of the machinery had perished. Defendants admitted that the furnace was received and set up, and that it was seen by plaintiffs' metallurgist, Mr. Needham, before it was got into working order. Defendants relied on a number of alleged breaches of the contract or warranties; they said that plaintiffs warranted that the furnace should be capable of producing straight steel of a tensile strength of 40 tons to the square inch, and 15 per cent. elongation unannealed; that it would produce steel entirely to defendants' satisfaction, and would not use more than 800 units of electricity per ton of metal melted.

Defendants said that these warranties were not complied with. Plaintiffs denied the warranties, and said the furnace was capable of doing what, under the contract, it was said it would do.

A considerable body of evidence had been given at the previous hearings, and the only witness now remaining was Mr. Edward A. Walsh, director and works manager of defendants, who referred to the giving of the alleged warranties, and said that they were never able to use the furnace successfully; as a commercial proposition it never produced steel suitable for steel castings, nor did it produce steel using 800 units per ton in the ladle.

After counsel had addressed the Court, Mr. Justice Sankey said it was alleged that plaintiffs warranted that the furnace would produce steel of tensile strength of 40 tons to the square inch and 15 per cent. elongation unannealed, but, on the whole, he could not conclude that any such warranty was given. The making of steel castings was an expert work, and he did not think that Mr. Walsh had adequate knowledge of those matters. He thought there was a guarantee that the consumption of electricity would be about 800 to 850 units for continuous working, but he was of opinion he could not find if there had been continuous working or that the guarantee would have been complied with. He was satisfied, on the whole, that the furnace was fitted for its work, but it was a long time being got into proper order, and defendants were entitled to recover as to certain expenditure for wages, electricity, &c. He gave plaintiffs judgment on the claim for £1 139 14s. 7d. and costs, and on the counter-claim he gave defendants judgment for £289 16s. 2d. and half the costs of the counter-claim.

Improper Use of Electricity.

At the Bradford Police Court last week, Harry Wilkinson, a builder, was charged with stealing electricity, the property of the Bradford Corporation, and William W. Threapleton was charged with laying an electric line communicating with another electric line, the property of the Corporation.

Mr. W. H. Leatham, who prosecuted, said it was difficult to say what was the value of the electricity alleged to have been taken. It was probably under £5, but for the purpose of jurisdiction he put it at £2. The defendant Wilkinson had built a house for himself at Baring-avenue, and Threapleton was an electric light contractor. Having described the procedure necessary for obtaining a supply of electricity, he said that Wilkinson applied for electricity in August, 1921. His house being further away from the cable than usual, the Corporation required him to agree to take a supply for five years instead of the usual two years, and to take current to the minimum value of £20 a year. He agreed to that. On Dec. 29 last a service cable was laid to the house and a service box installed. On Jan. 2 a meter was fixed, and that completed the business of the Corporation. They waited for the receipt of the test notice, which never came. The seriousness of the case was that if the wiring installation was not in order, and if it was connected up with the Corporation cables it might cause a fuse, with considerable damage over a great distance in the mains. When the meter was put into the house Threapleton was present. Two Corporation servants lived in the district, and they noticed that between Jan. 2 and March 10 the house was brilliantly lighted with electric light. Inquiries were made, and an inspector, who was sent to the house on March 10, found the service box had been broken and the installation connected direct to the service cable. He suggested that Threapleton had connected the wire direct to the service box without giving the required notice, and he also suggested that Wilkinson knew what he had done.

The Stipendiary Magistrate: You cannot assume that every householder who employs a man to put in an installation has guilty knowledge.

Mr. A. V. HAMMOND, who defended, asked permission to withdraw Threapleton's plea of "Guilty," and the magistrates agreed.

After Mr. Charles Gillin, mains manager for the Electricity Department, had given evidence,

The defendant WILKINSON said he had no knowledge of electrical fittings, and left everything to Threapleton. He had several times complained about the delay.

THREAPLETON said the connection was made on the morning the inspector found it. It was connected for testing purposes only. The testing instrument broke down, and the only alternative they had was to connect it up to the service pipe.

The STIPENDIARY MAGISTRATE said that on the face of it it looked very much as if Wilkinson must have known what was being done, and that his installation was being connected improperly without going through the meter. The Bench were not satisfied that Wilkinson was guilty of larceny, and the summons against him would be dismissed. Threapleton must have known he was doing wrong in making a connection in such a way that the current would not pass through the meter, and he would have to pay the maximum fine of £5.

At LARNE Petty Sessions on the 25th ult., Hugh J. M'Kerrell, proprietor of a motor garage, was charged by the Larne Electric Light Company with fraudulently obtaining a supply of electricity from the company's main.

It was stated that an employee of the company found two wires connected with the company's main and leading into defendant's garage, being there connected to a 100 W fixed lamp, to a portable lamp of 40 to 60 W, and a board for the charging of accumulators erected in the wall. The current for these lamps did not pass through the meter. For the quarter ending Dec. 31 defendant's meter only registered six units, but collectively the lamps on his premises would consume one unit in 2½ hours.

Defendant, who said he had only connected the wires on the previous night in order to get a light into the oil store, was sent for trial to the Quarter Sessions.

Telephone Pole Rental.

On Monday the Railway and Canal Commission Court (Mr. Justice Lush, Mr Tindal Atkinson, K.C., and Sir Lewis Coward, K.C.) delivered judgment in a re-heard action which recently came before Judge Crawford (at Romford County Court), and who fixed the rent of some telegraph poles on private land at Grays, Essex. The County Court Judge had fixed the rent of several poles at 5s. each, of some at 15s., and one at £1.

In delivering judgment, Mr. Justice Lush said the case raised a question of general importance as to the position and rights of the Postmaster-General with regard to the construction and maintenance of telegraph poles and wires. It was the first case under the Telegraph Construction Act of 1916, which enabled the Postmaster-General to apply to the court for a compulsory order if the owner refused his consent to having the posts on his land. The Act of 1916 brought the land of private owners within the range of the limited compulsory powers previously conferred on the Postmaster-General. Certain posts and wires were erected under an agreement between Mr. Brooks and the National Telephone Company; that agreement having come to an end, a difference arose between Mr. Brooks and the Postmaster-General, and that difference was referred to Judge Crawford, who made an award. The Postmaster-General was dissatisfied, and applied that it should be referred to that court. In his Lordship's opinion, a mistake had been made in the procedure adopted. It was never intended that a dispute as to the compulsory entry on land of a private owner should be referred to a magistate or County Court judge in the first instance, and Judge Crawford had no jurisdiction in the matter. Mr. Brooks had properly admitted that the question was only as to the terms and conditions under which his consent should be given. The poles were on woodland and near a private road, which was also his property. If the convenient user or enjoyment of the land was interfered with, such interference was subject to proper consideration. The land in question had a valuable bed of chalk under it, which would shortly be developed or sold in order that the chalk could be worked, and Mr. Brooks' chief complaint was that it would be a serious inconvenience to him, and would certainly cause him loss as a prospective vendor of the land to have those obstructions there. His Lordship thought that the amenities of the land were substantially affected by the existence of the posts and wires, and particularly in respect of three of the posts a substantial payment ought to be made. He held that the sum of 5s. each ought to be paid for all the posts, except those three. For two of the latter 10s. each should be paid, and for the third 20s. He did not think that these sums were excessive when the posts and wires were carried right across a wood, with a right to entry on the land. Moreover, the Postmaster-General had the advantage of taking these short routes for his telegraph wires. The present case must not be treated as a precedent applying to all cases. If a landowner made an unreasonable demand, which was successfully resisted, the court had power with respect to the costs, and the owner might have cause to regret making his claim.

Mr. Tindal Atkinson and Sir Lewis Coward concurred.

As Mr. Brooks said he had not incurred any substantial costs, no order as to costs was made.

Action Over Electrical Installation.

Before Mr. Justice Rowlatt on Monday Mr. George Pittman, electrician, sued Mr. Jerome W. May and Mr. Samuel Walbrock for £200 for electrical installation work at the Brixton Hall, and suggested that he found, after the instructions of Mr. May, that the defendants were in partnership as the Brixton Dancing Palace, Ltd., but he knew nothing of the company till he received a notification from its receiver and manager. The receiver said he had surrendered the lease as he was unable to pay the rent. Mr. May stated that he acted, and to plaintiff's knowledge, as agent for the Brixton Dancing Palace, Ltd., and Mr. Walbrock that he was never in partnership with Mr. May.

His Lordship, in giving judgment, said the question was whether the electrician was employed by Mr. May personally or employed by Mr. May on behalf of the company. The dispute showed how important it was that a contractor, when he was asked to do work, should say, "Who am I doing it for?" and if he was told it was a company, he ought to find out whether it was worth the money. The electrician had done work at Mr. May's own house. In respect of the work in question, May asserted, and plaintiff denied, that there was mention of the company. The documents were against plaintiff. He addressed Messrs. The Brixton Dancing Palace, and received three cheques signed by the company. Plaintiff said he did not notice the company's name on a document, but persons should notice things in business, and that showed him as clearly as possible that the persons to whom he was giving a receipt were the Brixton Dancing Palace, Ltd., and that the rest of the money was to come from them. He might have said, "The contract was with May; I am not going to have it altered now." He did not, and he did not see May till the company had practically gone to pieces. His Lordship did not feel justified in giving him a judgment against May. Judgment must, therefore, be entered for the defendants.

Weston Electric Lamp Company v. Baldes.

Last week Judge Cluer, in the Shoreditch County Court, heard an action, brought by the Weston Electric Lamp Company against Mr. C. Baldes, for the recovery of £2 7s., balance alleged to be due on the purchase price of an electric vibrator. There was a counterclaim for £2 1s., amount paid as a deposit, as it was alleged the vibrator was not up to guarantee. It was stated that defendant paid a deposit of £2 when he purchased the machine on May 31 last, since which time he had not been heard of.

LOUIS SUBTIL, clerk to plaintiffs, said that instalments should have been paid monthly. Defendant cross-examined to show that he paid a deposit of £2 instead of the usual 5s., and agreed to pay the balance in a month if the vibrator was satisfactory, but in three weeks it was useless, so he wrote to plaintiffs to that effect on August 18 and 22, and November 9. Plaintiffs' witness said they never received the letters.

JUDGE CLUER: A business man does not copy letters in a book, and then not post them. He then read the guarantee off the box, which was for a year, by the Fitzgerald Electrical Company, of Toronto and Conn., U.S.A.

DEFENDANT, in his evidence, said he was being constantly asked for the money, but he ignored the demands, as they took no notice of his letters of complaint.

Judge CLUER said there would be judgment for the defendant on the claim, and on his counterclaim for the return of the £2 deposit. "I should like to add," he went on, "that it is a gross untruth to say these letters were not received, and it is a misfortune that a tradesman in this district should send anyone to say such a thing."

Telephone Charges.

At Brighton County Court on the 27th ult. Judge Moore Cann heard an action by the Postmaster-General against Mr. Gordon H. Boswall Preston for the recovery of £22 9s. 4d., telephone rental fees and deposit alleged to be due under an agreement dated May, 1921.

It was stated that the service had been disconnected in consequence of defendant's failure to pay his account, but, notwithstanding the interruption in the service, defendant remained liable for rental, &c.

For the defence it was urged that defendant was willing to pay up to the time of disconnection, but it was contended that the Postmaster-General had no *locus standi* as a corporation to sue or be sued, and that the certified account of telephone charges which had been put in was not sufficient proof of the amount due.

The judge decided that the Telegraph Act of 1878 gave power to the Postmaster-General to sue as if he were a corporation. On the second point his honour held that a certificated account was not sufficient proof of charges, but he was of opinion that under the clause in the agreement the Post Office was entitled to the amount of outstanding rental. Accordingly he gave judgment for £14 9s. 9d.

Kelly v. Alexandra Clothing Company.

In the Shoreditch County Court on Tuesday, before Judge Cluer, Messrs. Kelly & Tarshis, electrical engineers, sued the Alexandra Clothing Company to recover £15 6s., balance of an account for £70 6s. for electrical work carried out.

Mr. TARSHIS gave evidence, and said that they fitted defendant's factory for lighting and power. He supplied a motor and starter for £25. A question arose about a radiator, but he denied that he had ever promised to take it back, as defendants had spoiled it themselves. They had laid it on its side, heated a kettle on it; the water had run over, causing "shorts." The electric lights in the office went wrong, but that was due to a leaky roof and not bad work.

In cross-examination, witness denied that he agreed to send a 3 H.P. motor for £25, but only a 2 H.P.

The defence was that the price had been agreed at £18 for a 2 H.P., which plaintiffs declared they could not get. Finally Mr. Tarshis said he could get a 3 H.P. for £25, to which defendant agreed, but he sent in a 2 H.P. after all. One of the radiators was intended for heating, but there was no heat from it.

Judge Cluer found for plaintiff for £3 16s. only, with costs.

Parliamentary Intelligence.

Grampian Electricity Scheme.

On Tuesday a Select Committee of the House of Commons, presided over by the Hon. W. Ormsby-Gore, commenced consideration of the Bill to authorise the incorporation of a company to construct hydro-electric works, to utilise the waters of Loch Ericht, Loch Rannoch, Loch Mihairg, Loch An Duin, Loch Garry, Loch Seilich, Loch Cuach, and certain rivers in their vicinity, and to supply electricity in the counties of Perth, Kinross, Forfar, Argyll, Stirling, and Inverness.

Mr. W. E. Tyldesley-Jones, K.C., opening the case for the promoters, said the area covered by the scheme was recommended as a desirable one by the Committee on Water-Power Resources in July, 1921. In all cases under the scheme the water would be discharged back into its natural waterway within a reasonably short distance from the places where it was diverted. There was under discussion with the Board of Trade a clause giving the State the right to acquire the undertaking at a certain date, provided such terms would not preclude the possibility of the company being able to raise capital. Last year the promoters deposited a Bill for substantially the same scheme, but withdrew it because one of their counsel retired and another was suddenly taken ill, and the negotiations with some of the landowners were not in an advanced stage. The British Aluminium Company also deposited a Bill last year which conflicted somewhat with that of the present promoters, and the result was that last year's Bill was ultimately dropped. The promotion of the present scheme was originally started by the British-Italian Corporation, and the present promoters, the Hydro-Electric Development Company, Ltd., were representative of those interests, and its shareholders included the British-Italian Corporation, the London County, Westminster & Parr's Bank, Wallace Bros. & Company, the British Steamship Investment Trust, Sir Henry Babington Smith, Sir Austin Harris, Mr. Ernest Cox, and Mr. Manzi Fe.

There were 31 petitions deposited against the Bill, but only three were left. The Spey Fisheries Board had been satisfied by the insertion of a clause requiring the company to main a certain flow in the river, and Dundee Corporation had withdrawn their opposition upon the insertion of a clause precluding the company from supplying in the Corporation's area of supply except for railway purposes. The three petitions remaining were those of three landowners, Mrs. Laterriere, the trustees of Col. Macpherson, and Sir George Macpherson Grant. The pomoters did not desire to oppose the granting of reasonable compensation to landowners whose property was injuriously affected. The estimated total cost of the scheme was 4½ millions, exclusive of generating plant, cables, &c., but in the early stages it was only proposed to raise one million in share capital, and power was sought to borrow 2½ millions. The four generating stations which it was proposed to build would generate 56 000 h.p. Counsel gave a brief outline of the proposed works, and evidence in support of the Bill was then given.

The promoters' case had not concluded when we went to press.

Sheffield Telephone Exchange Contract.

In reply to Mr. Manville, who asked (House of Commons, April 27) if the First Commissioner of Works was aware that a contract for the construction of the buildings of the new telephone exchange in Sheffield had been let by the Office of Works to the Wholesale Co-operative Society; and was it to be the policy of the Government in future to place contracts in the hands of this or similar organisations, which, under the present system of taxation, contributed nothing to the maintenance of the country, Lieut.-Col. Sir J. Gilmour (for the First Commissioner of Works) said that a contract for preliminary work upon the site for a new telephone exchange at Sheffield had been let to the Co-operative Wholesale Society, which submitted the lowest competitive tender. The Office of Works was satisfied that the firm was capable of executing the work in accordance with its requirements as to time and quality of craftsmanship. The decision was based on the general policy of economy. This consideration was entirely separate and distinct from any question as to the taxation of co-operative societies. On that question he referred Mr. Manville to the evidence given before the Royal Commission on the Income Tax and to the Report of the Commission published in March, 1920 (Cmd. 645), from which he would find that the suggestion contained in the last part of his question was based upon a misapprehension.

Imperial Wireless Chain.

In reply to Mr. Hurd (House of Commons, April 26), the Postmaster-General (Mr. Kellaway) stated that the only Dominion which had entered upon any wireless project of its own was Australia, whose representative at the Imperial meetings of last year reserved to the Commonwealth Government full freedom of action to decide in what manner it would co-operate in the Imperial wireless scheme. Precise information as to the project of that Government was not yet to hand, but when it was received its bearing on the remainder of the scheme would be carefully considered. The Indian Government had stated that they would have difficulty in finding funds to erect a high-power station of their own, and the position thus created would also be examined. Communications were proceeding with the Union Government, and the Canadian Government were sending two representatives to this country to discuss the matter. (Since the above date two offers, one by a British and the other by an Indian firm, have been received to construct and work a direct wireless service between India and Great Britain under licence and in accordance with Government requirements.)

Miners' Safety Lamp Glass.

In the House of Commons on Friday, Mr. Bridgeman introduced a Bill to restrict temporarily the powers of approving safety lamps under sec. 33 of the Coal Mines Act, 1911.

The Bill is intended to carry out a pledge given by Mr. R. McKenna, when Home Secretary, in regard to glass for miners' safety lamps. The glass came from Austria and Germany, and Mr. McKenna promised that British makers, in consideration of their laying down plant and erecting factories, should be relieved from foreign competition for three years after the official close of the War. Hitherto foreign glass has been excluded on the ground that it was of a "type" that would interfere with British-made glass. But it has been found that "type" does not, from a legal point of view, include place of origin, and the present Bill seeks to put this right, but a clause provides that the British glass must be adequate in quantity and quality.

Telephone Call Boxes.

Replying to Sir H. Brittain (House of Commons, April 26), Mr. Kellaway stated that the total number of public call-office stations at March 31 last was 15 874. The total revenue, exclusive of trunk calls, collected from public call offices during the past financial year was £490 000. No separate account was kept of the cost of maintaining call offices, but the operating was expensive where coin boxes were fitted, as was usually necessary, and there was, no doubt, some loss on this branch of the service.

Machinery Rating Bill.

That hardy annual, the Machinery Rating Bill, was read a second time in the House of Commons on Friday, and committed to a Standing Committee. This is the twentieth time the Bill has been introduced, and we are afraid, as it is a private member's measure, it will have the same fate as its predecessors.

Morecambe Corporation Tramways Bill.

The Bill to confirm the Morecambe Provisional Order was read a first time in the House of Commons last week.

Electricity Supply in South-Western Victoria.

The Victorian Electricity Commission state, in a report on electricity supply for the South-Western District of Victoria, that the population of the district is about 65 000, and Messrs. Lincolne, MacDougall & Demaine estimate that, at the outset, about 40 per cent. of this population would be served by the undertaking. Three alternatives have been considered: (A) A self-contained scheme, including a steam-driven plant within the district; (B) a transmission line passing through the main centres of population and taking current from the Melbourne Electric Supply Company.; and (C) a similar transmission line receiving its energy from the Government's Morwell undertaking. In regard to (A), with a generating plant at Warrnambool, the cost of the station, including two 750 kW generators, would be £76 400, and the cost of transmission lines and sub-stations £32 420, making a total of £108 820. The Commissioners are, however, of opinion that under (A) Camperdown and Terang would not obtain their requirements, except at a higher cost than under (B) or (C), or from their existing plants, and the average cost to the whole district would be higher than under (B) or (C). (B) and (C) are on identical lines as far as the district west of Geelong is concerned, but under (B) the supply would be immediately obtained from Geelong, while under (C) the supply of Morwell energy would later be made available at Geelong by a line from Newport. The estimates provide for a 44 000 V transmission line, consisting of a single circuit of aluminium conductors, steel reinforced and carried on wood poles. The price (under B) quoted by the Melbourne Company is £3.7 per kW per annum, plus 0.67d. per kWh, while in the case of (C) the estimated average price at which energy could be supplied at the Newport terminal of the Morwell line is £5·05 per kW per annum, plus 0.073d. per kWh, but this should be reduced if the Newport-Geelong line were at some future time called upon to supply in Geelong and neighbourhood, as well as the western district. The total capital cost of (B) is estimated at £117 120 and of (C) at 139 280, including in both cases an import duty of 10 per cent. on the aluminium conductors, but if the duty should be 45 per cent. the figures would be £122 130 and £145 810 respectively, and the annual expenditure would be £23 490 for (B) or £20 479 for (C). Assuming 45 per cent. duty on the conductors, the average price at which energy could be supplied to the towns to be served would be 4.21d. under (B), or 3·67d. under (C) for the south-western district only, or 3·32d. including supply in Geelong district.

The Commission recommend that, as a first step in the ultimate linking up of the South-Western district with the projected State bulk supply scheme from Morwell, the supply of energy to the south-western district be provided by the construction by the Commission of a transmission line from Geelong to Warrnambool, with an extension to Koroit and Port Fairy; and that a contract be entered into with the Melbourne Electric Supply Company for the supply of the whole of the electrical energy required for the recommended scheme at the rates quoted by the company for a period not exceeding five years.

Electricity Supply.

The annual accounts of NELSON (Lancs.) electricity undertaking show a deficit of £6 000.

The Minister of Transport proposes to confirm the NEWPORT (MON.) ELECTRICITY (EXTENSION) SPECIAL ORDER, 1922. Any objections must be sent to the Ministry of Transport by May 22.

At a meeting of the WARRINGTON Electricity Committee last week it was stated that applications for electricity had been received from several local firms and from the L. & N.W. Railway, who intimated that if they could not obtain supply they would apply to the Commissoners for an order to enable St. Helens to supply them with electricity.

To meet the growing demand for electricity, the STALYBRIDGE, etc., Joint Tramways and Electricity Board have sanctioned the installation of a 6 000 kW turbine. It is stated that the demands for current have increased so much that when trade revives and the mills in the four districts go on full time, the Board will have to ask the millowners to work some of their machinery during the night.

Mr. Williams, manager of Edmondson's Electricity Corporation, has asked ELGIN Town Council for their consent to an application by the company for a Special Order to supply electricity to the district. If the council's consent is obtained it is proposed to form a public liability company, called the Elgin Electrical Supply Company, Ltd., with a capital of £25 000, half of which, it is hoped, will be subscribed locally. The Council have appointed a committee to consider the matter.

BLACKPOOL Electricity Department generated 8 825 371 units during the year ended March 31, an increase of 256 848 over the previous year. New connections numbered 574, bringing the total up to 4 932. The estimated profit for the year, after providing for capital charges, is £10 000. The demand for electricity is increasing so rapidly that a big scheme of extensions is proposed, and the Electricity Commissioners on Monday held an inquiry into the Corporation's application for sanction to borrow £220 000.

According to a report prepared by Mr. E. Moxon, borough electical engineer of SOUTHPORT, nearly £70 000 is required for extensions and alterations to the municipal electricity works to meet the rapidly increasing demand for electricity. Between 1919-1922 the increased consumption averaged 333 300 units per annum. Mr. Moxon recommends the addition of a 1 500 kW three-phase turbo-alternator to the generating plant, which consists of two 3 000 kW turbo-alternators. He proposes to reorganise the distributing network and the equipment at a number of the more important sub-stations in the centre of the town. The total estimated cost of the schemes amounts to £69 881, and it will take three years to carry out the whole of the work.

The Minister of Transport proposes to confirm (1) the ISLE OF WIGHT ELECTRIC LIGHT AND POWER COMPANY SPECIAL ORDER for the amendment of the Bonchurch Electric Lighting Order, 1900; the East Cowes Electric Lighting Order, 1901; the Cowes Electric Lighting Order, 1902; the Carisbrooke and Northwood Electric Lighting Order, 1903; the Ventnor Electric Lighting Order, 1897; the Sandown and Shanklin Electric Lighting Order, 1899; and the Newport (Isle of Wight) Electric Lighting Order, 1899, by making provision for revision of the maximum prices authorised to be charged thereby; (2) the URBAN ELECTRIC SUPPLY COMPANY SPECIAL ORDER for the amendment of the Berwick-upon-Tweed Electric Lighting Order, 1900; the Redruth Electric Lighting Order, 1900; the Dartmouth Electric Lighting Order, 1900; the Illogan Electric Lighting Order, 1903; the Kingswear Electric Lighting Order, 1913; the Godalming Electric Lighting Order, 1896; and the Glossop Corporation Electric Lighting Order, 1899, by making provision for the revision of the maximum prices authorised to be charged thereby; (3) EDMUNDSON'S ELECTRICITY CORPORATION SPECIAL ORDER for the amendment of the Dorking Electric Lighting Order, 1897, and the Cromer Electric Supply Order, 1899, by making provision for the revision of the maximum prices authorised to be charged thereby; (4) the ALDERLEY AND WILMSLOW ELECTRIC SUPPLY SPECIAL ORDER for the amendment of the Wilmslow Electric Lighting Order, 1903, and the Alderley Edge Electric Lighting Order, 1905, by making provision for the revision of the maximum prices authorised to be charged thereby; and (5) the LYMINGTON ELECTRICITY (AMENDMENT) SPECIAL ORDER for the amendment of the Lymington Electric Lighting Order, 1899, by making provision for the revision of the maximum charges authorised to be charged thereby. Any objections to any of the proposed new orders must be sent to the Ministry of Transport by May 13.

New Schemes and Mains Extensions.

ABERDEEN Town Council have passed the plans for the new boiler-house extension at Dee Village-road. The estimated cost is £11 000.

BARNSTAPLE Town Council has received sanction to loans of £2 100, for condensing plant at the Electricity Works, and £1 500, for mains, services, and meters.

LUTON Town Council is applying for a loan of £3 733, for transformers and switchgear, and £8 267, for trunk cables, in connection with a supply of electricity in bulk from the North Metropolitan Electric Power Supply Company.

A public inquiry was held at NAVAN (Ireland) last week into a scheme of the Urban Council to establish electricity supply works in the town. It was stated that the cost would be £9 991, and no objection was raised by the ratepayers.

The decision of the Electricity Commissioners into the schemes for the reorganisation of electricity supply in the NORTH LANCS AND SOUTH CUMBERLAND electricity district is not expected until June, as the Commissioners have been busy on other work.

ROYTON District Council have decided that they have waited long enough for Oldham to supply them with electricity, and have appointed a sub-committee to meet representatives of Crompton Council in order to see if some joint scheme for supplying the districts cannot be decided upon.

At a meeting of BROWNHILLS Urban Council last week it was reported by Mr. C. Jones (electrical engineer to the Cannock Chase Colliery Company) that the company had decided to proceed with the scheme for supplying Chasetown, Chase-terrace, Burntwood, and Hammerwich with electricity. For private purposes the charge would be a maximum of 8d. per unit for lighting, and for public lighting the suggested charge was £3 per lamp per annum for the Brownhills West district and £3 5s. for the remainder of the Brownhills area. The company would bear the cost of the cables and standards. The council expressed its full sympathy with the scheme.

Alteration of Charges.

BARNSTAPLE Town Council has reduced the price of electricity for lighting to 9d. per unit, and for power to 7d. per unit.

WARRINGTON Electricity Committee announce a reduction in the price of electricity of 20 per cent. for power and heating, and of 10 per cent. for lighting and traction.

GRAVESEND Town Council have decided to reduce the electricity charges. As from March 31 last the flat rate has been reduced to 8½d. per unit, and the other rate from 80 to 75 per cent. over the pre-war figure. The minimum charge for the June and September quarters is to be 10s. per quarter, and for December and March 15s. per quarter.

MANCHESTER Electricity Committee have agreed to recommend the Council to make a slight reduction in the electricity charges as from the June quarter. The amount is not fixed. During the past year it was reported there had been an approximate net profit of £43 229, after meeting all capital charges and income tax, and this amount is to be placed to reserve account.

BIRMINGHAM Electricity Committee have decided, as from March last, to reduce the prices for l.t. supplies by ½d. per unit in the case of ordinary lighting, and by ¼d. for power supplies. The Committee report that there has been a marked improvement in sales during the past few months. There has already been a substantial reduction in the prices for manufacturing prices under contract.

The CITY OF LONDON ELECTRIC LIGHTING COMPANY announce the following reduced tariff :—For lighting, 8d. per unit in the winter quarters for the first eight units per 30 W connected, and 4d. per unit for all energy consumed in excess, and in the summer quarters 8d. a unit for the first four units per 30 W and 4d. after; for power, 1 2-3d. per unit, plus a fixed charge of 10s. a quarter per kW of connected demand; heating, 1½d. net per unit.

The following revised scale of charges for electricity for lighting purposes has been approved by CANTERBURY Town Council, the charges to become effective as from April 1 :—Up to and including 4 000 units per quarter, 8d. per unit; not less than 4 001 units per quarter, 7½d. per unit; 5 001 units, 7d. per unit; 6 001 units, 6½d. per unit; 7 001 units, 6¼d. per unit; 8 001 units, 6d. per unit; 9 001 units, 5¾d. per unit; above 10 000 units, 5½d. per unit. The maximum demand rate is to remain as at present—9d. and 6d. per unit. Current for motor generators for cinematograph purposes is also to remain at 3½d. per unit.

Institution Notes.

Sir Charles Parsons has placed unreservedly at the disposal of the council of the BRITISH ASSOCIATION a gift of £10 000 5 per cent. War Loan stock. The total grants in aid of research made by the association since its formation in 1831 exceed £83 000.

Mr. B. Welbourn has been nominated chairman of the LIVERPOOL SUB-CENTRE of the North-Western Centre of the INSTITUTION OF ELECTRICAL ENGINEERS. Messrs. E. M. Hollingsworth and H. H. Harrison have been appointed vice-chairmen, and Mr. O. C. Waygood, hon. secretary.

The annual meeting of the ROYAL INSTITUTION was held on Monday, Sir James Reid, vice-president, in the chair. Fifty-seven new members were elected in 1921; sixty-three lectures and nineteen evening discourses were delivered; 651 volumes were added to the library during the year, including 210 presentation volumes. The following were elected officers for the ensuing year :—*President*, the Duke of Northumberland; *Treasurer*, Sir James Crichton-Browne; *Secretary*, Colonel E. H. Grove-Hills.

In connection with the DOMESTIC LABOUR-SAVING COMPETITION organised by the Women's Engineering Society, prizes have been awarded as follows :—*Section A* (engineering devices suitable for mechanical, electrical and automobile work, &c.) : Miss Ashberry, for dish-washing machine; *Section B* (structural improvements) : The assessors have decided not to award a prize in this section, as the designs did not reach a sufficiently high standard to warrant an award; *Section C* (any other labour-saving appliance for the home) : Miss Ramage, for "Ideal Oven." Two certificates of merit were also awarded in Section C : one to Mrs. Lockyer, for the "Hotlock and Coldlock," and one to Miss Long, for "Forty Plates in One."

Electric Traction.

NELSON (Lancs.) tramways were run at a loss of over £3 000 last year.

For the year ended Dec. 31 last, DARLINGTON TRAMWAYS DEPARTMENT shows a net loss of £2 364, against £3 166 in the previous year.

The accounts of ROCHDALE Tramway Department show that for the year ending March 31 last the tramways were run at a loss of £19 500.

LUTON Town Council has applied for an extension of time, until August 11, 1923, to complete the work authorised by the Tramways Order, 1905.

GLASGOW Tramways Committee are recommended by the Sub-committee on Extensions to offer £250 000 for the purchase of Paisley District Tramway Company.

As a result of a deputation from ratepayers to the EDINBURGH Tramway Committee, the electrification of the tramways on the Stockbridge route is to be started at once.

PRESTON Tramways Department report a decrease in the March returns, as compared with last year, of 110 857 passengers, and a decrease in the receipts of £638. A request from an advertising agency for permission to erect electrically-illuminated signs on the tramway standards has been refused.

In a report of the Birmingham Corporation Salvage Department just issued, the Committee state that the department has at present a FLEET OF THIRTY-FOUR ELECTRIC VEHICLES, and that it is intended to buy seven more. The vehicles are used in the collection of refuse under the continuous system in those districts which are considerable distances from depots, and which could only be worked on the continuous system by horses at greatly increased cost.

The SOUTH EASTERN & CHATHAM RAILWAYS COMMITTEE have agreed with the Trade Facilities Advisory Committee upon the general principles for raising the capital for their scheme for the electrification of the suburban sections of their lines. The capital, which will be guaranteed by the Government, will amount to about £6 000 000, and as authority to raise it can be obtained under the Electrification of Railways Powers Act, it is probable that the actual work will soon be commenced.

For the three months ended March 31, the receipts on the YORK tramways system have decreased £1 480, or an average of £114 per week, compared with last year. In order to reduce expenses the Tramways Committee have decided that on four routes the service shall be reduced from 7½ to 10 minutes on all days except Saturdays, during the morning hours between nine and noon. This will effect a saving in mileage of 20 373, in wages £320, and in current of £246 per annum. The maintenance charges will also be smaller, and the reduced staff will be utilised to work in place of men taking their annual holidays.

Personal and Appointments.

Major WILLIAM PAXMAN has been elected to succeed the late Mr. J. N. Paxman, as chairman of Davey, Paxman & Company.

Dr. W. E. S. TURNER, Prof. of Glass Technology at Sheffield University, has been elected President of the Society of Glass Technology.

Mr. A. H. DYKES (Handcock & Dykes) has been elected chairman of Beckenham Urban Council for the ensuing year, which office he held also in 1914.

The marriage took place in Chester last week of Mr. D. JENKINS (Swansea district manager for the Metropolitan Vickers Electrical Company) and Miss J. W. Thomas.

CARLISLE City Council has adopted the recommendation of the Finance Committee to reduce the salaries of the electrical engineer (Mr. C. W. Salt) and the assistant electrical engineer by 10 per cent., as from Oct. 1 next.

Mr. W. L. GRIFFITH has been appointed by the Canadian Government to succeed Sir George Perley as the Dominions representative on the Pacific Cable Board. Mr. Griffith is permanent secretary of the High Commissioner's Office.

Mr. HENRY H. OXLEY has recently resigned the position of London and District Manager to Mann, Egerton & Company with a view to organising and developing the sale of the Sims light and power plant. Before joining Mann, Egerton & Company Mr. Oxley was on the staff of Vickers, Limited, for some years.

Mr. C. I. BAKER, Superintendent of Blackpool Corporation Tramways, entered upon his duties as manager of the Ashton-under-Lyne tramways on Monday. Prior to his departure he was presented with a cheque by councillor H. Brooks, chairman of the Electricity and Tramways Committee, on behalf of the Electricity and Tramways Employees' Institute (which Mr. Baker was largely instrumental in establishing, and of which he has been secretary). He was also the recipient of an oak grandfather clock from the tramways employees.

The late Mr J. N. GREENALL, of Nottingham, managing director of Thomas Danks & Company, has left estate valued at £23 255 (net personality, £17 633).

Telegraph and Telephone Notes.

The new underground trunk telephone service between MANCHESTER AND LONDON was opened for commercial use last week. One of the chief features of the new line is the adaptation of the thermionic valve amplifier. We recently gave particulars of the construction of this line.

Four AUTOMATIC TELEPHONE CALL BOXES have been installed at Charing Cross Railway Station, and five at the Bank. The method of procedure with the new instruments is that, instead of waiting for the operator to connect the caller with the number desired before the pennies are placed in the box, the pennies are inserted before connection is obtained. The insertion of the pennies causes the operator's lamp to glow, and she then inquires what number is required. Should the caller desire to cancel the call, he may depress a button labelled "B" and his money will be returned. Should the call proceed, the caller will hear the subscriber at the other end give the usual signal "Hello," but he will be unable to make himself heard until he has depressed button "A." The caller does this immediately on hearing "Hello," which depression transfers the pennies deposited into another channel, completing the circuit and enabling subscriber and caller to carry on as usual.

Wireless Notes.

The SWISS MARCONI WIRELESS STATION was formally opened at Munchen Buchseo, near Berne, on the 26th ult.

The NORTH ESSEX WIRELESS SOCIETY, of which Mr. H. E. Adshead is president, and Mr. F. T. Smith, Rutlands. Felstead, is hon. sec. and treasurer, hold weekly meetings at 15, Rayne-road, Braintree, for discussion of wireless topics.

The TORONTO correspondent of the "Manchester Guardian" states that the radio fever has spread from the United States to Canada, and all the electrical firms, and even other organisations not closely associated with electrical apparatus, are experiencing an extraordinary inflation of trade. Factories are running under pressure, with three shifts every twenty-four hours, under conditions similar to those prevailing in munition works in the urgent days of the war.

The INTERNATIONAL WIRELESS CONFERENCE, composed of representatives of the Radio Corporation of America, Compagnie Generale de Telegraphie sans Fil, Gesellschaft fur Drahtlose Telegraphie m.b.h., and Marconi's Wireless Telegraph Company, completed its sittings last week. A number of important questions dealing with the development in different parts of the world of wireless telegraphic and telephonic communication have been considered and satisfactorily settled. As a result of the agreement between the four companies a number of new international wireless telegraph services are to be opened in the early future. In order that commercial wireless telegraphy and telephony should be developed to the best advantage in the interests of the public and of international commerce, it has been decided that the companies should not erect any stations which would entail the harmful radiation outside an agreed radius of harmonics or secondary waves which are beyond the definite wavebands allotted to each particular station.

Business Items, &c.

WILKINSON BROS., electricians, of Eldon-street, Barnsley, have recently opened new showrooms at 15, The Arcade, Market-hill, Barnsley.

Mr. G. LOCK, late of the Surbiton Electric Company, has commenced business as an electrical engineer at 164, Thornhill-road, Tolworth, Surbiton.

ARTHUR JONES & COMPANY, of 15, Dock-street, Middlesbrough, have been appointed sub-agents for Middlesbrough and Teeside under the Simplex and Credenda joint sales service.

GREEN & SMITH, LTD., electrical engineers and contractors, Albert Works, Meadow-lane, Leeds, have been appointed sole agents in the West Riding of Yorkshire for Greenwood & Batley, Ltd., Leeds, a.c. and d.c. motors, dynamos, and alternators, and are open to receive inquiries for complete electric light and power plants, also a.c. and d.c. motors, dynamos, and switchgear.

JOHN M. HENDERSON & COMPANY announce that they have made arrangements with Mr. F. G. Mitchell, of The Mitchell Conveyor & Transporter Company, contracting engineers, Atlantic House, 45-50, Holborn-viaduct, London, E.C. 1, to undertake the manufacture of Krom crushers, Maxecon mills, and new-type Kent mills for that company. They have also acquired joint selling rights of these machines.

It is announced that the UNITED STATES GOVERNMENT have withdrawn their action against the Postal Telegraph Company for the recovery of £500 000 alleged to have been advanced to the Postal Telegraph Company during the period of Federal control of telegraph communications. The company, as well as the Commercial Cable Company, are subsidiaries of the Mackay Companies, who were strong opponents of Mr. Burleson's effort to take over the control of cable communications.

Imperial Notes.

The SHAWINIGAN WATER & POWER COMPANY has increased its capital from $20 000 000 to $40 000 000.

ST. GEORGE (N.S.W.) County Council has in course of erection generating plant for supplying current to the towns of Hogarth, Bexley, Rockdale, and Hurstville.

In the report of the NEW BRUNSWICK ELECTRIC POWER COMMISSION for 1921 it is stated that there are undeveloped water power resources in the Province capable of yielding 200 000 H.P. continuously. Apart from the Grand Falls, estimated at 90 000 H.P., the various falls vary from 1 000 to 10 000 H.P.

The AUSTRALIAN POSTMASTER-GENERAL recently informed a Sydney deputation, who complained of the INEFFICIENT TELEPHONE SERVICE, that this was due to the inadequacy of the sums voted by Parliament for the service, and the delay caused by having to wait for Parliamentary sanction to orders for materials. To bring the service up to date would require £9 000 000.

The accounts of the ADELAIDE (S. AUSTRALIA) MUNICIPAL TRAMWAYS TRUST for the half-year ended January 31 show revenue £288 696, operating expenses £206 249, and net surplus of £3 569, after providing for instalment of loans, interest, &c. The Trust is unanimously in favour of early connection of the Port Adelaide system to the Adelaide lines in order to reduce the loss on the former. Fifty additional cars were on order at the time the report was issued, and plans were being prepared for various extensions of tramways under the control of the Trust.

Foreign Notes.

An electrical crematorium has been opened in OSAKA.

The Griesheim Electron Chemical Works, GERMANY, are selling, it is stated, some of their patents to United States interests.

It is announced that a German firm has secured a contract for rebuilding PETROGRAD, including the restoration of the tramways of the city.

The CHINESE MINISTRY of Communications has decided to install a long distance telephone between Nanking, Chinkiang, Yangchow, Kiangying, and Shanghai. The material for this work will be supplied by the Japanese branch of the Western Electric Company of New York through its agents, the China Electric Company, Ltd., of Shanghai.

A Commission has been appointed by the DUTCH GOVERNMENT to examine a scheme for erecting five large power stations, which are to be linked up by a 50 000 V cable. One station will be in Amsterdam, one in Rotterdam, one in Dutch Brabant, and another in the Dutch coal-mine area. The situation for the fifth station has not yet been chosen.

The water power at St. Martin de Landres, HÉRAULT (France), is being developed by an agricultural co-operative society in order to provide electricity in thirty-seven communes. The projected station will be able to supply 1 500 H.P. for eight months, and for the remainder of the year at least 500 H.P. The necessary capital (three million francs) will be provided by members of the society, and electric current will be used for light, power, and domestic purposes.

Miscellaneous.

A NEW X-RAY APPARATUS was formally opened at Clayton Hospital, Wakefield, on Monday by Sir Edward Brotherton, by whom it has been presented.

The India Rubber, Gutta Percha & Telegraph Works Company have been awarded the first prize (£1 400) in the Air Ministry competition for SAFETY FUEL TANKS FOR AIRCRAFT.

Prof. ALEXANDER HORNE has notified his intention to resign on June 30 from the Chair of Engineering at Robert Gordon's Technical College, Aberdeen, having been appointed head of the Polytechnic School for Engineering, London.

A complaint has been made that OPTICAL AND SCIENTIFIC INSTRUMENTS manufactured in Germany are being sold in the United Kingdom at prices below those at which British goods can be profitably manufactured, and the Board of Trade have referred the matter to a committee to consider the question of the imposition of a duty under Part II. of the Safeguarding of Industries Act on such German goods. The committee will hear evidence on May 15.

Obituary.

The death occurred at Leigh-on-Sea on April 22 of Mr. JAMES F. CLUNAS, who for the last four years had been attached to the staff of Vickers, Ltd., in their electrical, and latterly in the hydro-electric, department. Mr. Clunas was trained and started his engineering career in the works of Bruce, Peebles & Company, and subsequently served in the London office of that firm. Previous to the outbreak of War, he had been a number of years in the office of Tozer, Kemsley & Millburn, whose service he left to volunteer for Service. He served in the Royal Naval Volunteers Signal Division, having gone through the Gallipoli Campaign from the second day until the withdrawal, and afterwards served a year and a-half in Flanders, when he was invalided out of the Army, owing to an accident. Mr. Clunas' cheerful, straightforward, and conscientious disposition had gained him a wide circle of friends, who will be grieved to hear of his sudden death.

Possible Trade Openings.

A WESTERN CANADIAN FIRM of wholesalers and distributors of electrical supplies desire to get in touch with United Kingdom manufacturers of radio-telephone apparatus and supplies, including tubes and bulbs.

A firm of machinery merchants and agents in Christchurch, with connections throughout the DOMINION OF NEW ZEALAND, desire to receive catalogues from manufacturers of engineers' supplies (mechanical and electrical), motor accessories, &c. The firm, who have shipping agents on this side, specially desire the catalogues of manufacturers who exhibited at the recent British Industries Fairs. Particulars can be obtained from the Department of Overseas Trade (Ref. No. 462).

H.M. Vice-Consul at St. Vincent, CAPE VERDÈ ISLANDS, reports that a local firm, which has secured the concession for lighting the town with electricity, is anxious to obtain an agency for a United Kingdom manufacturer of electric lighting house fixtures (switches, lamp sockets, reflectors, insulated wire, &c.), and for incandescent electric lamp bulbs of 200, 100, 32, and 20 c.p. The firm also require quotations for fixtures for electric (incandescent) street lamps. Applications for name and address must be sent to the Department of Overseas Trade (Ref. No. 475).

H.M. Trade Commissioner at WINNIPEG (Mr. L. B. Beale) has recently been consulted by a Western Canadian company, regarding the supply of transformers. Mr. Beale states that the general type in use throughout Western Canada is a single-phase service transformer, pole type, 60 cycle, 2 200 to 110/220 V. The prices in all cases quoted for these transformers include cut-outs and hangers. For the guidance of United Kingdom firms he has secured from the Winnipeg Hydro-Electric System details of tenders received during the past month for all sizes of transformers (single and three-phase). He has also forwarded to the Department of Overseas Trade, from whom further paticulars may be obtained, a rough sketch of the type of transformer that is in use in Western Canada.

Openings for Trade in the Netherlands.

Extracts from the Dutch press of recent dates include the following, which may lead to openings for British trade :—

The N.V. Provinciale Utrechtsche Electriciteits Mij. (Provincial Electric Supply Company of Utrecht), of 32, Catharijnesingel, Utrecht, are preparing plans, in co-operation with the management of the municipal electric works and tramways (Nicolaas Beetsstraat 3, Utrecht), for the building of a large provincial ELECTRIC POWER STATION NEAR UTRECHT.

Proposals have been put before Rotterdam Town Council to extend the telephone exchange by an additional building with a capacity of 20 000 numbers. Estimate Gld. 450 000. It is also proposed to build an additional electric power station, which will probably have three generating sets of 1 500 kW each. Estimate, Gld. 600 000.

In connection with works to be carried out in the Prise d'Eau, of the Dune Waterworks, and at the pumping station, "Leiduin," proposals have been put before the Town Council of Amsterdam for the erection of a pumping station and the adoption of electrically-driven pumps at the stations on the Westerkanaal and the Barnaart-Schusterkanaal; the laying down of a l.t. cable and of the necessary telephone communication; the erection and equipment of a transformer sub-station in the pumping station at the Barnaart-Schusterkanaal; the erection of a steam dynamo with condensing plant for the existing Laval steam turbine at the pumping station, "Leiduin."

Catalogues, Price Lists, &c.

An illustrated pamphlet, entitled MODERN WELDING METHODS, has been issued by Mr. C. L. Jones. Many patents covering improvements in welding methods and welding material have been filed by Mr. Jones, to whom also is said to be due the discovery of how to weld effectively alloy metals by the use of metal electrodes which will produce in the weld metal of the same composition as the metal welded. The illustrations show work being carried on in Mr. Jones's welding shops at Islington.

Great strides have been made since the war by FULLERS' UNITED ELECTRIC WORKS, LTD., in the manufacture of their "Ebonite" mouldings, and the firm state that they consider they are now equipped to compete with Continental manufacturers in most of the mouldings of which these firms held the monopoly. List No. 150 A, recently published, illustrates the variety of mouldings the company now manufacture, and includes telephone components, insulators, motor-car radiator caps, knobs, lead conduits, steering wheels, accumulator lids, stoppers, separators and grids, also containers for accumulators.

Two excellently produced and fully illustrated publications are to hand from METROPOLITAN-VICKERS ELECTRICAL COMPANY. Publication No. 7 874/2, entitled "Power in the Textile Mill," deals with both electrical and mechanical drive, and the illustrations show typical examples of installations carried out by the firm in this country, including electrical installations at the Premier Mills Company, Stalybridge; James Halliwell's Townsfield Mills, Darwen; Peel Mills, Bury; T. Ashton Harrison & Company; John Haigh & Sons, Huddersfield; Joshua Hoyle & Sons, Summerseat. Publication 7 840/2, "The Electrical Drive and Control of Machine Tools," embodies the results of the firm's investigations in regard to the individual electrical drive and control of machine tools, which for tools requiring approximately 5 H.P. or above has, they claim, an overwhelming advantage over the group system.

Companies' Meetings, Reports, &c.

British Electric Transformer Company.

The nineteenth ordinary general meeting of this company was held at Winchester House, E.C., on Tuesday, May 2, Mr. A. F. Berry (the chairman) presiding.

In moving the adoption of the report and accounts, the chairman compared the items in the accounts with those of the previous year, the principal point being the addition of £47 000 to the freehold land, buildings, plant, machinery account, &c., the bulk of which represented new plant and machinery installed during the past year. The loan on mortgage and interest accrued, amounting to £31,851, had disappeared from the balance sheet as being paid off in full. Of the available cash, £68 536 had been invested, and such investments had since been sold, the money realised being reinvested as opportunity afforded, so that it could be readily used when required for manufacturing purposes. The general charges on profit and loss account were £10 500 more than the previous year, but gross profit on trading had increased by £40 000 and net profit by over £21 000. Out of the available balance of £97 594 they were able to pay for the fourth year in succession a dividend of 10 per cent., plus 2½ per cent. bonus, and to carry forward £12 708. This was the nineteenth annual meeting, and none of the previous years had shown anything so good.

A Difficult Period.

Continuing, the chairman said: We have been, and are going, through times of such difficulty of late, that I cannot help feeling that the time may not be distant when the strong confidence of the shareholders will be needed to help us tide over the one or more years during which it may be impossible to produce the splendid results to which we are by now accustomed and therefore expect. To-day it would have been pleasant to say nothing but those things that please.

We have, however, at the annual general meeting, always endeavoured to give to the shareholders as much information as we could, and where it has been in any way possible to forecast results we have endeavoured to do so. You may remember that last year we started with 50 per cent. more work in hand (in money value, or 30 per cent. more in horse power) than we had at the beginning of 1920. This year we started with roughly 60 per cent. *less* work in hand (calculated in horse power, it would be still *worse* in money value) than we had at the beginning of 1921. This work in hand will not carry with it the same ratio of profit which we looked forward to at our last year's meeting. The difficulties due to this shortage of work, magnified as they are by strikes and lock-out troubles, cannot be overlooked.

Some Signs of Improvement.

Last year I ventured the opinion that "The next few years will test the capacity of even the best captains of industry." Some of us hoped that adversity would bring the different interest in the ranks of industry rather closer together, but we all know this is a state of affairs to be wished for and worked for rather than one accomplished. It appears to me that the active minorities, whose business or avowed intention it is to make trouble between the different members of the various British industries' teams, are having their own way far too much, and I fear that industry will not prosper as we desire until its natural leaders are actually encouraged to lead. You are well aware that the Stock Exchange, which usually bases its opinions and judgment upon the ideas of those best able to advise it, are indicating in no uncertain way their belief in a return of comparatively good times.

There are signs, too, in the heavier industries of some improvement, but I shall be agreeably surprised if the return of prosperity will be sufficient to enable ordinary dividends of any appreciable value to be obtained, at any rate, for the next year. These extremely bad times through which we are passing can be made to have their uses, and in a company such as ours there is very much to do in the way of staff work and co-ordination of effort with other sections of the industry. It is only by a continuance and even an improvement on the efforts of office and factory staff that we shall fit ourselves to play our full part in those better times which somewhere ahead we are steering and working for.

The Result of Prudent Planning.

Few of the shareholders outside this company realise what an effort it has been to achieve the results shown. They are the result of a carefully thought out policy carried out loyally and efficiently in the main by office and works staff, and it is a pleasure once more to be able to thank all those who have pulled their full weight during the past year and enabled us to accomplish what we have done. Some of you may be shareholders in concerns which are considered less fortunate than ourselves. I may tell you that unless our plans had been laid long ago with the greatest prudence and carried out with persistent care, we might, even during this past year, have found ourselves with a heavy loss instead of record profits. I do not mention these facts in any boastful spirit, but I wish shareholders to appreciate the position and times through which we are passing.

Once again it is my pleasure, on behalf of the board to thank not only those of the company's employees who have done their best in the company's interests during the past year, but also those shareholders who do their utmost to make it possible for themselves and their fellow shareholders, including those who work in office and factory, to derive the greatest advantage from this company by taking an intelligent interest in its products. On the other hand, it sometimes surprises me how little many of our shareholders do to further their own general and particular interest in this company, in spite of my requests made from year to year that they should take an interest *in* their company's products if they desire to take the maximum interest *out*. The real and ascertained value of what *is* done by the comparatively few gives a very clear indication of what great benefits to themselves and the company would result from individual interest and action by the many. For instance, shareholders might well go into electrical shops of all descriptions and ask about "Tricity" goods—"'Tricity' as Advertised"—"How it can help ME—Where—Why—and to what extent." Such action on your part may appear small to you, but please think of its effect taken with that of thousands of others in and out of this company. The report and accounts were adopted unanimously.

Indo-European Telegraph Company.

Presiding last week at the annual meeting of the Indo-European Telegraph Company, Mr. J. Herbert Tritton said that they were still without the necessary information from other administrations to enable them to close the books for 1921. The investments continued to show an appreciation, while, having regard to actual political developments, the position of the Russian assets might be regarded in a somewhat more favourable light; the directors were therefore of opinion that any drastic step, such as writing off, need not at the moment be taken. With regard to the final dividend for 1921, the equalisation of dividends fund was, as the shareholders were informed at the last meeting, now exhausted, and the total dividend for 1921 was, therefore, restricted to 7 per cent. The directors had at last good news to communicate. The Polish concession was signed some time back. Within the last few days they had been advised by the Russian Department of Posts and Telegraphs that their concession from the Moscow Government was signed on April 12. This was a very important fact, as the concession covered the whole territory traversed by their line from the Polish frontier on the west to the Persian frontier on the east, transiting various Federated States, who had also approved the concession. Their concession from Persia was already in existence, and that from the German Government, although not actually signed, owing to international politics, had for a long time been agreed in principle, and should offer no difficulty.

The condition of the company's line was more satisfactory than had been expected. They were informed from a reliable source that the line was workable for a stretch of over 200 miles north-west of Odessa, while east of Odessa a similar state of affairs existed for 300 miles into the Crimea. Beyond the Straits of Kertch the line was in working order between Ekaterinodar and Tiflis. Between Tiflis and Erivan there was a short section where the repairs had not yet been completed. The section Erivan-Djoulfa, on the Russo-Persian frontier, had undergone repair, and was now in working order, as was also the company's Persian section, Djoulfa to Teheran. The Black Sea cable, Odessa-Constantinople, was again in working order, and, they understood, had already been officially opened by the Soviet Government representatives at Odessa. This cable would, therefore, shortly be able again to carry the classes of traffic formerly dealt with by it, and would, they hoped, help to re-establish business relations generally with Southern Russia and the Black Sea ports. They were also informed by the Indo-European telegraph department that their Persian lines were in good order. The most arduous part of their work was undoubtedly the section from the German and Polish frontier on the west to the Polish-Russian frontier on the east. Much of their line in that territory had absolutely disappeared as a separate international line, and where three or four wires were suspended there were now ten to twenty of all sorts, including telephone wires; they, therefore, in accord with the Polish Government, arrived at the conclusion that their line must be rebuilt in a new location—namely, along the great *chaussées*, or high roads. The directors hoped before long to be able to announce that the Indo route was once more carrying international traffic, after being totally interrupted since July 31, 1914.

National Electric Construction Company.

In moving the adoption of the report and accounts at the annual meeting of the National Electric Construction Company last week, Mr. G. H. Nisbett (the chairman) said that the year's working had again shown an improvement, and the balance of profit amounted to £9 681, compared with £6 726 in 1920. Adding the balance of £8 538 brought forward, there was a total available of £18 219. It was proposed to write off £1 000 from the sum of £4 510, at which the free-wired installations appeared in the books, to start a general reserve fund with the sum of £3 000, and to provide a similar sum for a reserve for equalisation of dividends, with a view to providing as far as possible for the payment of a steady dividend in spite of the fluctuations which were inevitable with a trading company. It was further proposed that £1 300 should be added to the reserve on the Dewsbury and Ossett Tramways, thus providing a total reserve for renewals of £2 000. A dividend of 6 per cent. on the ordinary capital was recommended, leaving £4 819 to be carried forward. The Debenture Redemption Fund stood at £25 090, as compared with £21 700 the year before. The overdraft at the bank was £7 997 at the date of the balance-sheet, as compared with £12 003, but they had now a balance to their credit of over £4 000. Contracts in course of completion (less payments on account) were only £1 736, as compared with £12 106 last year, but they had reason to think that some further business of value would shortly be in hand. The expenditure on the Wisbech Electric Light & Power Company still continued. This concern was doing very well, and it followed that with a light and power company the better it did the more the capital expenditure increased for the provision of additional plant, mains, and services.

The directors of the City of Buenos Ayres Tramways Company (1904) have declared a dividend of 1s. 3d. per share (5 per cent. per annum), less tax, for three months ended March 31.

Chagford and Devon Electric Light Company are offering for public subscription £8 000 7½ per cent. guaranteed first mortgage debentures in 1 600 debentures of £5 each at par, and 5 000 9 per cent. cumulative preference shares of £1 each at par.

Mexboro' & Swinton Tramways Company announce a dividend of 2½ per cent., tax free, for the year. The sum of £2 000 has been placed to reserve renewal account, £245 written off for plant, &c., £500 for income tax, leaving £246 to be carried forward.

The sum of £3 064 on account of the sinking fund of the British Columbia Electric Railway Company's Vancouver Power Debentures, 1923, and first mortgage debentures is held by the British Empire Trust Company, who are prepared to receive offers for sale of the debentures up to May 22.

The directors of the Great Northern Telegraph Company of Denmark recommend a total dividend and bonus of 22 per cent. for 1921, including 5 per cent. already paid. The sum of £33 333 has been set aside for reserve and renewal, £55 555 for pensions, and £222 222 for extraordinary taxes, leaving £302 679 to be carried forward.

The scheme of arrangement (Electrician, April 28), considered last week at the meeting of the eight per cent. ten-year noteholders and shareholders of the Southern Brazil Electric Company, was unanimously adopted. The meeting of the six per cent. mortgage debenture holders was adjourned to next week in the absence of the necessary quorum.

The income of the Direct United States Cable Company for the year ended March 31, 1922, amounted to £45 224, plus £4 265 brought in, making a total of £49 489. After providing for income tax, directors' fees and administration expenses, a balance remained of £37 913, out of which the directors have paid a dividend of 4 per cent. for the year, carrying forward £3 916.

The net profit of Craigpark Electric Cable Company for the year ended March 31 was £12 054, after making provision for corporation tax, making, with £2 160 brought in, £14 214. The directors recommend that £2 000 be placed to depreciation of machinery, &c., £2 000 to reserve, and that a dividend be paid on 37 500 ordinary shares at the rate of 12½ per cent. for the year, leaving £2 676 to be carried forward, subject to directors' fees.

The net profit of the International Lighting Association for 1921 was £1 046, making, with the balance brought in, less dividend on the ordinary shares and directors' fees, £1 815. After payment of a dividend on the preference shares at the rate of 5 per cent. for the year, the balance of profit was £1 042, which the directors recommend be carried forward, subject to directors' fees. The report states that the dividend on the 6 per cent. cumulative preference shares of the Para Electric Railways & Lighting Company is in arrear from November 30, 1920.

In moving the adoption of the report and accounts at the annual meeting of the City of Santos Improvements Company, last week, Mr. N. B. Dickson said that the progressive results of the company's operations for the last two years had not been maintained owing to the acute depression, both financial and commercial, which had existed in Brazil. The approximate trade returns for 1921, however, indicated that the adverse trade balance of the country would be about £1 800 000, against £17 000 000 in 1920. That implied some improvement in the financial situation, and they might be justified in hoping that during the current year a favourable trade balance would be secured. An abstract of the accounts appeared in our issue of April 21.

The accounts of the Radio Corporation of America for 1921 show gross income from transoceanic communications $2 138 626; gross sales, $1 468 920; from marine service, $553 298; making a total of $4 160 844. After deducting general operating and administration expenses, depreciation of plant and cost of sales ($3 762 231), a balance of $398 613 remained, making, with other income, $426 800, applied against amortisation of patents. No dividend was paid during the year on either the preferred or the common stock outstanding. The report states that the current liabilities have been reduced by about $930 000, and that current assets exceed current liabilities by nearly $4 000 000. During the year $3 000 000 was spent in extending plant and equipment, investments in which now total $12 702 086. Reserves for depreciation and obsolescence of plant and amortisation of patents amount to $2 318 135.

The accounts for the year ended December 31, 1921, of the Madras Electric Tramways (1904), Ltd., show a gross profit of £34 661. After debiting interest and London office expenses, making provision for the debenture stock sinking fund, and transferring £10 000 to depreciation and renewal account, there remains a balance of £9 744. To this has to be added the sum of £5 556 brought forward from last year, making a total of £15 299. From this sum is deducted dividends on the preference shares paid, less income tax, on September 30, 1921, and March 31, 1922, amounting to £6 000, leaving a balance of £9 299. The directors recommend the payment of a dividend on the ordinary shares of 5 per cent. for the year, free of income tax (£2 863), leaving £6 436 to be carried to next year's accounts. The traffic receipts and running expenses in rupees show decreases of 15·5 per cent. and 10·5 per cent. respectively on 1920. Repairs and maintenance have been debited to revenue, and special improvements and renewals to "depreciation and renewal account," as usual The debenture stock sinking fund now amounts to £13 691.

Tenders Invited and Accepted.

UNITED KINGDOM.

Eccles Town Council. May 8.—Supply and erection of overhead distributing mains for 200 houses. Particulars from the Borough Electrical Engineer, Cawdor-street, Patricroft.

Mountain Ash Urban Council. May 8.—Extra high-tension overhead and underground transmission mains. Specification from the Electrical Engineer.

Bradford Corporation. May 9.—Wiring and fitting 120 houses, comprised in the municipal housing schemes. Specification from the City Architect, Town Hall, Bradford.

Fleetwood Urban Council. May 9.—One 1 000 kW d.c. turbo set, with switchgear and condenser. Specification from the Engineer and Manager, Electricity Works, Fleetwood.

Great Western Railway. May 15.—Supply for three or six months from June 1 of (18) telegraph instruments, (19) electrical apparatus (insulators), &c., (21) telegraph ironworks and tools, (22) telegraph drysalteries, (24) electric lamps. Samples and patterns may be seen and tender forms obtained on application at the office of the Stores Superintendent, Swindon.

Rathmines and Rathgar Urban Council. May 15.—Two 200 kW converting sets, with high and low tension switchgear, cable connections, &c. Specification can be obtained at the Electricity Works.

Edinburgh Corporation. May 15.—Six or twelve months' supply of electricity meters. Particulars from the Engineer and Manager, Electricity Department, Dewar-place, Edinburgh.

Edinburgh Corporation. May 16.—1 180 tons steel tram rails, 45 tons fishplates, 110 tramcar trucks, 110 trolley standards, and one electric welding plant.—Specifications, &c., from the Tramways Manager, 2, St. James's-square, Edinburgh.

High Commissioner of India. May 26.—Insulator cups, porcelain or glass. Particulars from Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1.

Stepney Electricity Department. June 8.—Manufacture, supply and erection complete of (*a*) three water-tube boilers, together with chimneys, economisers and other accessories; (*b*) two 10 000 kW turbo-alternators with condensers, accessories and switchgear. Particulars from Mr Wm. C. P. Tapper, Borough Electrical Engineer and Manager, 27, Osborn-street, Whitechapel, E. 1.

Hackney Electricity Department. June 14.—Pipework and valves. Particulars from the Borough Electrical Engineer, 306, Mare-street, Hackney, E. 8.

Kingston-upon-Hull City Council.—Automatic telephone exchange for Hessle. Particulars from Mr. T. Holme, Mytongate, Hull.

Powell Duffryn Steam Coal Company.—Six months' supply of copper wire and electrical accessories. Forms of tender, &c., from the Stores Manager, Aberaman Offices, Aberdare.

AUSTRALIA.

Department of Public Works, New South Wales. May 29.—*Supply, delivery and erection at the State power-house station, Uhr's Point, Sydney, together with the testing and maintenance thereof for a period of three months, of one 1 000 kW steam turbo-generator, complete with all fittings and accessories.

Cheadle and Gatley Urban Council has accepted the tender of the Macintosh Cable Company, for cables for the electricity scheme, at £18 736 17s. 9d.

Ventnor Urban Council has accepted the offer of the Isle of Wight Electric Light & Power Company for street lighting for three years for a quarterly payment of £68 15s., plus 6d. per unit for current consumed.

London County Council have accepted the tender of Emerson Bros. (lowest tender received) for the installation of electric lighting and fire alarms at the Intermediate Schools, Swaffield-road, Wandsworth, at £366 12s. Forty-seven tenders were received, the highest being £1 148 15s.

Sunderland Corporation have accepted the following tenders: British Insulated & Helsby Cables, Ltd., 600 yards 0·15 four-core cable; Callender's Cable & Construction Company, service boxes and link boxes; Armstrong, Addison & Company, capping; Ferguson, Pailin, Ltd., low-pressure switch panels: Cambridge & Paul Scientific Instrument Company, temperature and flue-gas recorders; Consolidated Pneumatic Tool Company, electric drilling machine.

Books Received.

"Electricity." By Sydney G. Starling, A.R.C.Sc., B.Sc., F.Inst.P. (London: Longmans, Green & Company.) Pp. viii.+245. 10s. 6d. net.

"A Course in Electrical Engineering." Vol. II., Alternating Currents. By Chester L. Dawes, S.B. (London: McGraw Hill Book Company, Inc.) Pp. xiv.+526. 20s. net.

"Economics of Electrical Distribution." By P. O. Reyneau, M.E.Mem.A.I.E.E., and H. P. Seelye, B.C.E.Assoc., Member A.I.E.E. (London: McGraw Hill Book Company Inc.) Pp. vii +209. 12s. 6d. net.

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* *Particulars from the Department of Overseas Trade.*

COMMERCIAL INTELLIGENCE.

County Court Judgments.

[Note.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

BARRACLOUGH, W., Ridgemont, Wyke, electrical engineer. £15 7s. 7d. Mar. 3.

BURROWS, Frederick, 52, Victoria-road, Clapham Common, electrician. £15 3s. Feb. 20.

HURLINGHAM ELECTRIC COMPANY, 28, New King's-road, Fulham, electricians. £11 11s.. Feb. 28.

MARCUS, C. A., 212, High-road, Willesden-green, electrical engineer. £17 0s. 1d. Feb. 24.

PERRIN, Francis Leopold, 5 and 7, College-street, Northampton, electrical engineer. £47 2s. 5d. Mar. 1.

SMART, Mr. W. N., Cross-street, Oldham, electrical engineer. £32 17s. 7d. Mar. 4.

SOHO ELECTRICAL WORKS, 6, Soho-street, Islington, Liverpool, electrical engineers. £19 1s. 3d. Feb. 28

SPRINGER, Robert, 253, Plymouth-green, Manchester, electrical engineer. £44 9s. 10d. Mar. 1.

Deed of Arrangement.

GRIFFITH, Benjamin, trading as EXCEL ELECTRIC COMPANY, 30, South Castle-street, Liverpool. In this matter (see our last week's issue) the following are creditors:—Siemens Bros. & Company, Ltd., London, £68; Newman Electric Company, London, £32; Baxendale Bros., Ltd., Liverpool, £946; Moore & Barker, Ltd., Liverpool, £63; British Thomson-Houston Company, Liverpool, £32; General Electric Company, Liverpool, £41; Woolliscroft, J. H., & Company, Liverpool, £18; Downes & Davies, Liverpool, £15; Buying, G., Liverpool, £15; Burns, D., Liverpool, £200; Thomas, F. G., Liverpool, £80; Ward & Goldstone, Ltd., Salford, £22.

Mortgages and Charges on Limited Companies.

[Note.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

LLANGEFNI ELECTRIC LIGHT & POWER COMPANY, LTD. Registered April 20, transfer of mortgage securing £700, to bank, charged on power station and electric light works, Mill-street, Llangefni. *£2 400. Jan. 14, 1921.

NEWCASTLE & DISTRICT ELECTRIC LIGHTING COMPANY, LTD. Registered April 15, debentures dated March 27, 1922, securing £10 000 and further sums not exceeding in all £20 000; general charge. *£301 180. April 7, 1922.

OMEGA LAMPWORKS, LTD., London, S.W. Registered April 18, £1 000 debentures; general charge. *£1 000. December 27, 1920.

WILKINSON (THOMAS) (ARNSIDE), LTD., electrical engineers. Registered April 18, £10 250 debentures and mortgage collateral thereto, to bank; general charge and land and works at Arnside. *Nil. May 14, 1921.

Satisfactions.

ELECTRIC CONSTRUCTION COMPANY, LTD., London, E.C. Satisfaction registered April 19, £47 200, part of amount outstanding July 1, 1908.

Private Meetings.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

HUBERT D. CARTER (BANGOR), LTD. (in voluntary liquidation), electrical merchants, &c., Bangor. The statement of affairs presented at the statutory meeting of creditors showed ranking liabilities of £2,073. The indebtedness to the trade was £1 035. Assets were estimated to realise £617, or a deficiency as regarded the creditors of £1 456. The company was registered in February, 1920, when it took over an existing business as a going concern. The company was to act as a distributing agency for another concern on a 10 per cent. basis. The purchase price paid by the company was £2 500, practically all of which was satisfied by the allotment of fully-paid shares. A petition has been presented for the compulsory winding-up of the company, but it was stated at the meeting that if the voluntary liquidation was continued Mr. Carter would withdraw his claim for £794. Several creditors expressed the opinion that it would not be advantageous for compulsory liquidation to take place, and a resolution was passed confirming the voluntary liquidation with G. G. Poppleton, of Poppleton & Appleby, Birmingham, as joint liquidator.

WATTS, WILLIAMS & COMPANY, LTD. (in voluntary liquidation), electrical engineers, Leysfield-road Works, Goldhawk-road, Shepherd's Bush, London, W. At a meeting of creditors, held recently, a statement of affairs was submitted which showed ranking liabilities of £25 607, against assets estimated to realise £11 027. After allowing £198 for preferential claims, the assets were estimated to realise £10 829, or a deficiency of £14 778. The company was registered in April, 1920, with a nominal capital of £60 000, and shares to the value of £35 700 were issued for cash. A further 5 000 shares of £1 each were issued as fully paid to the British Generator Company, Ltd., as consideration for assets transferred. The company had manufactured lighting sets, but had experienced great difficulty in perfecting them, while the sole selling agents recently went into voluntary liquidation owing Watts, Williams & Company, Ltd., £2 200, of which nothing had yet been paid. The company had also carried on a welding business and repair shops. During the year ended March 31, 1921, there was a loss on the trading of £8 350, while since that date there had been further losses aggregating £16 000. Owing to the heavy losses the directors and their friends had advanced substantial sums to enable the company to continue, and they were now cash creditors for rather more than £18 000. The creditors decided to confirm the voluntary liquidation of the company, with Mr. F. J. Carpenter, of W. B. Keen & Company, C.A., 23, Queen Victoria-street, E.C., as liquidator.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Companies Winding-up Voluntarily.

BRITISH GENERATOR COMPANY, LTD. F. J. Carpenter, of W. B. Keen & Company, 23, Queen Victoria-street, London, E.C., appointed liquidator. Meeting of creditors at the offices of the liquidator on Monday, May 8, at 3 p.m. Particulars of claims to the liquidator by May 27.

STANTON & COMPANY, LTD., electrical and general engineers, Albert-road, Hinckley, Leicestershire (in voluntary liquidation). Meeting of creditors at the offices of Watson & Meller, 29, Friar-lane, Leicester, Monday, May 8, at 3 p.m. Particulars of claims to the liquidator by May 24.

Bankruptcy Information.

MAYNER, Robert Victor, 62, Harris-street, Peterborough, late Narrow-street and Wentworth-street, Peterborough, electrical engineer. First meeting, May 9, 12.15 p.m. Public examination, June 9, 10.30 a.m., Law Courts, Peterborough.

MORRISON, Roy Thomas, 82, Lumb-lane, Bradford, electrical enigneering contractor. First meeting, May 6, 10 a.m., 12, Duke-street, Bradford. Public examination, May 24, 10 a.m., County Court, Manor-row, Bradford.

ORMONDE, Frank Sinclair, in co-partnership with another under the style of the SOHO ELECTRICAL WORKS, 125, Islington, Liverpool, electrician. First meeting, May 11, 11 a.m., 11, Dale-street, Liverpool. Public examination, May 30, 10.30 a.m., Court House, Government Buildings, Victoria-street, Liverpool.

RIMMER, W. F. (male), 21, Ellesmere-street, Patricroft, Lancashire, electrical engineer. Receiving order, April 28. Creditor's petition.

THREAPLETON, William Walton, Thornbury-drive, Bradford, electrical, &c., engineer. Receiving order, April 26. Debtor's petition. First meeting, May 10, 10.30 a.m., 12, Duke-street, Bradford. Public examination, May 24, 10 a.m., County Court, Manor-row, Bradford.

Edinburgh Gazette.

LIVINGSTONE & MALCOLM, electricians, 7, Canal-street, Coatbridge (James Livingstone & Frank Malcolm, trading as). Estates sequestrated April 22. Meeting to elect trustee and commissioners, Library Hall, County Buildings, Airdrie, on Monday, May 8, at 11.15 a.m.

Bankruptcy Proceedings.

CAMP, WILLIAM, trading as WILLIAM CAMP & COMPANY, Carr-lane, Slaithwaite, near Huddersfield, Yorkshire, electrical engineer. The first meeting of creditors was held recently at Huddersfield. The statement of affairs showed gross liabilities of £594, all of which was expected to rank, against assets of £100, or a deficiency of £494. Debtor attributed his failure to shortness of capital, bad trade, and ill-health. The case being a summary one, was left with the Official Receiver.

HENDERSON, Charles Archibald, 63, Queen Victoria-street, E.C. At the statutory first meeting of the creditors, held on Monday, the Official Receiver reported that, according to statements, the debtor, shortly after being demobilised in 1919, bought for £450, which he borrowed, the business of Allen &

McMaster, insulating materials merchants. The trading was a success until some nine months ago, when he found himself short of capital in consequence of guarantees. Certain of his customers also curtailed their credit when they heard that it was his intention to manufacture on his own account. He had been hoping from day to day that friends would provide the money necessary to equip a factory, but he had done practically no business for some months past. He roughly estimated his liabilities at £2 000, of which, he said, £500 was due to moneylenders and the balance in respect of trade accounts. Those liabilities were, however, apart from contingent liabilities amounting to £20 000 (less £2 000 repaid), which represented loans to him on security of life policies for £30 000. Those liabilities were guaranteed jointly and severally by certain other persons. He added that he had received no part of the loans in question nor any consideration, and that the money had been lent to another company. He had roughly valued his assets at £19 540, excluding the equity of redemption in a freehold house at Sutton. He attributed his present position to the failure to equip a factory to manufacture the goods in which he had dealt, and to heavy interest and loans and guarantees from friends. He was prepared to make an offer for the payment of 7s. 6d. in the £ to trade creditors. It was understood that for the purposes of such a proposal the family creditors would withdraw their claims. On behalf of creditors, Mr. Webb pointed out that the bankruptcy petition was adjourned for months to enable the debtor to make a proposal. He was not very hopeful. The chief creditor, however, remarked that he was in favour of an adjournment, and the Official Receiver thereupon adjourned the meeting until May 22.

MAIDMENT, Percy Charles, electrical engineer, &c., 13, Beauchamp-place, South Kensington, W. This debtor attended last week for his public examination on a statement of affairs showing liabilities of £1 688, all of which were expected to rank for dividend, and assets £92. Debtor stated that after he was demobilised in February, 1919, he entered into partnership with two other persons, and they began business as electrical engineers, under the style of Wright Brothers & Maidment, at 164, Sloane-street, S.W. They continued together until August, 1919, when the partnership was dissolved. The debtor said that he agreed to pay his late partners £4 250 for their interest in the business, stock, lease and fixtures, and he continued the business under the style of P. C. Maidment until March of last year, when he disposed of it for £4 500. He then began to trade as a builder, decorator and electrical engineer at 13, Beauchamp-place, where he carried on business until January, when his stock-in-trade was sold under an execution. He attributed his insolvency to lack of capital and to bad trade. His brother prepared a balance sheet in October, 1920, which disclosed an excess of liabilities over assets amounting to £800. In March, 1921, his brother left him, and the debtor, having no knowledge of book-keeping, had not since kept up the books. He realised that he was in a very bad way in October, 1920, but, notwithstanding the loss shown in the balance sheet prepared, he continued the business in the hope that trade would revive. He tried to find a purchaser for the business, and that he eventually did in March, 1921, when his liabilities approximately exceeded his assets by £1 500. Since starting the business in Beauchamp-place he had contracted further debts amounting to £100. To enable him to carry out the purchase he borrowed £3 600 from his bankers, which loan he had since repaid, and he also obtained a loan from his father, which was still outstanding. This was the only occasion on which he had been bankrupt. The examination was concluded.

VIVIAN, ALBERT, electrical engineer, 140, Gray's inn-road, W.C. Under a receiving order made against this debtor, on April 10, on the petition of the Burke Electrical Company, of Westminster, the act of bankruptcy alleged being notice given by the debtor on March 10 of suspension of payment, the statutory first meeting of creditors was held last week. The debtor in June, 1920, entered into partnership with another person, and they traded together as bakers' engineers in Birmingham under the style of A. Vivian & Company. The business was, however, unsuccessful from the beginning, and in March 1921, the partnership was dissolved; his partner taking over the assets and liabilities. He then met another person, who suggested that he should begin business by himself. Financial backing was promised provided that the debtor took two of this person's relatives into the business as employees. A sum of £355 was actually provided. The business, however, from the outset was not very brisk, and the coal strike affected his trade very adversely. Moreover, not having sufficient capital, the debtor was unable to buy advantageously, and his business rapidly declined. In January the other person, who had guaranteed his overdraft at the bank, stopped his account, at that time overdrawn to the extent of £140, and through his solicitors applied for repayment of his advances. The debtor, therefore, placed his affairs in the hands of another, who immediately took possession of the business and acted as trustee. A private meeting of the creditors was afterwards held, when joint trustees of the estate were appointed. In March he executed a deed of assignment of his property in favour of his creditors. He estimates his liabilities at £2,200 and values his assets at £140. He attributes his insolvency to depression in trade and to his having begun the business without sufficient capital. The case remains in the hands of the Official Receiver as trustee.

Arrangements for the Week.

FRIDAY, May 5th (to-day).

THE IRON AND STEEL INSTITUTE.

10 a.m. At the Institution of Civil Engineers, Great George-street, London, S.W. 1. Annual meeting.

ROYAL SOCIETY OF ARTS.

4.30 p.m. At John-street, London, W.C. 2. Lecture on "Imperial Wireless Communication," by Prof. W. H. Eccles, D.Sc., F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS.
(LONDON STUDENTS' SECTION.)

7 p.m. At the Institution, Savoy-place, London, W.C. 2. Lecture on "Electrically Oscillatory Discharges," by Mr. R. P. Howgrave-Graham.

THE JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Lecturette on "Gold Casting under Steam Pressure," by Mr. E. N. Ching.

EDINBURGH ELECTRICAL SOCIETY.

8 p.m. At Philosophical Institute, 4, Queen-street, Edinburgh. Annual meeting.

SATURDAY, May 6th.

ROYAL INSTITUTION OF GREAT BRITAIN.

3 p.m. At 21, Albemarle-street, London, W. 1. Lecture on "Industrial Relationships: (II.) The Problem of Structure," by Mr. D. H. MacGregor, M.A.

LONDON ASSOCIATION OF FOREMEN ENGINEERS.

6 p.m. At Cannon-street Hotel, London. Sixty-ninth Anniversary Festival.

MONDAY, May 8th.

ROYAL INSTITUTION OF GREAT BRITAIN.

5 p.m. At Albemarle-street, London, W. 1. General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS.
(LIVERPOOL SUB-CENTRE.)

7.15 p.m. At Compton Hotel, Church-street, Liverpool. Third Annual General Meeting.

TUESDAY, May 9th.

INSTITUTION OF ELECTRICAL ENGINEERS.
(EAST MIDLAND SUB-CENTRE.)

6.45 p.m. At Loughborough College, Loughborough. Annual General Meeting.

THURSDAY, May 11th.

THE OPTICAL SOCIETY.

7.30 p.m. At the Imperial College of Science and Technology, London, S.W. 7. Discussion on "Motor-car Head-lights."

FRIDAY, May 12th.

PHYSICAL SOCIETY OF LONDON.

5 p.m. At the Imperial College of Science, South Kensington.

1. "A New Apparatus for the Measurement of the Polarisation Capacity of Platinum Plates in Sulphuric Acid," by Dr. A. Griffiths and Mr. W. T. Heys.
2. Demonstration of Some Electrical Properties of Neon-filled Lamps, by Mr. S. O. Pearson and Mr. H. St. G. Anson.

New Companies.

Gardner Engines, Ireland.

GARDNER ENGINES, IRELAND, LTD. (N.I. 23). Private company. Reg. in Belfast April 27. Capital, £3 000 in £1 shares. To carry into effect an agreement between Norris, Henty & Gardners, Ltd., and L. Gardners & Sons, Ltd., and to carry on business as mechanical, Electrical engineers, &c. Subscribers: C. Kendrick Edwards, M. R. Wylie. Secretary: Mary R. Wylie. Registered office: 65, 66, 67, Scottish Temperance-buildings, Donegal-square South, Belfast.

Invincible Electrical Engineering.

INVINCIBLE ELECTRICAL ENGINEERING COMPANY, LTD. (181 286). Private company. Reg. April 24. Capital, £1 000 in £1 shares. To carry on business as indicated by the title. First directors. J. H. Challinor, B. A. Kelsall, and C. J. Arnold. Registered office: 134, Park-lane East, Tipton, Staffs.

Sturge & Baker.

STURGE & BAKER, LTD. (181 382). Private company. Reg. April 27. Capital, £8 000 in £1 shares (1 500 6 per cent. cumulative preference and 6 500 ordinary). To take over the business of electrical accessories manufacturers carried on by W. H. Sturge and E. T. Baker at Premier Works, Sheepcote-street, Birmingham, as "Sturge & Baker." Permanent directors: W. H. Sturge and E. T. Baker. Secretary: E. T. Baker. Registered office: Premier Works, Sheepcote-street, Birmingham.

Winsor Engineering.

WINSOR ENGINEERING COMPANY, LTD. (12 171) Private company. Registered in Edinburgh April 25. Capital, £15 000 in £1 shares. Ventilating, heating, cooling, air conditioning, insulating engineers, &c. First directors: J. Marshall, G. Browning, and T. Neilson. Registered office: 41, Cogan-street, Pollokshaws, Glasgow.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Complete Specifications.

170 114 British Thomson-Houston Co. Ltd. & Whitaker, F. P. Dynamo-electric machines. (14/7/20.)
170 117 Nichols, E. F. Electric circuit closers. (16/7/20.)
170 148 Bolton, R. A. R. Construction of electric switches. (3/8/20.)
170 154 Franklin, C. S. Continuous wave telephony and telegraphy. (5/8/20.)
170 158 Bailey, H. & Pritchard, A. C. Means for use in the testing of internal combustion engine ignition apparatus as employed on motor vehicles and for remagnetising the permanent magnets of such apparatus. (14/8/20.)
170 170 Robinson, J. & Crowther, H. L. Apparatus for indicating the reception of sound, light, heat or electricity. (23/8/20.)
170 180 British Thomson-Houston Co. Ltd. (General Electric Co.). Electric regulating systems. (4/9/20.)
170 191 Staunig, K., Fritz, O. & March, A. Method of spectrum analysis of Röntgen rays and for apparatus therefor. (1/10/20.)
170 207 Dick, E. Electrical quick-acting step regulator. (4/11/20.)
170 237 Igranic Electric Co. Ltd. (Cutler-Hammer Manufacturing Co.). Electric switches. (16/2/21.)
170 327 Taggart, J. Scott-, & Radio Communications Co., Ltd. Construction of vacuum tubes and the like as used for radio-signalling. (10/6/20.)
170 331 Brecknell, Munro & Rogers, Ltd., & Willis, A. M. Bow current-collectors in overhead wire systems of electric traction. (17/6/20.)
170 344 Hanman, J. Sparking-plugs. (12/7/20.)
170 357 Poole, G. Portable dynamo-electric lamp. (14/7/20.)
170 371 Master, S. D. Trolley wheel guides for electric tration. (16/7/20.)
170 375 Stone & Co., Ltd., & Honey, A. E. Dynamo-electric machines. (16/7/20.)
170 377 Taggart, J. Scott-, Radio Communication Co., Ltd., & Turner, L. B. Trigger relays especially for use in radio communication. (17/7/20.) (Addition to 130 408.)
170 378 Taggart, J. Scott-, & Radio Communication Co., Ltd. Modulation systems and the like in radio comn.unication and the like. (17/7/20.) (Cognate application 25 066/20.)
170 385 Automatic Telephone Manufacturing Co., Ltd. (Automatic Electric Co.). Relays and their application to automatic telephone or like systems. (19/7/20.)
170 400 Riley, G. B. Telephones. (20/7/20.) (Cognate application 4 737/21.)
170 401 Nadaud, C. L. J. B., & Young, F. Electric switches. (20/7/20.)
170 402 Reyrolle & Co., Ltd., A., & Harriman, W. A. Contacts for electric fuses, cut-outs, and the like. (20/7/20.)
170 414 Lamb, H. R., & Huartson, H. Method of and apparatus for conveying electric current to a movable truck or the like. (24/7/20.)
170 420 Sykes Interlocking Signal Co., Ltd., W. R., & Sykes, F. J. Mercury signal arm contact. (26/7/20.)
170 435 C. L. I. Manufacturing Co., Ltd., & Watson, E. A. Control devices for electric circuits. (9/8/20.) (Cognate application 27 360/20.)
170 459 Joseph, B. C., & Joseph, N. C. Electrically-heated cooking utensils. ((27/8/20.) (Addition to 158 073.)
170 469 Brown, A. G. Sparking-plugs. (6/9/20.) (Addition to 145 348.)
170 472 Atkins, J. Electric switching systems for charging batteries. (8/9/20.)
170 605 Jackson, W. J. Mellersh- (Taylor, A.). Radio-telegraphy signalling systems. (12/4/20.)

APPLICATIONS FOR PATENTS

April 18, 1922.

10 728 D. C. Williamson. Circuit controlling devices for ignition systems.
10 744 H. J. Osborn. Incandescent lamps, wireless valves, &c.
10 754 S. R. Gibbon. Electric switches.
10 791 J. A. Crabtree. Electric fuses.
10 792 A. E., J. G. & M. A. Muirhead. Production of radiant energy.
10 796 J. B. Belcher. Electric pump.
10 812 E. W. O'Hara, W. N. Cheyney & D. Maclachlan. Electric pumps.
10 815 E. Lawrence. Apparatus for recording telephone messages.
10 821 British Brass Fittings, Ltd., Sperryn & Co. & G. N. Sperryn. Switches.
10 835 E. Schröder. Electric seam welding machines.
10 836 E. Schröder. Electric cuff welding machines.
10 837 E. Schröder. Electric heating and welding apparatus.
10 861 Safety Car Heating & Lighting Co. Storage batteries. (11/3/21, U.S.)
10 871 G. Passarge. Wireless telegraphy. (25/4/21, Germany.)
10 886 C. Rockley. Selecting devices for telephone systems.
10 887 Western Electric Co. Inductance devices. (21/5/21, U.S.)
10 895 B. Rogge. Electric pocket lamps.
10 903 Etab. Gaiffe-Gallot, et Pilon. Radioactive tubes. (24/5/21, France).
10 904 Cie d'Entreprises Electro-Mecaniques. Cable guide for cable drums. (6/5/21, France.)
10 905 J. Bally. Commutating switches. (13/7/21, France.)
10 919 R. L. Rolfe. Lock for incandescent lamps.
10 923 E. J. Halling. Electric condensers.

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10 932 W. Frisby. Apparatus for automatically operating electric switches.
10 946 R. F. Woodburn. Electrodes.
10 953 W. Calder. Ignition magnetos.
10 967 Metropolitan-Vickers Elec. Co. & F. B. Holt. Connection of cables to electrical apparatus.
10 968 X-Rays, Ltd., & A. C. Gunstone. Regulation of gas-filled X-ray tubes.
10 975 H. Kauffmann. Magneto electric machines.
10 982 Orientex Handelsges. Electric flatirons. (12/9/21, Germany.)
10 987 A. P., G., C. & P. A. Lundberg & G. Pegg. Electric switches.
11 006 Cie Francaise pour l'Exploitation des Procedes Thomson-Houston. Automatic traffic distribution for telephone systems. (19/4/21, France.)
11 007 B. T.-H. Co. Suspension devices.
11 008 B. T.-H. Co. (International General Electric Co.). Electrically heated devices.
11 009 H. Baron (Frister Akt. Ges.). Electric flat iron.
11 027 J. R. Quain. Electric water heaters.
11 044 Automatic Telephone Mfg. Co. Automatic step by step switches. (29/4/21, U.S.)
11 046 H. Goldschmidt & A. Stock. Electrolytic manufacture of compact metallic beryllium
11 047 A. Baderna. Electric cut-outs. (28/4/21, Italy.)

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11 060 R. Ainsley. Apparatus for actuating electric indicators for engine rooms, &c
11 095 B. R. Charles. Electric heating fabric.
11 121 E. Haefely et Cie Akt. Ges. Insulating sleeves for transformers, &c. (21/4/21, Switzerland.)
11 127 English Electric Co. & W. E. M. Ayres. Protective devices for electric machines.
11 145 B. T.-H. Co. (Gouverneur). Insulators.
11 154 N. W. McLachlan. Telegraphic sending keys
11 164 A. Negromanti. Electric thermal fabric. (30/4/21, Italy.)
11 165 Scintilla. Switch apparatus for electric starters. (4/5/21, Switzerland.)
11 173 H. Wade (Gould Storage Battery Co.). Storage battery separators.
11 184 V. Martinetto. Asynchronous induction machine. (2/7/21, Italy.)

April 21, 1922.

11 201 H. Sutton. Tramcars.
11 227 J. Jones. Squirrel cage rotors, &c.
11 259 J. Erskine-Murray. Electro-magnetic apparatus.
11 281 P. Sartóry. Electric heating apparatus for hair waving.
11 287 Automatic Telephone Mfg. Co. Telephone systems. (29/3/22, U.S.)
11 295 Soc. Anon. le Carbone. Primary cells. (18/3/21, France.)
11 300 Siemens & Halske A. G. Alternating current rectifiers. (24/5/21, Germany.)
11 302 General Electric Co., Ltd. Repeaters for railway signalling systems.
11 306 Landis & Gyr. Supporting core on electrical measuring instruments. (21/4/21, Switzerland.)
11 312 Naamlooze Vennootschap Philips Gloeilampenfabr. Electric lamps with light diffusing globes. (28/2/21, Holland.)
11 314 Anc. Etab. Barbier, Bénard et Tarenne. Automatic commutating switches. (10/6/21, France.)
11 318 Electro-Mechanical Brake Co & M. J. Pattison. Electric controllers.

April 22, 1922.

11 338 D. Denholm. Cover for protection of cables laid in the ground.
11 349 B. J. Baker. Multi-pole magnetic pendulum.
11 356 F. Marshall. Electric light fittings.
11 362 Siemens Bros. & Co. Telegraph instruments.
11 363 R. Amberton. Electricity meters.
11 367 Siemens Bros. & Co. & A. Gordon. Telegraph instruments.
11 368 Siemens Bros. & Co. & W. G. Patterson. Metering calls in telephone systems.
11 369 Siemens Bros. & Co., J. Berry & C. L. Peters. Circuit arrangements for operating automatic telephone systems, &c.
11 379 Telephone Mfg. Co. & R. L. Murray. Automatic telephone systems.
11 380 Ges. für. Drahtlose Telegraphie. Telephone systems. (23/4/21, Germany.)
11 382 J. Hall. Oil immersed overload circuit breakers.
11 383 Nobel's Explosive Co. & W. O. Littlebury. Fuel heads for electric firing.
11 396 J. T. Thompson. Overhead construction for electric conduits, &c.
11 397 J. Scott-Taggart. Radio communication signalling systems, &c.
11 401 Johnson & Phillips & G. C. Pearson. Telephone cables.

Prices of Metals, Chemicals, &c.

Tuesday, May 2.

		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£63 0 0	—	—
Electro Wirebars ..	„	£66 10 0	—	—
H.C wire, basis	per lb.	0s. 9 1/16d.	—	1/8d.
Sheet	„	0s. 9 7/16d.	—	—
Phosphor Bronze Wire (Telephone)				
Phosphor-bronze wire, basis	„	1s. 1 3/16d.	—	1/8d.
Brass 60/40—				
Rod, basis	„	0s. 7d.	—	1/8d.
Sheet, basis	„	0s. 8 3/4d.	—	1/8d.
Wire, basis.....	„	0s. 9 1/4d.	—	1/4d.
Pig Iron—				
Cleveland Warrants .	per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 SWG	„	£18 0 0	—	—
Lead Pig—				
English	„	£25 0 0	—	5s.
Foreign or Colonial ..	„	£24 0 0	—	2s. 6d.
Tin—				
Ingot	„	£151 12 6	—	£1 17s. 6d.
Wire, basis	per lb.	2s. 1d.	3/4d.	—
Aluminium Ingots	per ton	£120 0 0	—	—
Spelter	per ton	£26 17 6	—	7s. 6d.
Mercury	per bottle	£11 0 0	—	—

Salammoniac.—Per cwt. 65s.-60s.
Sulphur (Flowers).—Ton £10 15s.
„ (Roll-Brimstone).—Per ton £10 15s.
Sodium Bichromate.—Per lb. 5½d.
Sodium Chlorate.—Per lb. 3½d.
Sulphuric Acid (Pyrites, 168°).—Per ton £9 10s.
Copper Sulphate.—Per ton £26 10s.
Boric Acid (Crystals).—Per ton £60
Rubber.—Para fine, 10 3/4d.; plantation 1st latex, 8 3/4d

The metal prices are supplied by British Insulated & Helsby Cables, Ltd, and the rubber prices by W. T. Henley's Telegraph Works Company.

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CONTENTS.

Notes of the Week.

What More Wireless Means.

As we pointed out a fortnight ago, the awakening of public interest in the employment of wireless methods for the dissemination of news cannot fail to have a satisfactory influence on the progress of that branch of the electrical industry which is concerned with such matters. This progress will be accelerated by the decision of the Postmaster-General to establish a number of broadcasting stations which will be operated by approved British firms, the selection of which we hope will be as wide as possible. But at the same time it will bring with it an increase in responsibility. For the wireless amateur will require simple, cheap, and efficient apparatus if he is to be able to take advantage of the facilities provided, and equipment of the same qualities will be equally required by the "broadcasting" stations. Designers and manufacturers will, therefore, have to devote close attention to a study of all the questions which the production of this class of wireless apparatus will involve, and to keep themselves acquainted with what is being done in both theoretical and practical fields. To ensure that acquaintance is obviously the duty of a technical journal.

"The Electrician" and Wireless.

For that reason we propose to devote a certain amount of space in The Electrician, which appears on the second Friday of each month, to a consideration of technical wireless matters, in the hope that by so doing we may assist in the "broadcasting" of information on this most important question. Not the least useful part of this scheme will be the series of articles by Prof. G. W. O. Howe, which we shall publish in these issues, in which he will discuss theoretical and technical matters of a controversial character connected with the progress of wireless telegraphy and telephony. In this particular issue Prof. Howe deals with the recording and printing of high-speed radio signals, and points out to how large an extent the economic success of long-distance radio-telegraphy must depend on the development of both transmitting and receiving apparatus for this purpose. He mentions what has been actually done in this direction, and describes a new type of siphon recorder which has been developed by the Radio Corporation in America. This is a matter to which it will be agreed close attention must be paid, and the development of which will be of the greatest of use for the purposes we have mentioned above.

A Survey of Wireless Literature.

There is, perhaps, no electrical subject upon which more is being written at the present time than that which can be conveniently placed under the heading of radio communication. But the earnest seeker after truth finds the distribution of the information so wide that it is a matter of considerable difficulty not only to find any particular detail for which he is seeking, but to discover what has been written on a particular subject. We propose to make this task easier by publishing in our second issue each month references (they are hardly abstracts) to articles and other publications on wireless subjects, always excepting patents, which will be found, as heretofore, in our Patent Record. This last is an important reservation, for in modern patent literature there are perhaps to be found the most accurate indications of the trend of wireless progress, and, not less interesting, the attempts and failures that have been made to reach success by a particular route. It may also be pointed out that a great deal of useful wireless information is to be found in publications which are not strictly technical, and to which the scientific worker does not have access or of which he is not even aware. That gap will, we hope, be filled by the feature which appears for the first time in our columns this week.

Imperial Wireless Communication.

In the Paper on "Imperial Wireless Communication," which he read before the Dominions and Colonies and Indian Sections of the Royal Society of Arts last Friday, Prof. W. H. Eccles took the wise course of summarising in non-technical language what has been done to bring radio communication to that state when it can not only render useful international service, but can be used with pleasure and profit by any ordinary human being. His avowed object was to publish information which ought to be in the possession of those who wish to form their own opinion on the proposal to erect an Imperial Wireless Chain. And though some of his conclusions were traversed by Mr. Godfrey Isaacs in the course of the discussion, they are not the less valuable for that. Prof. Eccles, of course, represents the official view; Mr. Isaacs an alternative method of providing a similar service. It is hardly likely they would agree on all points.

The "2 000" Mile Scheme.

One of the points of difference seems to be the advisability or otherwise of working on the "2 000 mile scheme" recommended by the Imperial Wireless Committee. Mr. Isaacs, argued against the scheme, but Prof. Eccles, by means of an interesting meteorological analogy, was able to show the technical disadvantages of building stations with ranges beyond that limit. Purely from the traffic point of view, the argument in favour of the shorter range is also the more cogent, as messages can be both transmitted and received at the intermediate stations, and a more distributed and efficient communication thereby maintained. It is significant that Prof. Eccles's review states that few stations are working normally at a much greater range than 2 000 miles, though, of course, the extreme range at times may be much greater for reasons that are well-known.

The Patent Situation.

Speaking upon the patent situation, Prof. Eccles also made some interesting remarks. Except for the Meissner "feed-back" invention, owned by the Marconi Company, the heterodyne patents of the Metropolitan-Vickers Company, and two small German patents, no other patents of outstanding fundamental importance appear to be employed, and wireless communication is, therefore, free to develop on the technical side without what cannot be regarded other than as a most serious stranglehold. We hope that the other kind of monopoly which might be brought about by business and financial combinations may also be dissolved, if necessary by Government action. It is essential for the general good that it should.

Amateur Wireless in the United States.

The possible wide extension of the use of wireless equipment by amateurs as a result of the concessions which it is understood are to be granted by the Postmaster-General receives striking confirmation in reports that have been published in the United States, where the use of radio apparatus has evidently become a craze. It is stated that there are now about one million people in that country who amuse themselves by listening to the broadcasting of news, picking up "commercial codes," and taking the time from Arlington. As there were only forty thousand receiving stations a year ago, the rapid increase is truly astonishing, even for America. On the industrial side, we note that organised efforts are being made to sell radio receiving apparatus and equipment, and to develop the business as a distinct branch of the electrical industry. There is, however, another aspect of the matter, as we pointed out last week, for the multiplication of stations has made the exercise of some control by the Government necessary, and this will not appeal to the average American, who strongly resents any check on his actions.

Control of Radio Apparatus.

The Technical Committee of the Radio Control Conference have, in fact, issued a long report, which recommends complete control by the Department of Commerce over transmitting stations, though receiving stations are to be exempt. It is also recommended that wave lengths below 6 000 metres should be reserved for radio-telephone service, but wave lengths which have become standardised for telegraph service within this range, such as SOS signals, are to be retained. The present development of radio art warrants the employment of twenty different wave bands, of which seventeen are below 2 000 metres, and the Committee consider that in assigning these wave lengths the "broadcasting" service should have priority; but in dealing with this "broadcasting" the Government should come first, then education and public work, with private broadcasting (including entertainment, news, &c.) third, and toll broadcasting last. Amateurs are to have wave lengths of 150 to 275 metres reserved for them, but are to be given some opportunity to use experimental wave lengths. It is further proposed to limit the amount of power used in transmitting stations, in order to confine each of them to some special zone, and thus minimise interference with one another. This is an excellent provision, and a Bill has been introduced authorising the Department of Commerce to prevent the establishment of a transmission monopoly and to regulate the hours during which sending stations may operate. We do not envy the task of the Government officials who will have to enforce these regulations. They will have a lively time, and what is more—an unusual thing with officials—they will fully earn their salaries. What we may learn from what has happened is that rules for amateur wireless should be laid down at once, not in a rigid, restrictive spirit, but so as to protect the community generally.

Ultra Vires.

We wonder how many electricity supply underakings commonly perform actions which are *ultra vires*, or, on the other hand, fail in some respect to comply with some stipulation that is laid down by statute. The fact is that many supply engineers are but imperfectly acquainted with the contents of the various Acts that are supposed to govern their actions, and it would be interesting to know how many officers of position in undertakings could acquit themselves satisfactorily under even an elementary catechism of these formidable documents. It is true to say that every one in any position of authority ought to have at his fingerends the chief points in electricity supply legislation, and this should not be difficult, as the public Acts make in the aggregate only a quite slender volume. Nevertheless, we are often astonished at the vagueness shown by many officials on points connected with their own special work. Most of them, of course, know generally what is required, but that is quite a different thing from being able to give the exact text. Fortunately, consumers are more ignorant still, though this is no argument for a state of affairs which cannot be commended.

An Illegal Advertisement.

As an example of what we mean we may cite a case which occurred in the Midlands. A large supply undertaking

advertised that a special discount would be given for a certain period to all new consumers. This policy was, of course, adopted merely as an advertisement, and as such is to be commended as the awakening of the commercial spirit. Unfortunately, it ignores the stipulation in the Electric Lighting Act that preference must not be given to one consumer as against another of the same kind. So far as we know, no question was raised, probably because no one knew of the statutory provisions governing the matter. But such ignorance or indifference cannot always be defended, and an intimate acquaintance with the few Acts governing the industry is certainly a duty incumbent on everyone to whom any section of an electricity undertaking is entrusted.

Paying for Electricity Inquiries.

Under Section 34 of the Electricity Supply Act, 1919, the Electricity Commissioners are empowered to make rules as to the cost of any inquiries they may undertake. The draft rules, which have now been issued, scheduling all costs and expenses of the Commissioners arising out of any inquiry held by them, are, therefore, of interest. They lay down that the costs shall be borne by the parties concerned, or by such of them and in such proportions as the Commissioners may direct. As heretofore, of course, the individual expenses of the various parties at all public inquiries will be borne by themselves, and the Order refers to the special expenses incurred by the Electricity Commission, the general expenses of the Commission being borne by the industry as a whole. This seems to be the most equitable procedure, and though we do not know on what basis the Commissioners will apportion the expenses, we hope the effect will be to get rid of the long-windedness which has been too prevalent. If the parties find that the more they talk the more they have to pay a most desirable succinctness will result. To act in this way would, therefore, be well-warranted self-protection on the part of the Commissioners, since they are already worked hard enough without having to spend valuable time in listening to long-drawn-out arguments and counter-arguments that everyone in the industry by this time knows by heart. Arguments, too, which fill legal pockets, drain the industry, and lead nowhere.

The Gas Light and Coke Company's Order.

It is not often necessary for us to deal with the Legislation governing the supply of gas, but the Special Order of the Gas Light and Coke Company contains some provisions of such far-reaching effect that attention must be called to them. The Company, which seeks authority to purchase the Ilford Gas Company's undertaking, also desires to obtain power to lay pipes through parts of premises for the supply of other parts in different occupation without apparently obtaining either the consent of the owner or occupier. Only twenty-four hours' notice of the intention to lay the pipes is to be given, and neither the owner nor occupier is to have a voice in determining the position of the pipes or the manner of laying! If a similar suggestion was made by some electricity supply undertaking what an outcry there would be by the gas journals.

Control of Fittings.

This, however, is not the only high-handed procedure which the Company would like to adopt, for it is also seeking power "to specify the size and material of the pipes, with the fittings thereof, which are to be laid by the owner or occupier of any premises, either in the first instance or on the occasion of any renewal." Notice of any such work must be given to the Company which is to be empowered to approve or disapprove of the work, and in case of disapproval to refuse a supply of gas. While we sympathise with the desire to secure proper fittings and good workmanship, the power sought is altogether too wide for the protection of the Company's interests, and goes farther than the corresponding powers of electricity supply authorities. The only safeguard which the prospective gas consumer will have is a right of appeal to a Petty Sessional Court. In practice this will prove quite ineffective, as magistrates have little or no technical skill, and a monopolist Company like the Gas Light and Coke Company will have pretty much its own way. A better plan would be to refer any dispute concerning fittings to an engineering inspector of the Board of Trade or to an arbitrator.

Minimum Charge to be Enforced.

There is a third point in the Company's Order which seems to call for some modification. The Company wants to be in a position to make a minimum charge, not to exceed 25s. a quarter, for a stand-by supply of gas. The principle of the stand-by charge is now well known and is generally inserted in Electricity Supply Special Orders and in Gas Acts and Orders, but a sum of £5 a year is an exorbitant charge and cannot be justified. It would appear to be required as a menace to would-be users of electric light and power, who may wish to retain a gas supply for occasional heating or some other purpose, rather than as a protection to the Company. Those who wish to secure modifications of the clauses we have referred to should take steps to make representations at once to the Board of Trade. We believe the electrical industry is not likely to be affected by the provisions, which, if adopted, will assist rather than retard the progress of electricity supply. Their real effect to us therefore will be beneficial, though that is not their evident purpose.

Supply of Domestic Electrical Apparatus.

With the rapid expansion of the applications of electricity, particularly in the domestic sphere, new demands and changes in practice have arisen. These developments, which are the outcome of public needs and requirements, are of gradual growth, and frequently their true significance and trend are not understood or appreciated at the outset by those who are most interested or affected. We are afraid that many electrical contractors and supply dealers are not yet sufficiently alive to the need for meeting the increasing demands for domestic electric apparatus. This business has already become an important branch of the industry, and in the course of time it will attain to far greater importance. Therefore, we hope that steps will be taken to keep the supply of vacuum cleaners, electric washing machines, and other domestic apparatus in the hands of those who are competent to handle it. From the letter of Mr. Morton, which appears in another column, there would seem to be some danger of this lucrative trade being captured by those engaged in another trade. Apparently others believe there is money to be made by catering for modern domestic requirements, and we venture to suggest that those whose primary duty it is to develop this growing branch of the electrical industry should organise themselves so as to keep this trade in their own hands.

Inadequate Illumination and Miners' Nystagmus.

Much is heard in these days of the importance of good industrial lighting, but we doubt if there is any problem more urgent than the provision of adequate light in mines,

where work is carried on in such abnormal and difficult circumstances. It may be recalled that this point was illustrated in a discussion before the Illuminating Engineering Society last year, when a concensus of opinion emerged that the disease of the eyes known as miners' nystagmus is due mainly to work by insufficient light. This conclusion is now endorsed in a report recently issued by a committee working under the Medical Research Council. The committee unanimously regard deficient illumination as the chief cause of this disease. The small candle-power available from many forms of miners' lamps, the distance at which they have to be placed from the working surface, the very dark nature of the coal-surface itself, and the effect of coal dust and grime in absorbing light are all contributory factors. The committee suggest that an increase in candle-power to at least 2 to 3 candles is desirable, that lights might with advantage be so designed as to be used on the miner's head and so brought nearer the work, and that in parts of the pit other than the coal-face whitewashing would form a useful method of increasing the available illumination. If such remedies are adopted it is believed that miners' nystagmus of sufficient severity to cause disablement can, by degrees, be entirely prevented. We should like to take this opportunity of referring to the very valuable pioneering work done in this field by Dr. T. Lister Llewellyn, the secretary of the committee, who was responsible for opening the discussion before the Illuminating Engineering Society last year. It is gratifying that this country has taken a leading part in this research, and we have no doubt that makers of miners' lamps will be quick to respond to the requirements indicated as essential.

International Radio-Communication.

A most important measure of agreement was arrived at last summer at the meeting of the Technical Committee on International Radio-communications, as appears from the report, printed in the French and English languages, which has just been issued. This Committee, which comprises representatives of the Governments of the United States, France, Great Britain, Italy, and Japan, has been considering a number of important questions, and while decision on some of these is left in abeyance, in other cases complete agreement has been attained.

Ether Becoming Too Small.

To those in touch with wireless matters, it has been obvious for some years that the ether—usually considered as of vast extent—was becoming much too small, in the two-dimensional sense, for the enormous number of electrical signals continually being shot into it, and that unless some systematisation, based upon international agreement, were inaugurated, this valuable method of communication would suffer a setback owing to the chaotic conditions which the near future would probably bring. For this reason little surprise will be felt that the deliberations of the Committee were concerned almost entirely with the broad, yet enormously important, question of the classification of waves and their distribution among the various communication services, so that unnecessary interference is avoided.

Fourteen Important Points.

For the benefit of those who have not yet seen the Report, it may be mentioned that after dealing with certain small matters such as nomenclature, and the use of frequencies (kilocycles per sec., kc/s) rather than wave-lengths, the remainder of the Report is concerned with fourteen questions, to which answers were to be supplied by the Committee.

The first question, which deals with the classification of waves, furnishes the key to the objects of the conference. The next three questions are concerned only with particular wave-lengths. Question 5 raises the matter of the privileges of different classes of waves, Questions 6 and 7 further dealing with this. Questions 8 and 9 consider undesirable emissions; Question 10, the long-wave services. Question 11 asks for a definition of normal range, while Nos. 12 and 13 deal with radio-beacons and radio-goniometry. Question 14 was left open in order that other matters which might be brought forward by the delegates could be dealt with under this head.

Classification of Waves.

The Committee has adopted a classification under which five *types* of waves are recognised, namely, four types of A or continuous waves, and a fifth type, B, damped waves. The four A types of waves comprise A for unmodulated continuous waves, A1 for key-modulated C.W., A2 for audio-frequency modulated C.W., and A3 for speech-modulated C.W. Within each type waves are classified according to the degree of interference they produce at some distance away, this degree being estimated by the "equivalent decrement" (more fully defined in the Report). In the waves of Class 1, the equivalent decrement may be anything from zero up to 0·005 in Class 2, from 0·005 to 0·02; in Class 3, from 0·02 to 0·08 while in Class 4 it may range from 0·08 to 0·10. Under this scheme it results that the only type of wave permissible for stations of longer wave-lengths than 8 000 m. is Type A1. Class 2. In the next lower range of wave-lengths, namely, 2 850 to 8 000 m., the damping of waves used for high-speed signalling on waves of Type A1 has to be such that the emission complies with the requirements for Class 2.

Wave-Lengths for Radio-Telephony.

Now that so much interest is taken in wireless telephony the question of the range of wave-lengths permitted is a matter of concern to numbers of people. For fixed stations this has been agreed on as from 1 550 to 1 650 m., and for mobile services from 300 to 340 m., but using continuous waves of Type A1 only.

Long-Wave Fixed Services.

The recommendation that a study of the world needs for wave-lengths above 2 800 m. should be made should be of value in preventing the indiscriminate putting into operation of mammoth stations without due regard to the interference which may be caused with stations already working; and the fact that it is proposed that each nation should supply to the next International Conference a table of data relative not merely to stations in operation, but to those which are to be put into operation during the subsequent period of five years, will assist this laudable endeavour. A further recommendation, that a nation, before employing a new wave-length, should endeavour to utilise the directional properties, is of interest as showing that more attention will have to be paid to improving the directional qualities of transmitters using long waves, in the sense of narrowing the beam of rays emitted, as in the recent attempt of Franklin with very short waves.

Normal Range.

The normal range is assumed to be the distance obtained from the formulæ in the report, calculated on the basis of an induced E.M.F. in the receiving antenna of 150 mV per metre. In a table are shown the values of hI (the

product of the radiation height of the antenna and the current at the base of the antenna) that are necessary at the transmitter for this value of 150 mV to be obtained in the receiving antenna at ranges of 100 to 300 km. for waves of 450, 600, and 800 m.

The ranges adopted for mobile, short range, and long range beacons are respectively 10, 30, and 200 nautical miles. Radio-goniometric coast stations must be able to give bearings either on 600 *or* 800 m. only, or else on 600 *and* 450 m. or 800 *and* 450 m.

Distribution of Wave-Length Amongst the Various Services.

Perhaps the most interesting thing in the whole report—interesting because it has never before been shown up clearly—is the graphic chart given at the end, showing the distribution of frequencies and wave-lengths among the different services. The range of wave-lengths dealt with is 200 m. up to 5 000 m., and the distribution is shown among the following four classes of service: Mobile, fixed, military, special—for each type of wave and class. Little fault, it is felt, can be found with the rather extensive bands of wave-lengths appropriated for the military services. The mobile services, however, also claim a fairly extensive series of bands, and the result is, that only comparatively thin bands are left for the fixed services—namely, four, at 200 to 280 m., 950 to 1 050 m., 1 550 to 1 850 m., 2 850 to 3 300 m., and 3 900 to 4 800 m. respectively. These bands are, further, only of this extent for the highest class of wave, A1, there being only three bands of reduced width for the more damped Class A3 wave. For the special services there are six wave-lengths allotted, not bands; these are well known (450, 600, 800, 1 000, 2 100, 2 650 m.).

Post Office Matters.

It is often our duty to deal in these columns with the ethics of municipal trading as evidenced by the electricity supply departments all over the country. Our view is that consonant with financial stability, the prices charged should be kept as low as possible, and that under no circumstances should the electricity consumers' pockets be searched for the benefits of the general body of ratepayers. These views are, it will be agreed, sound enough, and are equally applicable to Governmental as to municipal trading. In other words, to fix the postal rates high in order to relieve the general body of ratepayers is economically unsound, and is, moreover, which is an added argument against it, likely to defeat its own object. The operations of the Post Office, which is the principal Government trading department, should, therefore, be governed by the principle of keeping the rates at the lowest possible level. For it is one of the disadvantages of any public trading department that it is not necessary for it to make a profit, but at the same time it is important that it should not be allowed to do so.

Trade and Lower Postal Charges.

The Postmaster-General is, therefore, to be congratulated upon reducing the postal charges, and may also be adjured to pluck up his courage, as he seems a little fearful of the result. For this reduction will assist trade, increase revenue, and will, we hope before long, make still further reductions possible. The figures on which these reductions are based are of interest. In 1920-21 there was a loss of £7 300 000. In the first six months of last year there was a loss of £2 800 000, and in the second six months, when the increased charges began to operate, a surplus of £1 000 000, leaving a deficit of £1 800 000, which would have been the enormous sum of £5 000 000 but for the increased charges. Owing, however, to the present improved position, which is entirely due to a reduction in expenditure from £67 120 000 to £53 800 000, the estimated surplus in 1922-23 with the old charges would have been £9 300 000. The Postmaster-General is, therefore, quite right in reducing the charges as he has done, and quite right, too, to resist the attempt of the Treasury to sequester the balance.

It may be pointed out that the reduction now given will not entirely wipe out the surplus, but Mr. Kellaway feels it is wiser, in view of the uncertainty as to revenue, to go slowly. We think that he is a little pessimistic, as with lower charges, especially on printed matter, the revenue might be considerably increased without any difficulty. The Postmaster-General must also turn his attention to the reduction in the rates for telegrams and parcels.

Telephone Enterprise.

To electrical engineers, however, the most interesting portion of the Postmaster-General's review, apart from that on wireless broadcasting, upon which we comment elsewhere, is that which deals with the telephone system. We are glad to see that the report of the Select Committee on this ever-burning subject has induced Mr. Kellaway not only to reduce the present high charges, but to prepare a scheme of development on enterprising lines. It is a good beginning, which will have good results, especially if the pressure is kept up. By this time the Post Office Engineering Department should have caught up with its war arrears, and should be in a position to launch out into a development which is badly needed.

This development will be encouraged by a reduction of the rental to private users by 30s. a year, by a reduction in the local message rate from 1½d. to 1¼d. per call, by a 25 per cent. reduction on trunk calls between 2 p.m. and 7 p.m., by improved facilities in country districts, by the abolition of local fees on the longer trunk calls, and by a reduction of the hotly-resented mileage charges from £10 to £8 per mile. This, once again, is a good beginning, but progress must go on at the same rate.

High Charges No Check on Progress.

It is interesting to note that in spite of the present high charges the total number of telephone stations on March 31 was 995 242, an increase of 16 991, and that the total number of new subscribers was 75 000, and the number of cessations 64 000, of which 29 000 were due to an increase of tariff. The remainder are probably explained by trade depression, and, we hope, by the gradual cessation of Government departments' activities. During the year 530 rural call offices were opened, while 3 290 party line subscribers were taken on, showing that the prejudice against this system of inter-communication is departing. This is satisfactory as far as it goes, but it does not go far enough. For, as Sir Henry Norman said, in the course of the debate: "The Post Office must do what any business man would do—reduce charges, risk a gamble, and advertise. The Postmaster-General must thrust the telephone down the throats of the people."

Economy a Necessity.

But what is wanted more than anything else in the Post Office, as in other branches of the Government service, is rigid economy. The lack of necessity of obtaining a profit, which we mentioned above, is inclined almost unconsciously to induce invertebrateness and to engender a disregard of these true principles of trading, by following which alone can true success be obtained.

The Recording and Printing of High-Speed Radio Signals.

By Prof. G. W. O. HOWE.

There can be little doubt that the future economic success of long-distance radio-telegraphy depends to a large extent upon the development of reliable high-speed transmitting and receiving apparatus. The speed of hand-sending and direct telephonic reception cannot exceed about twenty-five words per minute, and the large amount of capital represented by the equipment of a high-power radio station cannot obtain a satisfactory return on the limited amount of traffic which it is possible to put through at this rate. The Wheatstone automatic working over ordinary land lines is capable of transmitting and receiving at speeds of 300 to 400 words per minute, and the radio engineer cannot regard the wireless problem as satisfactorily solved so long as the speed attainable is very much inferior to this figure.

Is the Limitation in the Transmission or Reception?

Whether the limit is at present imposed by the transmitting or by the receiving apparatus it is difficult to say. In a paper recently read before the Institute of Radio Engineers, Mr. Weinberger, of the Radio Corporation of America, stated definitely that "the limitation of working speed is practically confined to the receiving side of the radio system, so that it is obvious that increased speed possibilities must be obtained entirely by the development of receiving apparatus." In our opinion, this is an unduly optimistic view of the position with regard to high-speed transmission, although the thermionic valve has done much to reduce the instrumental difficulties on the transmitting side.

In discussing the Hoxie recorder in the same paper, the author states that "it has extraordinarily high speed capabilites (far in excess of what is actually required)," which certainly suggests that the speed is limited elsewhere than in the recorder. Hoxie himself, in describing his recorder on another occasion, showed a record taken at 600 words per minute.

The Lorenz and Hoxie Recorders.

One of the first to develop a system capable of recording radio signals at high speed was C. Lorenz, who in 1908-9 adapted the Einthoven string galvanometer with photographic recording and automatic development and fixation. It was operated by a crystal detector, and in the absence of reliable amplifiers it is not surprising that it was little used on a commercial scale, although very good experimental results were obtained on high-speed signals from Poulsen arc transmitters. It was capable of operation at 300 words per minute. The Hoxie recorder, which has been developed by the General Electric Company of America within the last three or four years, also employs photographic recording, with automatic developing, fixing, washing, and drying.

The actual recording instrument is really a vibration galvanometer inserted in the anode circuit of the last valve of the audio-frequency amplifier and tuned to the note frequency, which, in the case of continuous wave transmission, is adjusted by means of the local heterodyne generator. The coils and polarising magnets of the galvanometer are fixed, and the received signals cause the vibration of a thin iron strip stretched between the poles of the magnet; this movement of the strip is transmitted by a light rod to a mirror rotating about a knife-edge on jewelled bearings.

This recorder has been used at several stations in the United States on Transatlantic work, and, as already mentioned, can operate at speeds up to 600 words per minute. A single 1 000 foot roll of sensitised paper records about 10 000 words, and this suffices for several hours at the speeds of forty to fifty words per minute commonly employed in high-speed transmission. One of the great advantages of the Hoxie recorder is the large degree of freedom from interference obtained by the sharp mechanical tuning of the vibration galvanometer to the audio signal frequency. This is enhanced by shunting across the instrument a sharply tuned, closed oscillatory circuit, which acts as a shunt for all but its resonant frequency.

Phonographic Recording.

Quite a different direction along which much work has been done is that of recording the high-speed telephonic signals upon the wax cylinder of a phonograph or upon the steel wire of a telegraphone. The instrument is then run at a reduced rate, and the message read by means of a telephone receiver, as in the dictaphone. A limitation is imposed on this method by the fact that the pitch of the note is reduced in the same ratio as the speed. One advantage of this method is that it utilises the operator's power of discrimination between the signals and disturbances due to other stations or atmospherics; it has the disadvantages of being expensive in operation, of allowing a considerable time to elapse before any faults of transmission or reception are discovered and reported to the transmitting station, and of leaving no permanent record of the message as received.

In the very early days of radio-telegraphy it was considered essential to record the signals, and telephonic reception was unknown. Two methods were employed; the Marconi coherer operated a Morse inker, and gave dots and dashes on the tape, whilst the Lodge-Muirhead mercury and steel wheel detector operated a siphon recorder, and gave a line with humps of shorter or longer duration. Both these methods have lately been modified and applied to the recording of high-speed signals, using, of course, modern methods of detection, amplification, and rectification, by means of thermionic valves.

The British and German Post Office engineers have developed methods in which the beats produced by the local heterodyne are rectified and, through an intermediate relay, caused to operate a Wheatstone receiver, in which the message is recorded as dots and dashes on the tape.

A New Type of Moving-Coil Siphon Recorder.

The Radio Corporation of America have lately developed a new type of siphon recorder, which was very fully described in the paper by Weinberger referred to above. One advantage of the siphon record, as compared with that of the Wheatstone, is that it is easier to detect and allow

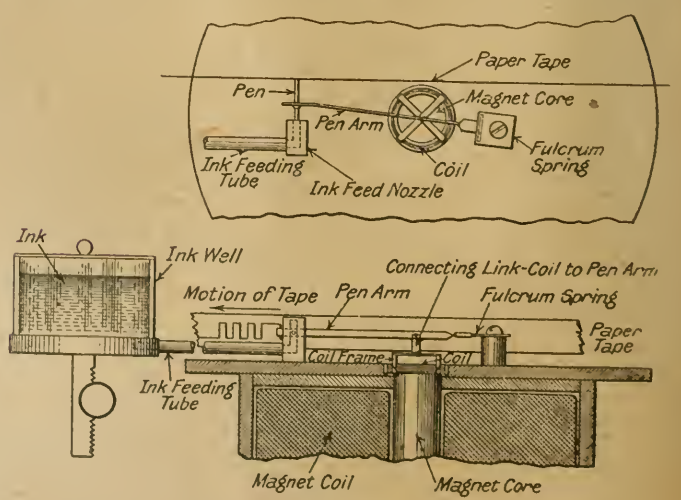

Fig. 1.—Essential Elements of Ink Recorder.

for the effects of atmospheric disturbances in the continuous ink line of the former than in the dots and dashes of the latter.

The new siphon recorder, or ink recorder, as its designers prefer to call it, is a very robust and well-designed apparatus. The circular moving coil is very light, and moves

vertically in the annular gap between the top of the central vertical core and the surrounding iron cover of a cylindrical electromagnet. The moving coil hangs, by means of an aluminium link, from the spring-supported pen-arm, which

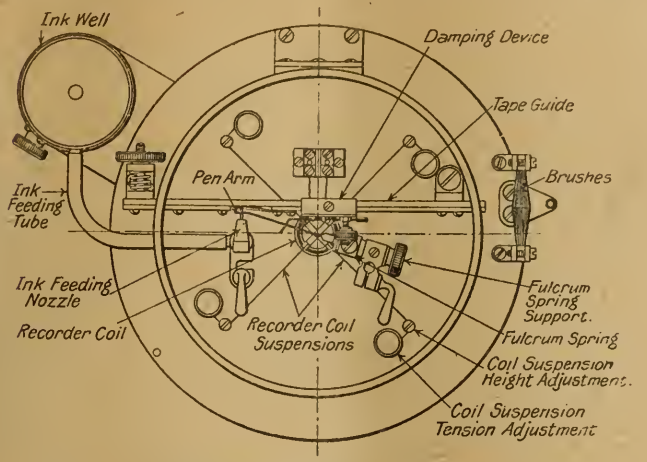

Fig. 2.—Ink Recorder, Commercial Model, Top View.

carries a pen consisting of a short piece of fine brass tubing. One end of this pen-tube moves over the surface of the paper tape whilst the other moves freely up and down in a groove in a fixed metal block, the groove being kept charged with ink by means of a flexible tube connecting the block with an ink-well, the height of which can be adjusted to maintain the ink level at the correct height. The slot being only a sixteenth of an inch wide, the surface tension prevents any spilling of the ink. Details are given in the accompanying illustrations.

The moving coil has 600 turns, a resistance of 1 000 ohms, and gives a full-sized record of $\frac{1}{8}$ in. at 100 words per minute, with a current of 4 mA. For higher speeds the fulcrum-spring which carries the pen-arm has to be changed, and at double the above speed double the current

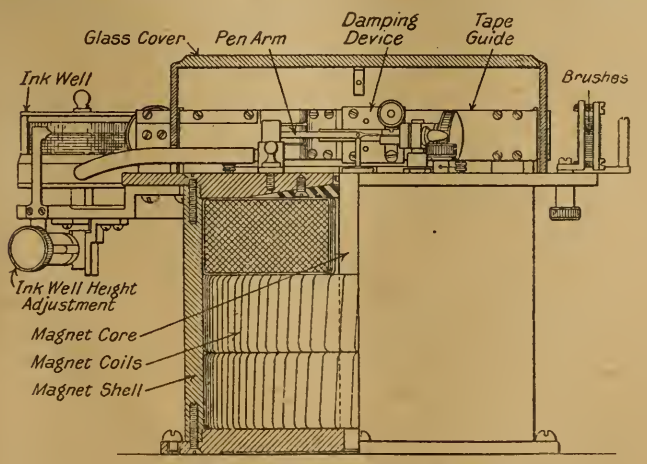

Fig. 3.—Ink Recorder, Commercial Model, Section.

is required. On its way to the recorder the paper-tape passes through a pair of brushes, which remove any paper dust which might clog the pen. The friction of the pen on the paper does not provide sufficient damping, and a special damping device is fitted to prevent over-shoot; this device is of the simplest character. The pen-arm moves between the prongs of a lever, which it is forced to carry with it towards the end of its travel, either up or down; this lever is held friction-tight between two washers, which are forced together by a spring, which can be adjusted by means of a milled nut.

A motor-driven tape-puller is installed at some distance from the recorder, the tape passing in front of the clerk or clerks on its way from one to the other. These clerks read the message from the tape and record it directly on typewriters. A single operator can take down the message up to a speed of forty-five words per minute, but above this several operators, each with his typewriter, have to be spaced at distances of 10 ft. along the tape, the first man doing what he can as the tape passes him, and marking on the tape where he commenced and finished; the second man starting in where the first finished, and so on.

This sounds very cumbersome, and suggests a weak link in the high-speed chain.

Although the Radio Corporation transmitting aerial at Long Island is 18 miles away from the receiving aerial at Riverhead, they are both connected by land lines, and suitable relay and transfer apparatus, to the operating office in New York City, where the transmitting clerk sits at the

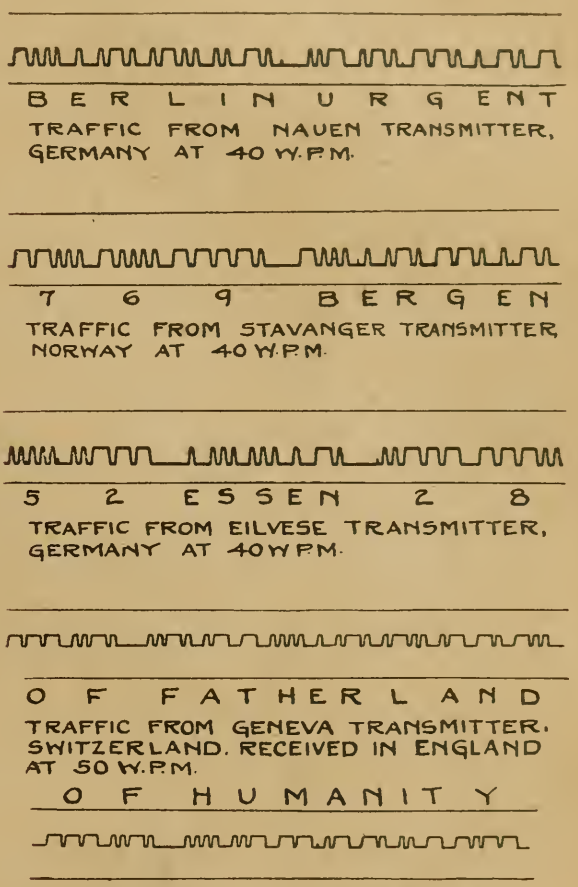

Fig. 4.—Typical Ink Recorder Tapes.

same table as the receiving clerk, so that the latter can immediately report any faulty reception to the European transmitting station and request any necessary repetition.

The Use of the Creed Printer.

The only alternative available at present to the transcription of the tape is the installation of that triumph of ingenuity, the Creed Printer. In this system, which is being used to some extent both in this and in other countries, the received signal, after passing through the usual amplifiers, detectors, and rectifiers, operates through relays the slide valve of a pneumatic perforator, thus giving a perforated Morse record, which is then fed into the Printer proper, which is essentially a pneumatically operated typewriter controlled by the perforations of the tape passing through it. This delivers the message printed directly in Roman characters. Although in use on some Anglo-Continental services, we do not know whether it has yet been successfully employed on long-distance work, where the factor of safety against atmospheric and other types of interference is necessarily greatly reduced.

The death occurred at Tynycymmer Hall, Porth, on Monday of Mr. W. H. Mathias, a director of the Treforest Electrical Consumers Company and a leading public figure in the Rhondda Valley for some forty years. Mr. Mathias was seventy-seven years of age.

High Voltage Switchgear Design.

By W. A. COATES.

(*concluded from page* 530.)

The problem of building electrical equipment for the high voltages which are now becoming common is mainly one of insulation. Two main types of insulation are required, that which merely supports the conductor and that which insulates the conductor where it passes through an earthed body. In high voltage work the limitations in design are mechanical rather than electrical, and in other ways greater simplicity is possible than at lower pressures. Though high-voltage gear was at first contained in cubicles, it was soon found that this was unnecessary, while in 1908 *the advantages of placing the gear out of doors was discovered. Mr. Coates discusses at length the details of modern outdoor switchgear compared with indoor equipment, and points out its economic and engineering advantages.*

Details of 100 kV Scheme.

In Fig. 6 is reproduced the section through the power-house of the Tata Hydro-Electric Company, Ltd., Bombay. This layout may be taken as a sound engineering design, without any unnecessary elaboration or waste space. The ground area occupied is, in fact, unusually small, due to the double-floor arrangement. The step-up transformers, which are in single-phase units, are placed in line, each within its own cubicle, which is provided with a roller-type fire-door. Along the front of the transformer cubicles is laid a pair of rails, carrying the transfer truck employed when it is necessary to remove any transformer unit for repairs.

The high-voltage oil-switches are arranged in a single row on the upper-floor. The transformers, rather than the switches, control the length of building required, so that an extremely simple supporting structure is possible for the busbar and outgoing isolating switches.

The electrolytic lightning arresters for the outgoing lines also are on two floors. A somewhat unusual arrangement is adopted in that the short-circuiting device for the horns is operated from the ground-floor. Since it is desirable for the operator to see the arc when charging his lightning arresters, the more usual practice is for the short-circuiting lever to be on the framework carrying the horn itself.

The isolating switch in series with the electrolytic arrester, is not generally provided, since the horn itself can be swung wide open, and thus acts as an isolating device.

Alternative Outdoor Arrangements.

For the purposes of illustration alternative arrangements of the high-voltage equipment have been prepared, everything being out of doors. With these schemes, in addition to the generator and turbine room, the building would only have to enclose the switchgear at generating voltage.

As with the indoor scheme, the circuit centres on the outdoor arrangements would be controlled by the transformers, the overall length of the two schemes being the same. Sectional elevation drawings will, therefore, serve to give a proper comparison between the actual layout and the possible alternatives.

In the first case, on the assumption that ground area is not of particular importance, all apparatus has been shown on ground level—Fig. 7. The equipment included is precisely the same as with the indoor scheme, with the exception that separate isolators for the electrolytic arresters have been omitted as unnecessary.

The steelwork required is quite simple. Double-tower structures, as shown, would be placed between every three circuits, the towers being tied together only by the horizontal I beams run to support the busbar isolating switches, which are operated from ground level as three-pole units. It is very unlikely that any access will be required to the isolating switches, and there is no need to run handrails or footwalks out to them. In all cases the connections are arranged so that, with the switches open, the hinge element, which houses the blade-lifting mechanism, is dead. The busbars themselves are strained between the tower structures, the various lengths being connected by bus-sectionalising isolating switches.

Unusual Method of Straining-off.

The method of straining-off the transmission lines is a little unusual. A steel cable is run between the tower structures and the link-type strain insulators fastened to this. It is more usual to provide a rigid support in the form of a horizontal, lattice-member spanning from tower to tower. This arrangement facilitates straining the lines when erecting, but is, of course, appreciably more expensive. The choice between these two methods depends mainly on the position of the first tower, since, if the line tension on the switch structure is considerable, the rigid construction would be preferable.

The choke coil is built around a strain insulator, and may safely be inserted in the length of the transmission line itself. Electrically, it is equally effective, and it is somewhat easier to erect, if it is suspended in the length of the jumper which goes to the feeder isolating switch, in the manner shown in the illustration.

Since this equipment would be placed immediately adjacent to the power-house building, no special structure is required for the star-point connection on the H.-T. side of the transformers. A light, steel cantilever built out from the wall would support the insulators carrying this connection.

For handling the single-phase transformer units a transfer truck, similar to that used on the indoor scheme, would be provided. In this way any transformer in need of attention could be transported bodily into the power-house workshop. The pipe-work for cooling water, and for oil drainage, together with the low-tension cable connections, are brought to that side of the transformer remote from the track, so as not to interfere with removal.

When horned arresters are placed out of doors greater clearance has to be given, to allow for the effect of wind on the arc. This is sometimes the controlling factor which determines the height of the main structure, since the transmission lines must be carried well clear of the horns beneath.

Position of the Tanks.

The tanks containing the aluminium trays are the only portion of this equipment which may be at high potential, and which are accessible from the ground. On the assumption that only skilled operators will ever be inside the h.t. switchyard, it is not usual to do more than put a handrail round the tanks, so as to prevent accidental contact, and quite often even this is omitted.

With the high-tension apparatus arranged as Fig. 7, the total space occupied by the whole plant would be 220 ft. by 166 ft. The transformers and outdoor switchgear would occupy 220 ft. by 96 ft., and would require some 26 tons of structural steelwork. There is no real need for the whole ground area to be concreted, if small plinths are made for each piece of apparatus and proper footings for the towers. Assuming, however, that the full area is covered with 3 in. concrete lying on 9 in. rubble, the present-day cost of concrete and steel would be about £2 300, if erected in this country.

The power-house buildings necessary have been estimated at £20 000 present-day prices (roughly, 7·25d. per cub. ft.). The switchgear and transformers would be worth, say, £64 700, giving for the items which vary with the switchgear arrangement a total of £87 000.

Against this for the fully indoor scheme, shown in Fig. 6, we have an estimated building cost of £45 000 (6·3d. per cub. ft.). The difference between indoor and outdoor apparatus, erected, is not so marked at the higher voltages, and the current price of the indoor gear would be £61 570, giving a total of £106 570. The total space occupied by this plant would be 220 ft. by 124 ft.

A More Economical Arrangement.

Another outdoor arrangement which might be adopted is shown in Fig. 8. This is considerably more economical

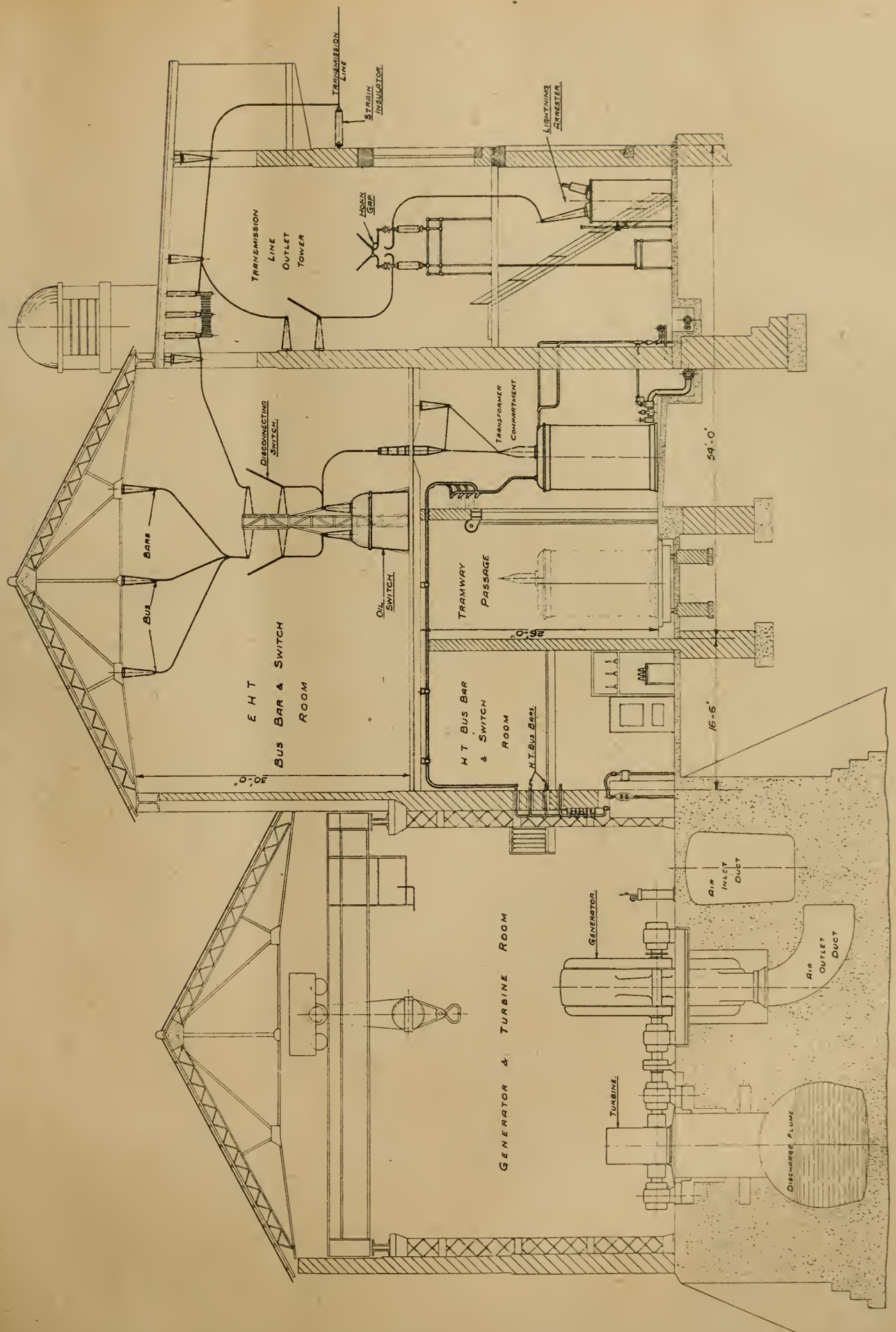

Fig. 6.—Sectional Elevation of Power House (J. Tata Hydro-Electric Company, Ltd., Bombay).

in the matter of space occupied, but to some extent open to the accusation of being "a forest of steel." This impression is very easily gained from pictures of outdoor stations, particularly by those who have not seen the actual structures, but it is nearly always a matter of the angle from which the photograph was taken.

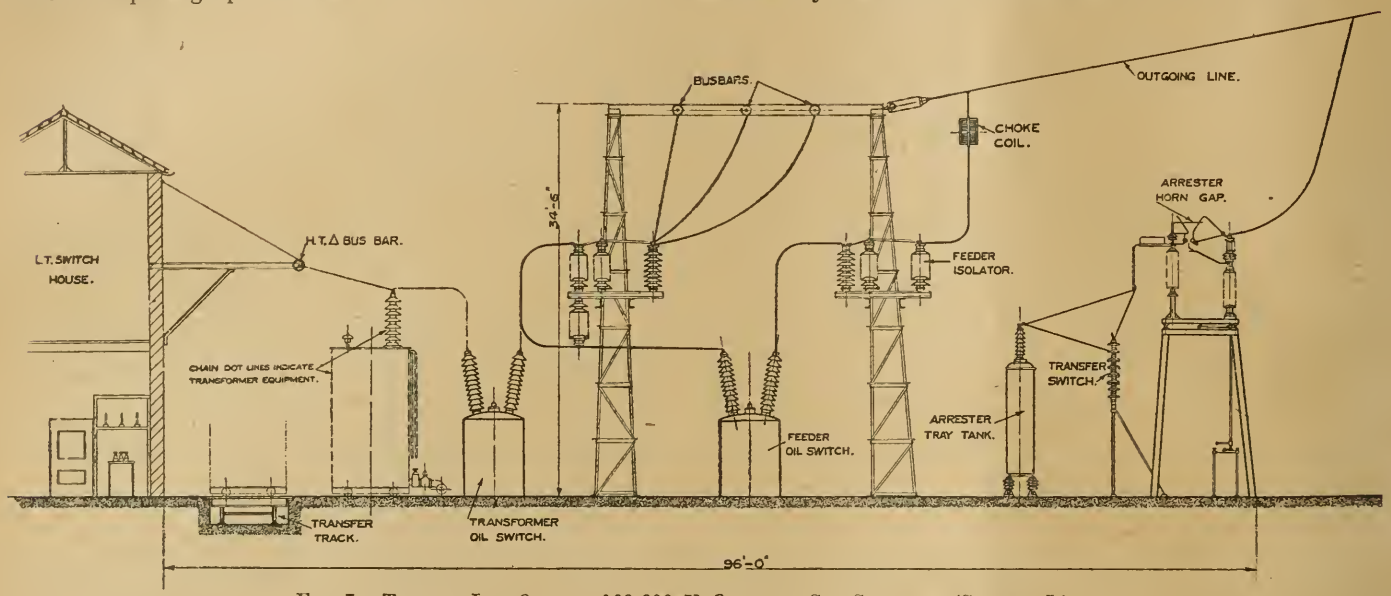

FIG. 7.—TYPICAL LAY-OUT OF 100 000 V OUTDOOR SUB-STATION. (SCHEME I.)

It will be recalled that there is only one outgoing line to every three circuits. It would thus be quite feasible to space out the lines sufficiently to permit other conductors to pass them. This is done, the horns of the lightning arresters being placed right at the top, where, incidentally, they are entirely removed from any risk of trouble due to a flaring arc. The transfer switches are placed half-way down, and the tanks on ground level. The method of supporting the vertical connections is noteworthy. Multiple shed insulators are much better in tension or compression than when mounted with their axes horizontal. Stub connections are, therefore, strained between insulators top and bottom, and jumpers taken to them from the trays and transfer-switch. Similarly, just below the fuse of the arrester, the connection is steadied between insulators strained by steel cables off the steelwork.

Charging operations would be carried out from the platform on the same level as, but on one side of, the transfer-switch, the operating levers for the gap-shortening device and the transfer-switch being brought down to this point.

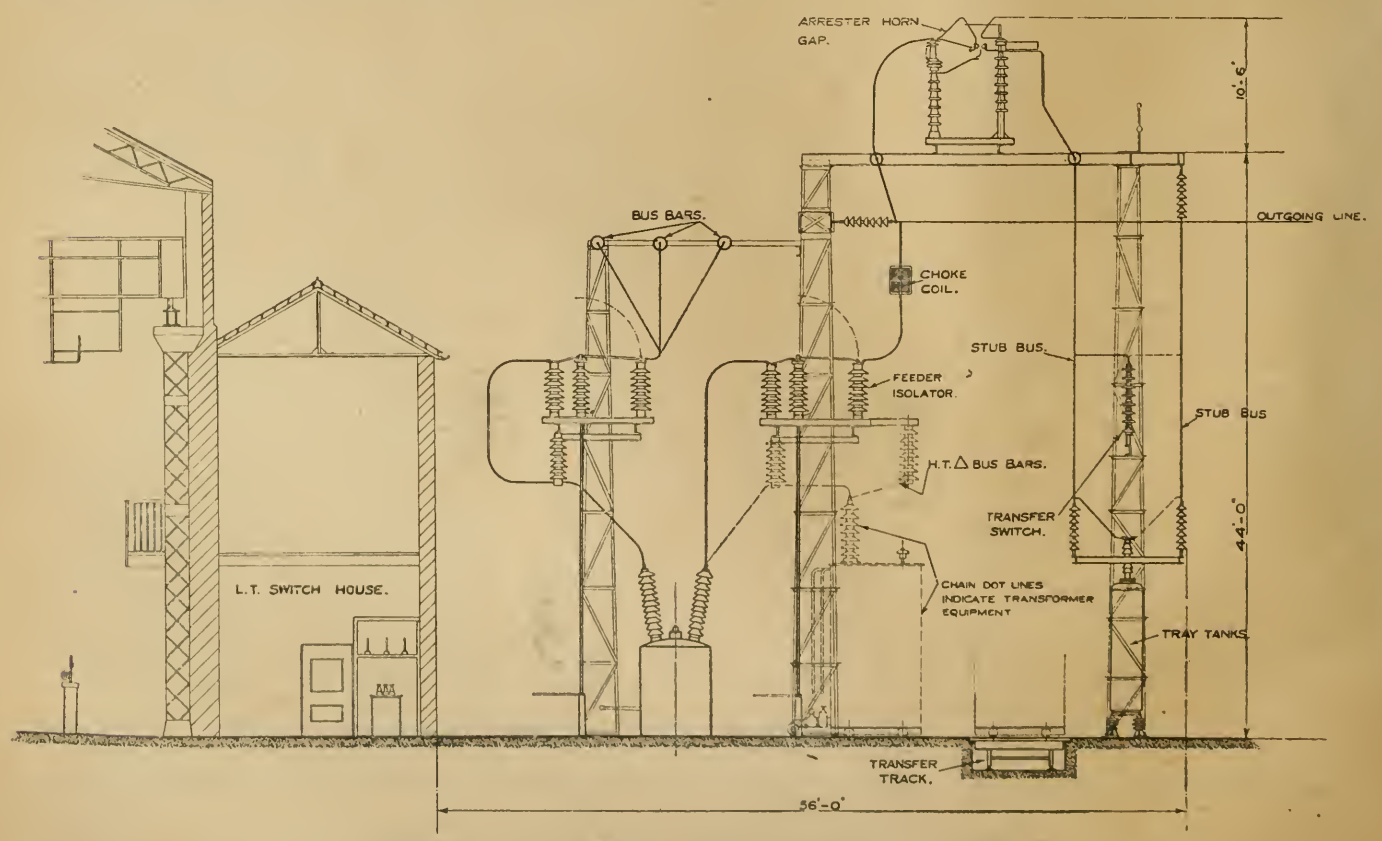

FIG. 8.—TYPICAL LAY-OUT OF 100 000 V OUTDOOR SUB-STATION. (SCHEME II.)

To facilitate renewal of fuses, a footwalk and handrail is shown on the top of the structure, a ladder up the tower giving access.

In this case the area occupied by the whole plant would only be 220 ft. by 126 ft., and by the outdoor gear 220 ft.

by 56 ft., but the outdoor steelwork goes up to 54 tons. The complete cost of the scheme, on the same basis as previously, works out at approximately £88 000.

The Power-House Roof as Switch-Yard.

Still another possibility, and one which has been quite frequently adopted, is that of putting all high-voltage switchgear on the power-house roof, as in Fig. 9. This takes up less ground space than the indoor scheme actually employed. No special comments need be made on the lay-out suggested, since the notes on previous schemes apply with equal force here.

That portion of the building which is retained is considerably more expensive than the corresponding section of the all-indoor building, since the roof has to be strong enough to carry the switchgear, and all the main walls must be stiffened right down to the foundations to bear the extra load.

A rough estimate places the cost of building at £22 000 where the power-house stands on the dam itself, or even in some city terminal stations, ground space considerations alone will often justify this construction.

The following table summarises the points for comparison in the various schemes:

Fig. No.	Brief description of H.T. equipment.	Sq. feet occupied by complete plant.	Approximate costs.			Total cost of variants.
			Switchgear and Transformers.	Outdoor structure and concrete	Building.	
6	All indoors ...	27,280	£61,570	—	£45,000	£106,570
7	Outdoor simple structure ...	36,520	£64,700	£2,300	£20,000	£87,000
8	Outdoor: two tier structure ...	27,720	£65,800	£2,200	£20,000	£88,000
9	Outdoor on roof ...	21,120	£65,800	£1,000	£22,000	£88,800

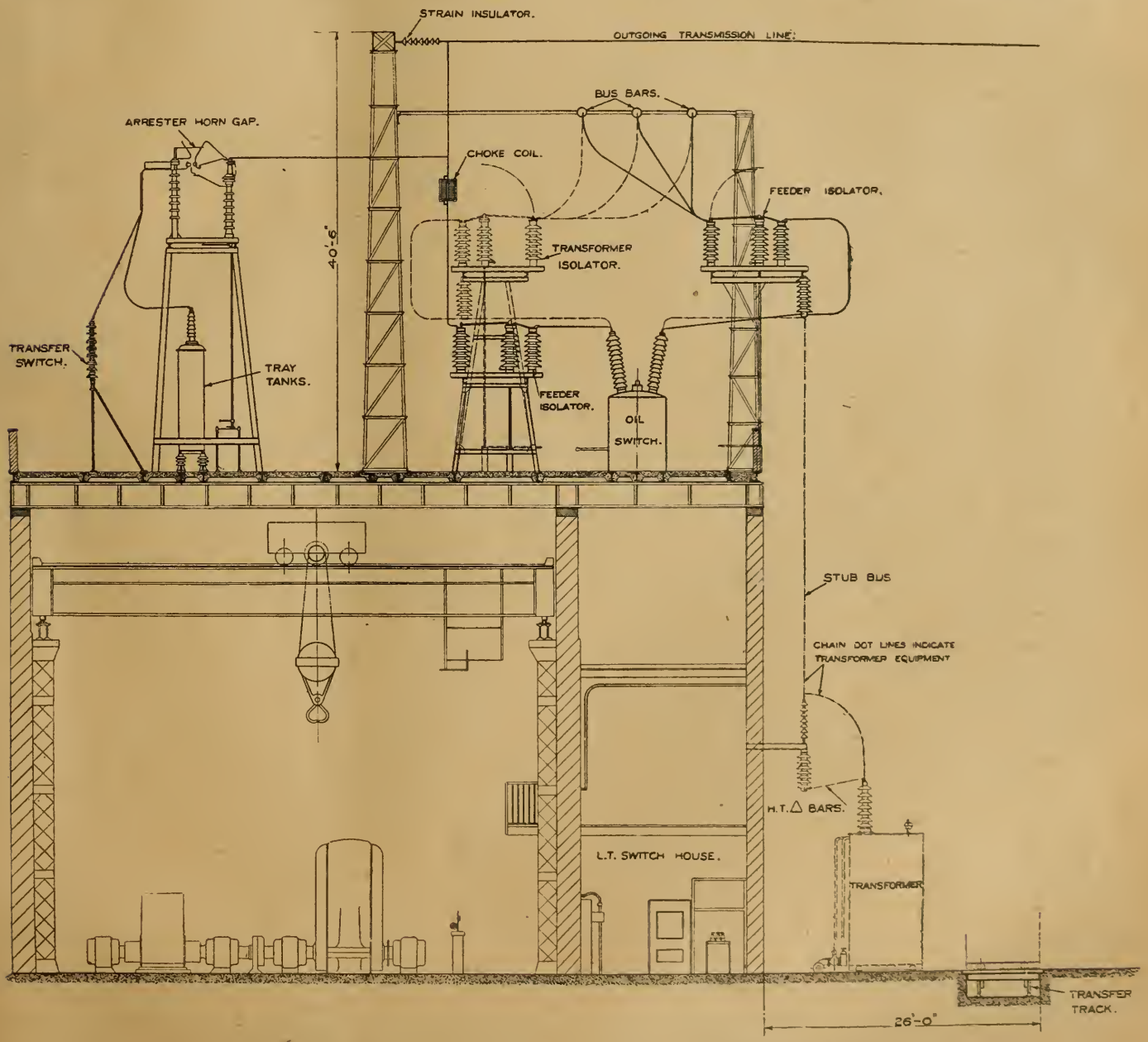

Fig. 9.—Typical Lay-Out of 100 000 V Outdoor Sub-Station. (Scheme III.)

(8d. per cub. ft.), which, with the price of transformers and switchgear, gives a total (comparable with those given for other schemes) of £88 800.

It will be seen that on cost, apart from ground space, this arrangement is the least favourable of the outdoor schemes. In the case of a low or medium head hydro-electric station,

It is impossible to set down in writing the whole case for the outdoor station. It is submitted that enough has been said to make it clear that outdoor construction has not only come to stay, but that in the end it will probably oust completely the use of buildings for high-voltage switchgear and transformers, save only in exceptional cases.

Chains of Magnetically-Coupled Circuits.

By E. BELLINI, D.Sc.

In an article recently published in this journal * the frequencies occurring in three magnetically-coupled circuits were mathematically determined and shown to be practically verified by experiments.

In the present article the cases of four and five magnetically-coupled circuits will be solved, and attempts to solve the problem of six and seven circuits will be made. From the results obtained some general rules for an indefinite number of magnetically-coupled circuits will be deduced.

A chain of magnetically-coupled circuits is shown in Fig. 1. Each circuit is magnetically coupled to the preceding and to

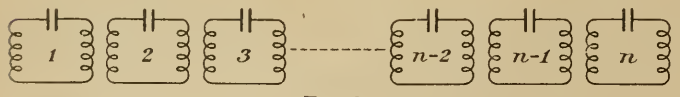

FIG. 1.

the following ones, the first and last circuits being coupled only to one circuit.

The method adopted for the calculations is the method of operational determinant suggested by Mr. L. C. Pocock in a letter† published on the occasion of the publication of the article above cited.

As in the former article, it will be presumed in what follows that the ohmic resistances of the coupled circuits are zero and that all the circuits possess the same inductances and capacities.

Four Magnetically-Coupled Circuits.

The operational determinant in this case is :

$$\begin{vmatrix} \frac{1}{C}-Lp^2 & -M_{12}p^2 & 0 & 0 \\ -M_{12}p^2 & \frac{1}{C}-Lp^2 & -M_{23}p^2 & 0 \\ 0 & -M_{23}p^2 & \frac{1}{C}-Lp^2 & -M_{34}p^2 \\ 0 & 0 & -M_{34}p^2 & \frac{1}{C}-Lp^2 \end{vmatrix} = 0$$

Multiplying out this determinant one obtains

$$\left(\frac{1}{C}-Lp^2\right)^4-\left(\frac{1}{C}-Lp^2\right)^2(M_{12}^2+M_{23}^2+M_{34}^2)p^4+M_{12}^2M_{34}^2p^8=0$$

In order to find the roots of this equation let us put in it $p=\frac{1}{\sqrt{LC}(1+a)}$; we obtain

$$a^4-a^2(K_{12}^2+K_{23}^2+K_{34}^2)+K_{12}^2K_{34}^2=0$$

where $K_{12}=\frac{M_{12}}{L}$, $K_{23}=\frac{M_{23}}{L}$ and $K_{34}=\frac{M_{34}}{L}$.

By solving this equation with respect to a we obtain

$$a=\pm\frac{1}{\sqrt{2}}\sqrt{K_{12}^2+K_{23}^2+K_{34}^2\pm\sqrt{(K_{12}^2+K_{23}^2+K_{34}^2)^2-4K_{12}^2K_{34}^2}}.$$

Hence, the four periodicities of a chain of four magnetically-coupled circuits are :

$$p_1, p_2, p_3, p_4=\frac{1}{\sqrt{LC}}\cdot\frac{1}{\sqrt{1\pm\frac{1}{\sqrt{2}}\sqrt{K_{12}^2+K_{23}^2+K_{34}^2\pm\sqrt{(K_{12}^2+K_{23}^2+K_{34}^2)^2-4K_{12}^2K_{34}^2}}}}$$

In the particular case of $K_{12}^2=K_{23}^2=K_{34}^2=K^2$ the four periodicities are :

$$p_1, p_2, p_3, p_4=\frac{1}{\sqrt{LC}}\cdot\frac{1}{\sqrt{1\pm K\sqrt{\frac{3\pm\sqrt{5}}{2}}}}$$

* THE ELECTRICIAN, July 16, 1920.
† THE ELECTRICIAN, Aug. 6, 1920.

Three- and Four-Coupled Circuits Compared.

In the case of three magnetically-coupled circuits it was found that, though three frequencies existed in the system of circuits considered as a whole, only two frequencies existed in the central circuit. This fact must logically lead us to verify if all the four circuits in the present case possess four frequencies. This verification can be accomplished by employing the above operational determinant in which the values of C and L for each circuit in turn will be made different from those of the other circuits, by multiplying it out and by verifying if the equation so obtained is confirmed by the four periodicities found. If one or more periodicities were found to confirm this equation, it would mean that in this particular circuit the periodicity or periodicities considered do not occur and that the timing of this circuit has no influence upon the existence of these periodicities in the other circuits.

To simplify the calculations, it is convenient to suppose all the M equal, as the values of the M (except in the extreme case of one or more of them being equal to zero) cannot have any influence upon the existence of the frequencies.

If we apply this method to the actual case of four magnetically-coupled circuits, we can find that the timing of the four circuits is necessary for obtaining the four frequencies, and we can infer, then, that the four periodicities exist in each of the four circuits.

Five Magnetically-Coupled Circuits.

By multiplying out the operational determinant in this case we obtain an equation of the fifth degree :

$$\left(\frac{1}{C}-Lp^2\right)^5-p^4\left(\frac{1}{C}-Lp^2\right)^3(M_{12}^2+M_{23}^2+M_{34}^2+M_{45}^2)+p^8\left(\frac{1}{C}-Lp^2\right)(M_{12}^2M_{34}^2+M_{23}^2M_{45}^2+M_{45}^2M_{12}^2)=0$$

It is immediately obvious that $p=\frac{1}{\sqrt{LC}}$ is a root of the equation.

By dividing the equation for $\left(\frac{1}{C}-Lp^2\right)$ it becomes :

$$\left(\frac{1}{C}-Lp^2\right)^4-p^4\left(\frac{1}{C}-Lp^2\right)^2(M_{12}^2+M_{23}^2+M_{34}^2+M_{45}^2)+p^8(M_{12}^2M_{34}^2+M_{23}^2M_{45}^2+M_{45}^2M_{12}^2)=0$$

To solve this equation let us put in it $p=\frac{1}{\sqrt{LC}(1+a)}$. We obtain :

$$a^4-a^2(K_{12}^2+K_{23}^2+K_{34}^2+K_{45}^2)+K_{12}^2K_{34}^2+K_{23}^2K_{45}^2+K_{45}^2K_{12}^2=0$$

from which we draw out :

$$2a^2=K_{12}^2+K_{23}^2+K_{34}^2+K_{45}^2\pm\sqrt{(K_{12}^2+K_{23}^2+K_{34}^2+K_{45}^2)^2-4(K_{12}^2K_{34}^2+K_{23}^2K_{45}^2+K_{45}^2K_{12}^2)}$$

The five periodicities of five magnetically-coupled circuits are, consequently

$$p_1=\frac{1}{\sqrt{LC}}$$

$$p_2, p_3, p_4, p_5=\frac{1}{\sqrt{LC}}\cdot\frac{1}{\sqrt{1\pm\frac{1}{\sqrt{2}}\sqrt{K_{12}^2+K_{23}^2+K_{34}^2+K_{45}^2\pm\sqrt{(K_{12}^2+K_{23}^2+K_{34}^2+K_{45}^2)^2-4(K_{12}^2K_{34}^2+K_{23}^2K_{45}^2+K_{45}^2K_{12}^2)}}}}$$

In the particular case of $K_{12}^2=K_{23}^2=K_{34}^2=K_{45}^2=K^2$ the five periodicities are :

$$\frac{1}{\sqrt{LC}}, \frac{1}{\sqrt{LC(1+K)}}, \frac{1}{\sqrt{LC(1-K)}}, \frac{1}{\sqrt{LC(1+\sqrt{3}K)}}, \frac{1}{\sqrt{LC(1-\sqrt{3}K)}}.$$

It is interesting to note that five equal and equally magnetically-coupled circuits possess the frequency of each

circuit separately and those of two of these circuits magnetically coupled.

By applying the method described for the case of four circuits we obtain that:

(1) the periodicity $\frac{1}{\sqrt{LC}}$ exists in the circuits 1, 3, and 5 and not in the circuits 2 and 4.

(2) The periodicities $\frac{1}{\sqrt{LC(1\pm K)}}$ exist in the circuits 1, 2, 4 and 5 and not in the circuit 3.

(3) The periodicities $\frac{1}{\sqrt{LC(1\pm\sqrt{3}K)}}$ exist in all the circuits.

Six Magnetically-Coupled Circuits.

By multiplying out the operational determinant in this case we obtain:

$$\left(\frac{1}{C}-Lp^2\right)^6-p^4\left(\frac{1}{C}-Lp^2\right)^4(M_{12}^2+M_{23}^2+M_{34}^2+M_{45}^2+M_{56}^2)+$$
$$p^8\left(\frac{1}{C}-Lp^2\right)^2(M_{12}^2M_{34}^2+M_{23}^2M_{45}^2+M_{34}^2M_{56}^2+M_{45}^2M_{12}^2+M_{56}^2M_{23}^2+$$
$$M_{56}^2M_{12}^2)-p^{12}M_{12}^2M_{34}^2M_{56}^2=0.$$

It was impossible to solve this equation. It shows, however, that six frequencies exist in the system of six magnetically-coupled circuits, and that the common natural frequency of the circuits is not comprised among them.

Seven Magnetically-Coupled Circuits.

The operational determinant in this case, when multiplied out, furnishes the following equation:

$$\left(\frac{1}{C}-Lp^2\right)^7-\left(\frac{1}{C}-Lp^2\right)^5p^4(M_{12}^2+M_{23}^2+M_{34}^2+M_{45}^2+M_{56}^2+M_{67}^2)+$$
$$\left(\frac{1}{C}-Lp^2\right)^3p^8(M_{12}^2M_{34}^2+M_{12}^2M_{45}^2+M_{12}^2M_{56}^2+M_{12}^2M_{67}^2+M_{23}^2M_{45}^2+M_{23}^2$$
$$M_{56}^2+M_{23}^2M_{67}^2+M_{34}^2M_{56}^2+M_{34}^2M_{67}^2+M_{45}^2M_{67}^2)-\left(\frac{1}{C}-Lp^2\right)p^{12}(M_{12}^2M_{34}^2$$
$$M_{56}^2+M_{23}^2M_{45}^2M_{67}^2+M_{12}^2M_{34}^2M_{67}^2+M_{12}^2M_{45}^2M_{67}^2)=0$$

It is immediately visible that the fundamental periodicity $\frac{1}{\sqrt{LC}}$ is a root of the equation.

If all the M are equal the equation, divided for $\left(\frac{1}{C}-Lp^2\right)$ simplifies to

$$\left(\frac{1}{C}-Lp^2\right)^6-6p^4\left(\frac{1}{C}-Lp^2\right)^4M^2+10p^8\left(\frac{1}{C}-Lp^2\right)^2M^4-4p^{12}M^6=0$$

It was not possible to solve these equations. But it can be verified by substitution that

$p_2p_3=\frac{1}{\sqrt{LC(1\pm\sqrt{2})K}}$ are two roots of the latter.

It is worth while to note that seven equal and equally magnetically-coupled circuits possess the frequency of each circuit separately, and those of three of these circuits magnetically coupled (which, in their turn, possess the first frequency).

Summary for the Case of Equality of all the Coupling Coefficients.

1 circuit	$\frac{1}{\sqrt{LC}}$
2 circuits	$\frac{1}{\sqrt{LC(1\pm K)}}$ in both circuits.
3 circuits	$\frac{1}{\sqrt{LC}}$ only in the end circuits
	$\frac{1}{\sqrt{LC(1\pm\sqrt{2}K)}}$ in all circuits
4 circuits	$\frac{1}{\sqrt{LC(1\pm K\sqrt{\frac{3\pm\sqrt{5}}{2}})}}$ in all circuits
5 circuits	$\frac{1}{\sqrt{LC}}$ in circuits 1, 3, and 5
	$\frac{1}{\sqrt{LC(1\pm K)}}$ in circuits 1, 2, 4, and 5
	$\frac{1}{\sqrt{LC(1\pm\sqrt{3}K)}}$ in all circuits
6 circuits	.. ..
7 circuits	$\frac{1}{\sqrt{LC}}$, $\frac{1}{\sqrt{LC(1\pm\sqrt{2}K)}}$, ...

Conclusions.

From the arguments set out it appears justifiable to draw the following conclusions:

(1) The number of resultant frequencies of n magnetically-coupled circuits is n.

(2) When the number of coupled circuits is even all the resultant frequencies are present in all the circuits.

(3) When the number of coupled circuits is odd, only the end circuits have all the resultant frequencies; circuits 2 and $n-1$ have $n-1$ frequencies; circuits 3 and $n-2$ have $n-2$ frequencies, &c., so that the middle circuits have only $\frac{n+1}{2}$ frequencies.

(4) When the number of coupled circuits is odd, only the circuits numbered 1, 3, 5, . . . $(n-4)$, $(n-2)$, n possess the natural frequency of each circuit separately.

(5) The frequencies proper to n equal and equally magnetically-coupled circuits exist in a chain of $2n+1$ magnetically coupled circuits.

Correspondence.

DOMESTIC ELECTRICAL APPLIANCES.

To the Editor of THE ELECTRICIAN.

SIR,—We feel that that section of the electrical industry which is in closest touch with the general public, *i.e.*, the electrical contractor and retailer, should be made aware of the endeavours that are being made in another industry to secure a portion, if not all, of the business to be done in the above.

The official organ of the retailers of sewing and washing machines and carpet sweepers is continually advising its readers to take up these lines.

The following passage is taken from the said journal, dated May 1:

"We will only add that the daily Press is creating a demand for sewing and washing machines and carpet cleaners, and that it is for the domestic washing trade to supply the demand and not leave it to the electrical trade."

Our own practice has, of course, been to treat with the legitimate electrical trader, but we think you should impress on your readers the great danger they are in of losing a good portion of what is proving a very lucrative and growing field.—I am, &c.,

THE SUN ELECTRICAL COMPANY
(E. R. Norton, Works Manager).

London, W.C. 2, May 6.

AN ANOMALY.

To the Editor of THE ELECTRICIAN.

SIR,—The following should, I think, be placed on record in all electrical papers:

The headquarters of the Electricity Commissioners is Gwydyr House, Whitehall, a board on the door announcing this fact. I was passing the place last Friday, and first noticed that the lamp over the gate is fitted with an upright incandescent gas mantle; further investigation resulted in finding two large cone-shaped candle or torch snuffers, one on each side of the gateway on the railings. Further, a notice is on the door stating that admittance can be obtained by ringing the bell, which is one of the old-fashioned brass knob crank bells. The place was closed, but it would be interesting to know whether gas is used for lighting the interior as it is for the outside lamp.—I am, &c.,

WILLIAM B. CLARKE.

Ponders End, Middlesex, May 8.

The History of the Spearing Boiler.

Although the water-tube boiler came into being more than half a century ago, it is only within the last twenty years or so that it has been extensively used, and to a large extent its adoption was the result of engineering developments peculiar to recent times. The growth of electric power stations, the increase in the speed and size of steamships—these and kindred conditions created a demand for boilers more flexible, more efficient, and of greater capacity than the traditional types. In turn, the success of the water-tube principle encouraged engineers to make further demands upon it, in order to obtain still higher thermal efficiencies. Hence the movement towards higher steam pressures and higher superheat. Since the war, owing to the heavier cost of fuel, labour, and materials, the need for boiler efficiency has become more and more insistent. The water-tube boiler of to-day has, it will be agreed, to fulfil requirements much more onerous and exacting than those formerly imposed.

An Established Boiler.

The Spearing boiler has been designed to meet these conditions in the highest degree, compatible with economy in first cost and maintenance charges. But it is not, in its essential features, a new boiler. The principles upon which it is constructed were put to the test about twelve years ago; and their soundness has been proved by the continuous existence in satisfactory service of boilers then built. Improvements have been embodied from time to time, partly as the result of accumulated experience and partly in response to the evolution of steam engineering in the directions indicated; and to-day it is claimed that the boiler has proved its ability to meet the most exacting requirements. The chief interest in the present stage of the Spearing enterprise lies in the arrangements which are being made to establish manufacture on an adequate scale. A controlling interest in Tinkers, Ltd., an old-established firm of boiler makers at Hyde, near Manchester, has been acquired and the works will shortly be enlarged to double their former capacity.

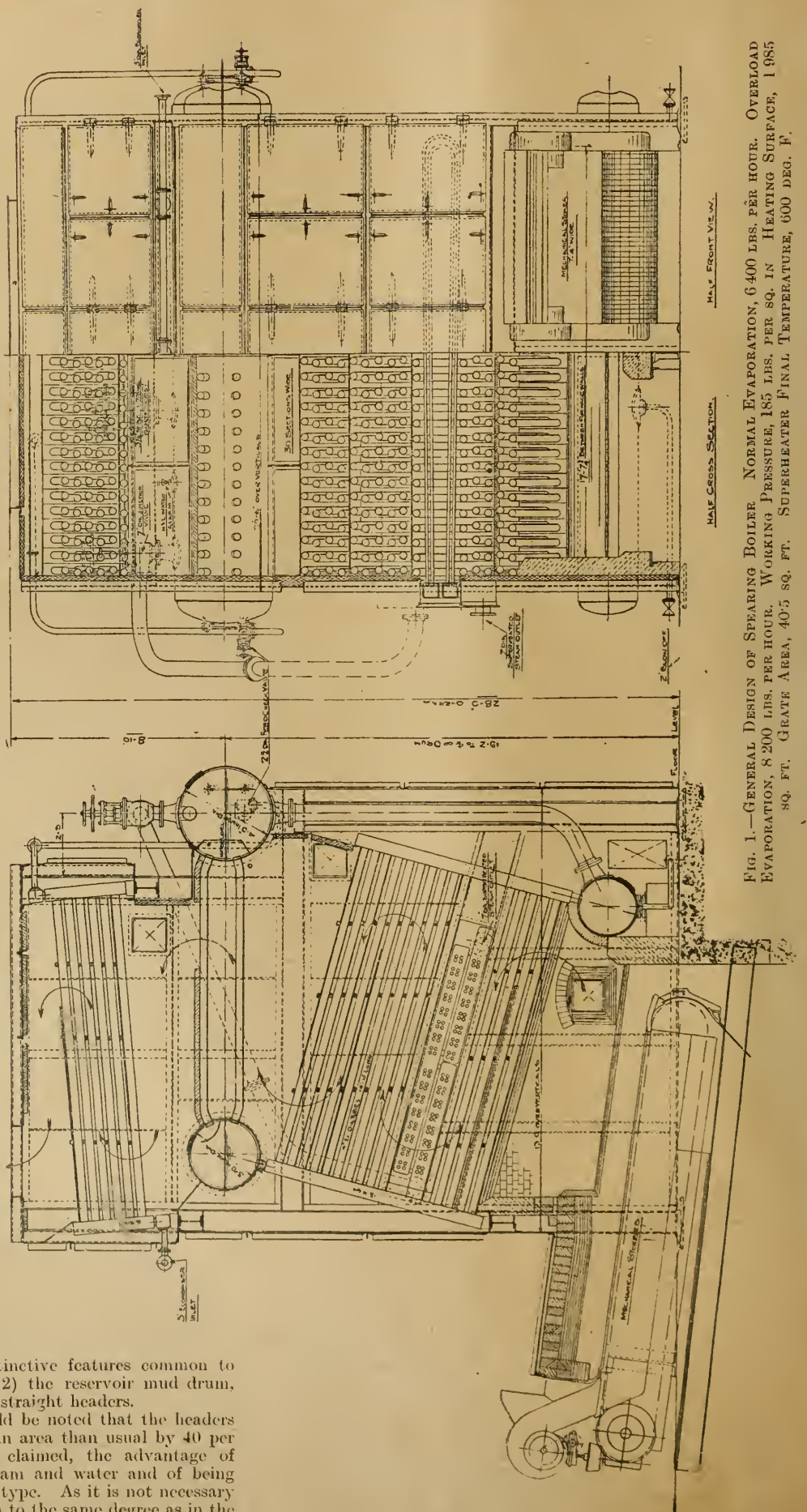

Fig. 1.—General Design of Spearing Boiler. Normal Evaporation, 6 400 lbs. per hour. Overload Evaporation, 8 200 lbs. per hour. Working Pressure, 185 lbs. per sq. in. Heating Surface, 1 985 sq. ft. Grate Area, 405 sq. ft. Superheater Final Temperature, 600 deg. F.

The Two Types of Spearing Boiler.

It may be mentioned that there are two types of Spearing boiler, the first with a longitudinal drum and the second with a cross drum. The first type is adopted for smaller sizes and the latter for boilers of larger capacity. Both are of the sectional header class; and the distinctive features common to both are: (1) the downcomer pipes, (2) the reservoir mud drum, (3) the enlarged nipples, and (4) the straight headers.

Taking the last point first, it should be noted that the headers are straight, rectangular, and larger in area than usual by 40 per cent. Straight headers have, it is claimed, the advantage of affording freer circulation to the steam and water and of being more easily cleaned than the sinuous type. As it is not necessary to stretch the material in construction to the same degree as in the sinuous headers, the thickness of the straight headers is more

uniform. Further, it is a simpler matter to make the joints between the straight headers airtight. The headers are connected to the drums by nipple tubes which are 28 per cent. larger in area than is usually the case—a feature which increases the safe and steady steaming capacity of the boiler.

The Downcomer Pipes.

The reservoir mud drum has to be considered in connection with the downcomer pipe which leads to it from the circulation drum. The function of this pipe—one, two or more are fitted according to the evaporative capacity of the boiler—is to secure positive circulation from the main steam and water drum through the mud drum to the headers and tubes. Usually the internal diameter of the downcomer pipe is about 8 in., so that the risk of choking by deposit or incrustation is altogether negligible. In the position it occupies it is not subjected to excessive temperature. Each pipe is solid drawn, and is flanged at each end so that it may be bolted to stand pipes riveted to the steam drum and mud drum respectively. This arrangement enables the downcomer pipe to be readily detached if necessary.

Efficient Circulation.

By means of the downcomer pipe all the water is circulated through the mud drum, which efficiently collects and retains deposit which would otherwise be distributed through the headers or on the steam generating surfaces. The mud drum is of ample size and is easily accessible for cleaning. The water flows from it through short connecting nipples to the back headers; and a glance (Fig. 1) at the general design of the boiler will show that this arrangement provides a full supply of water to the bottom rows of tubes first. Again, the flow is in the right direction along the tube—upward and onward. As the tubes nearer the fire play the larger part in steam generation, the correct mode of water supply is of great importance.. It is claimed that the Spearing boiler (Fig. 1) surpasses other water-tube boilers in this connection, and it has been successful in the case of oil firing, the freedom from blistering of the tubes due to the positive supply of water to the bottom rows of tubes being very marked.

In the longitudinal drum type the headers are connected to the drum by curved nipples directly expanded into holes in the drum. These holes are compensated for by a doubling plate, thus avoiding the weakness of a cross-box with a large opening in the shell and a considerable flat surface. In the Spearing boiler the water tubes are staggered about 1 in., but no claim is made that the arrangement adds anything to the efficiency of the boiler. The advantage of the relatively small stagger is that it facilitates the removal of soot by blowers.

Circulation Advantages.

One outstanding result of the general design of the Spearing boiler, with large downcomer pipe, the large nipples, and straight headers, is that a free, natural and positive circulation is secured. This feature, combined with the ample steam and water capacity, enables the boiler to respond readily to overload demands. The renewal and the cleaning of tubes are not only exceptionally simple, on account of the tubes being straight and easy of access, but the necessity for either is reduced by the peculiarities of circulation mentioned above. Expansion and contraction stresses are also minimised, as all parts liable to considerable changes in dimensions are free to adjust themselves to an unusual degree. A general view of the boiler is given in Fig. 2.

Fig. 2.—General Assembly of the Spearing Boiler.

Street Lighting in the United States.*

The evolution of electric street lighting in all countries has necessarily been dependent on the development of dynamo-electric machinery. The electric arc lamp reached a fairly advanced stage at a time when the distribution of electricity was in its infancy. The City of Paris, in years prior to 1878, had made lavish use of gas light (according to the standard of that time), and the exhibition of the now obsolete Jablochkoff candle for the illumination of the Avenue de l'Opéra in that year attracted much interest and may be said to mark the initiation of the use of arc lamps for street lighting. The decade from 1880 to 1890 was signalised by the development of series arc lighting stations, mainly using the Brush and Thomson-Houston plant, about 50 to 75 arcs on a 10 A constant current system being used. The Thomson-Houston dynamo had peculiar features and attracted much attention at the Inventions Exhibition in London in 1885, where electricians, on seeing the dynamo-connections declared "It can't work, but it does!"

Arc Lamp Progress.

Before 1890 street lighting with arc lamps had made considerable progress, which was aided by the few restrictions then placed on the use of overhead high-tension wires. The first notable change was the reduction of the current to 6·8 A, with a corresponding increase in the number of lamps that could be run with a given energy-consumption. Enclosed arcs subsequently replaced open arcs in many cases, owing to the longer life of the carbons, but the efficiency of light-production with alternating current was very low. The development of flame arcs, luminous ("magnetite") arcs and incandescent lamps of progressively higher candle-power and efficiency has created an interesting situation, and to-day it is scarcely possible to predict which will finally "win out." In the United States one feature of street lighting that differs materially from conditions in this country is the general use of series constant-current circuits. This system is most common both for arc and incandescent lamps, though there are large multiple systems in operation—notably in New York, where the limitation of the pressure to a low value is considered an advantage. Series systems, as a rule, do not use a total voltage in excess of 5000 V, but insulation must withstand at least twice that voltage, as an earth on any part of the line may increase the voltage by 50 to 100 per cent.

Many installations are carried overhead, but the necessity for a safe and inexpensive earth system in cities and for parks, playgrounds, &c., has led to the development of steel tape cable, which can be laid direct in the ground at a comparatively small depth, being frostproof and waterproof.

Gasfilled *v.* Magnetic Lamps.

It would appear that the two lamps most favoured for street lighting are gasfilled incandescent lamps and luminous, or magnetite, arc lamps. For gasfilled lamps, as well as arcs, the series lamp is still the standard, and types taking 6·6 A, 15 A and 20 A are in

* Based on a series of articles in the "General Electric Review."

common use. With such relatively high currents, strong filaments and good conditions as regards life and efficiency can doubtless be obtained. Thus the 20 A lamps are credited with 19·3 lumens per watt, which is equivalent to about 0·66 W per mean spherical candle-power—probably within half a watt per rated candle-power. It is recognised, however, that rating in terms of candle-power in one direction is unsatisfactory. Lamps are now rated in lumens; what was formerly a 400 c.p. lamp, for example, being now regarded as 4 000 lumens (the product of the "reduction factor" and 4 A being approximately 10). It is stated that for typical street lamps the depreciation should not exceed 10 per cent. over a natural life of 1 350 hours; some companies replace all lamps that have burned for 1 500 hours. Naturally the use of high-tension series systems makes the series lighting transformer an important piece of apparatus, and various models are described in the original articles. Another essential piece of apparatus, also illustrated in detail, is the cut-out, which is described as the safety valve of the a.c. series system, and which automatically short-circuits any lamp that fails.

Details of the Magnetite Lamp.

The "luminous" or magnetite arc lamp was first put into operation in 19·3, and is still used in most of the larger cities of the United States. It will be recalled that in this lamp, which is little known in England, the upper electrode consists of a rod of solid copper, which is relatively non-consuming, and may last for 2 000-6 000 hours. The nature and efficiency of the light is determined by the lower electrode, which has been the subject of much study. A mixture of titanium oxide with magnetite, together with a small amount of chromium oxide to give added steadiness, is now commonly used. It appears that the life of this lower electrode, which furnishes the stream of luminous vapour, is about 150 to 200 hours, but depends on the material. A high efficiency (17 to 25 lumens per W) involves some sacrifice of life; with the long-life electrodes 11 to 18 lumens per watt is aimed at. It is stated that the slight motion of the arc across the electrode that invariably occurs in these lamps does not result in a positive flicker but is "just enough to give a sort of sparkle or animation to the light."

The natural colour of the light is white, and these lamps are commonly used in diffusing glass globes to give a soft effect. In certain regions, however, such as the famous "Path of Gold" in San Francisco, a yellowish tone is obtained by the use of suitable tinted panes of glass. Clear globes are, however, also used, and the fact of the light coming from a bridge of vapour of considerable length is also regarded as an element contributing to softness of light. Another point emphasised is that the light is derived from a vertical column of vapour, and is therefore a maximum in a horizontal direction. Relatively little modification of the natural distribution of light is therefore necessary in order to secure conditions favourable to street lighting.

White-Way Illumination.

A feature of street lighting in American cities has been the method known as "white-way illumination," the latest development of which, described as "super white-way lighting" was adopted in San Francisco in October 1916. Generally speaking, white-way lighting involves the use of clusters of high-powered incandescent or luminous arc lamps, commonly installed in diffusing white globes in ornamental standards. In the latest form, such lighting utilises standards 18 ft. or more in height, carrying two, three or more high-power luminous arc or incandescent fixtures. The distinction from the old white-way methods is mainly a matter of higher posts and more powerful units, coupled with greater illumination. The cost of installation is stated to be four to eight dollars per foot frontage, as compared with one to two dollars per foot on the original white-way basis. For such lighting, gas-filled lamps of 1 000, 1 500 and 2 500 c.p. are commonly used. In the original article some effective photographs of streets lighted by these methods are shown

Another matter to which much attention has been given is the design of ornamental street-standards of which attractive illustrations are also given. For general work 600 to 1 000 c.p. lamps are installed in diffusing globes about 17 in. in diameter and 18 to 20 in. long. This is assumed to give a degree of brightness that can be viewed without disagreeable sensations of glare. Apart from the shaping of the standards, colour is of some importance, and it is considered preferable for them to be painted in some light tint of buff, green, or brown. Even trolley-poles, also carrying lights, have been subjected to decorative treatment.

The Finance of Street Lighting.

A point of considerable interest in connection with street-lighting is the method of finance. It is stated that three chief methods are employed.

1. Popular subscription amongst business men or property owners, or both.
2. Installation by the lighting company, which charges a slightly higher rate for current to amortise the original investment.
3. Financing by commercial clubs or other civic organisations which, in turn, pro-rate the cost against members of the organisation.

This special white-way lighting, the nearest equivalent to which is perhaps what is known as "parade-lighting" in this country, is regarded as being of special benefit to business houses fronting on the region so illuminated. In some states the "Improvement Law" has been modified to enable a special assessment to be levied against the abutting property on which the improvement is made. Statistics are presented showing the comparative expenditure on lighting of a large number of cities. It is perhaps difficult to draw general conclusions from such statistics. It appears, however, that the expenditure on lighting varies from 1·23 to 3·86 per cent. in different cities—in any case a comparatively small proportion. The average cost per capita for 227 cities with populations over 30 000 has been found to be approximately 72 cents. There are, however, a few cities whose expenditure rises over 3 dollars per capita. For the 50 best lighted cities the average per capita is about 2 dollars. The yearly cost of street-lighting commonly varies from about 2 cents per linear foot of street for a poorly lighted village to over 5 dollars for an intensive system such as that in Market Street, San Francisco. The average for all streets in the United States, excluding "white-ways," would not exceed 5 cents per foot per year. However if, as is indicated by the acceptance of extra lighting in many districts, property owners and merchants consider it a good investment to pay over 6 dollars to light one foot of street, the question may be raised whether it is not worth while for a city to consider paying at least 5 cents ?

Classes of Street Lighting.

Setting aside special white-way or spectacular lighting, Dr. L. Bell divides street lighting into three classes, *i.e.*, (1) those in which to the ordinary requirements of safety and convenience something is added with a view to display; (2) normal street-lighting suitable for thoroughfares carrying important traffic; and (3) lighting for residential and other streets where traffic is small and requirements of the police are not severe. For the highest grade of lighting the eye must receive enough light to get beyond the "twilight vision" stage, and, in practice, the most important public streets should receive an average of 0·25 foot-candle. In such cases one may compare the street to a corridor, the sides of which receive fairly liberal illumination in order to produce an agreeable effect. Powerful arcs, placed fairly high and spaced at a distance not over four to five times their height are effective.

The great bulk of street-lighting, however, demands less exacting conditions, and a general order of illuminating comparable with full moonlight, and ranging say from 1·20 down to 1·50 foot-candle should answer. Here the larger incandescent lamps of 100 to 500 W prove useful.

Need for Careful Tests.

In view of the low orders of illumination practicable in most street-lighting, illumination tests, if embodied in the contract, require special care. A sufficient number of lamps must be tested, and due consideration must be given to the effect of reflection from buildings, shadows cast by trees and other extraneous factors. Important decisions should be based on laboratory tests, where exact conditions can be noted. The most logical method, in rating lamps for street-lighting, is to specify the mean spherical candle-power, and to describe the lamp by type. Allowance for depreciation of incandescent lamps during life must also be considered. With regard to failures of lamps it is suggested that the central station should be given sufficient notice to replace a defective lamp before the deductions are made. If not replaced within twenty-four hours the central station may be deemed liable to a penalty.

The choice of the type of glass for the diffusing globes now becoming commonly used for street-lighting presents interesting problems. The aim of modern design is to secure complete diffusion of light without undue loss of light, and without the globe becoming too heavy. Diagrams show that increasing weight is accompanied by progressive increase in absorption of light, but a transmission of 87 per cent. is claimed for some of the latest "alabaster" and "carrara" glassware. Generally speaking the transmission varies from 60 to 80 per cent. according to type. Considerable improvements in the manufacture of such diffusing glass have been made during recent years. Various special units intended to modify the natural curve of light distribution so as to secure even illumination in streets have been devised. Some of these depend on the use of prismatic glass refractors.

One special type, the "Highway" lighting unit, consists essentially of two approximately parabolic reflectors pointing down the street in either direction, whereby the peculiar curve necessary for theoretical even illumination of pavement may be secured.

There appears to be much activity in the development of HYDRO-ELECTRIC POWER IN THE UNITED STATES at present. The Southern Power Company has let a contract for a 80 000 H.P. hydro-electric plant at Mountain Islands for $3 000 000, and it is also to develop 60 000 H.P. at Great Falls (S.C.). Contracts, amounting to nearly $3 500 000, have been placed by the Southern California Edison Company for generating plant and auxiliary apparatus for a 75 000 kW plant, an additional hydro-electric unit at an existing station, sub-station equipment, and the conversion of the 150 000 V Big Creek lines to 220 000 V operation.

Recent Progress in High Frequency Inductive Heating.*

By E. F. NORTHRUP.

A somewhat detailed description is given of the furnaces designed by the author for heating with high frequency currents. The furnaces are made by the Ajax Electrothermic Corporation. The high-frequency converter sets used for the purpose have been greatly simplified. Those under 25 kW are designed for operation on single phase circuits. They include three essential parts, namely, an oil-cooled transformer, with internal reactance, a set of condensers, and a metal discharge gap. A diagram of connections for a 20 kW set is shown in Fig. 1.

Where the supply voltage is 6 600 V, it is practicable to operate the three-phase high frequency converter set directly off the supply circuits, no step-up transformers being required. On the other hand, three high-tension reactances of 25 kVA capacity must be inserted in the supply line to limit the flow of current. An oil-switch must be used as a starting switch; and two current and two potential

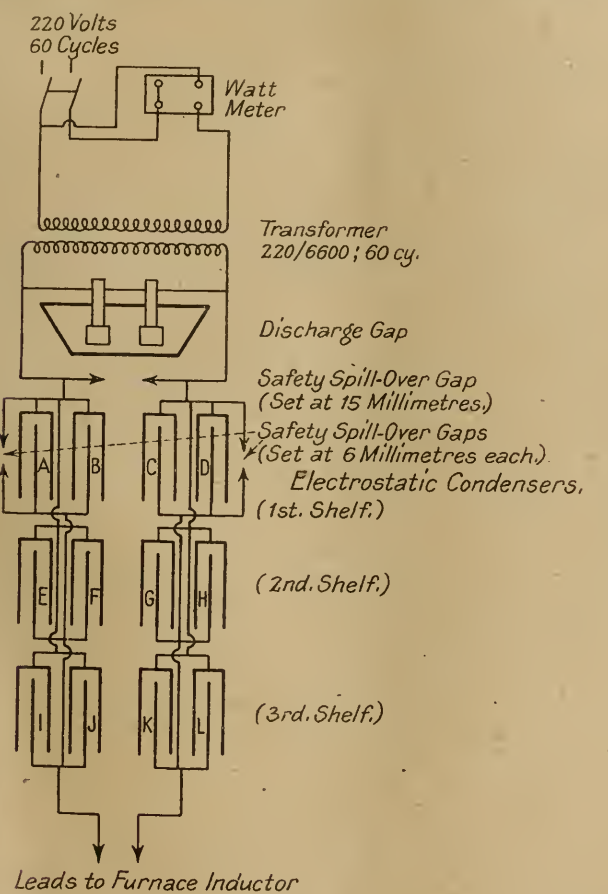

Fig. 1.—Theoretical Diagram of Connections of 20 kW High Frequency Converter Set.

transformers are needed to operate the integrating wattmeter. There is, therefore, a loss in simplicity and little is gained in economy of first cost in operating directly from high-tension supply lines.

Facts About High Frequency Converter Sets.

On account of the intrinsic high cost of transformers and condensers, these high-frequency converter sets constitute from 80 to 90 per cent. of the selling price of a complete metal melting outfit. The high-frequency converter sets have, however, no moving parts and the nature of the materials which enter into their construction is such that they depreciate scarcely at all.

These high-frequency converter sets have proved in practice to be so reliable and efficient, as constructed in units not exceeding 60 kW, that a high-frequency alternator of this rating could scarcely compete with them in simplicity, ease of operation, life and cost. It is only when single units of over 100 kW capacity are considered that we should look to the high-frequency alternator of about 12 000 cycles per second as the better apparatus for supplying high-frequency current for heating purposes. Satisfactory alternators of 200 kW capacity have been designed, but as yet they have not become available.

Types of Furnaces.

Several types of furnace are described in the original paper. A high temperature furnace, which may be used with a vacuum, is shown in Fig. 2. Here the inductor coil is made of 42 turns of in. (1 cm.) flattened copper tubing. The inductor is wound as a solenoid

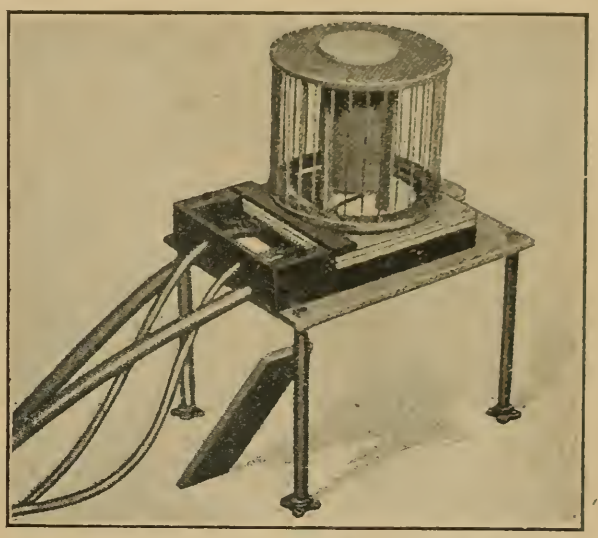

Fig. 2.—Standard D—1 Model Furnace.

and is 9 in. (23 cm.) long and $4\frac{3}{16}$ in. (10·5 cm.) inside diameter. The high frequency potential is applied to the terminals of this solenoid and also a water pressure of 30 lb. (13·7 kg.) or more, which maintains a flow of water through the flattened tubular solenoid. The furnace may be used as a vacuum or as a non-vacuum furnace. It is of the non-tilting type, and its contents are removed through the bottom by withdrawing a slide of asbestos board. This type of furnace under favourable conditions will melt molybdenum and can

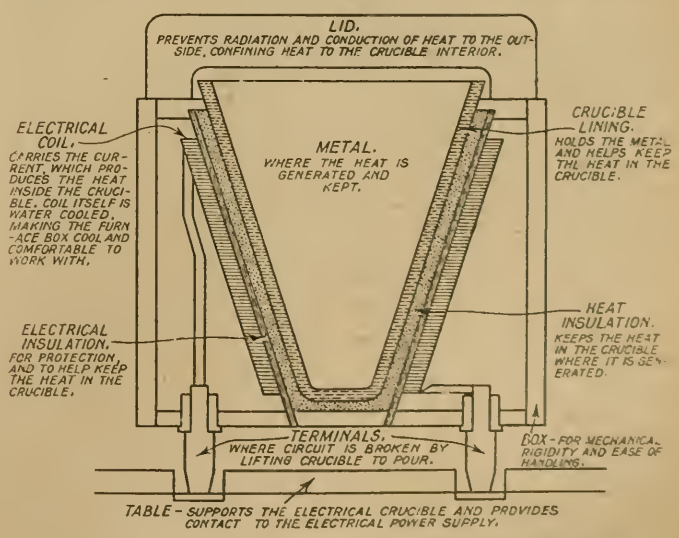

Fig. 3.—Cross Section of Ten-Inch "Electric Crucible."

be used to melt electrolytic iron in 5 to 6 lb. (2·3 to 2·7 kg.) lots strictly carbon free. The furnace is very suitable for the recovery of platinum scrap. When a crucible of carbon or Acheson graphite 2¼ in. (5·6 cm.) inside diameter by 7 in. (17·5 cm.) long is used, and this is heat-insulated with lampblack, it is not difficult to obtain temperatures in from fifteen to twenty minutes which are more than sufficient to graphitise carbon completely.

Electric Crucible Furnaces.

For melting in vacuum, a quartz tube is used closed at the bottom, which just fits the coil. Electric crucible furnaces are made in the form shown in Fig. 3. Since all types of furnaces operated by high-

* Abstract of a Paper read before the American Electrochemical Society.

frequency induction are substantially at room temperature on the outside, they can be handled very easily. A furnace of this type is well adapted to the melting of precious metals and will melt and pour about 15 lb. of copper. The melting is extremely rapid, and when non-conducting crucibles are used the molten metal becomes violently stirred, so that there is perfect mixing.

When very high temperatures are required in electric crucibles, it has been found advantageous to maintain a flow of water through the inductor coil, the water connections being made by means of rubber tubing.

Several high-frequency furnaces have been used in the United States Mint in Philadelphia. With an in-put of 121 kW per phase 5.905 lb. of silver were melted per kW hour, but, in this case the furnace was really underloaded.

In the case of metals which do not take up carbon it is advantageous to employ graphite crucibles, but these are subject to the disadvantage that they oxidise and burn away. To overcome this difficulty the author has developed a coating which will not oxidize at a temperature of 1 800° C., even when a jet of oxygen is steadily blown upon it. The coating is put on at a temperature of 2 200° C. An additional coating of zirkite, magnesite, &c., may be easily applied.

In the original paper some particulars are given on the use of special furnaces for heat treatment and graphitisation, c. With regard to the latter, lamp black, or carbon black, is found to be the best of all insulators at temperatures above 2 000° C.; it is also an electric insulator when not strongly compressed. Consequently, when a pile of carbon blocks are embedded in this material and inductively heated with high frequency current, they are heated rapidly and uniformly and can be quickly brought to the temperature of graphitisation. The efficiency compares very favourably with that of other methods.

Magnetic Properties of Compressed Powdered Iron.*

By B. SPEED and G. W. ELMEN.

The development of a successful method of compressing insulated grains of iron to produce a material magnetically and electrically suited for use in the telephone plant has had a determining effect upon methods of loading and compositing telephone lines and the introduction of carrier current systems of multiplex telephony. This material is used in the construction of the cores of the loading coils introduced to increase the inductance of a telephone circuit, also in the cores of inductance elements in filters for carrier current systems, and reactance coils and transformers for radio telephone circuits. Such coils have to meet special requirements.

The inductance, and hence the permeability, of the loading coils must remain constant throughout the entire range of intensities (as much as 1 : 100) of the currents employed.

In addition, the variation in effective resistance caused by hysteresis, which occurs when two currents of different frequencies and amplitudes are superposed, must be so small that "flutter" in the transmitted speech is inappreciable. Finally, the total resistance of the coil, including copper loss, must be small compared with the resistance of a length of line conductor equal to the length of the loading section. Hence the effect of hysteresis and eddy currents which depends upon the frequency and amplitude of the telephone currents must be reduced to a minimum.

Meeting the Requirements.

These requirements were met successfully in the early development of loading coils by the use of hard iron either in wire or in sheet form. Cores of hard-drawn wire were developed and adopted by the engineers of the American Telephone Telegraph Company, and were used successfully until the core-material herein described was put on a production basis. Two advantages pertain to the use of hard material in preference to soft. In the hard material the variation in permeability for a large range of magnetizing forces is less than in the soft iron. This is especially true at the initial part of the magnetization curve where, for a very large range of magnetizing force, the permeability of the hard material is constant. The second advantage is due to the fact that over the range in which the permeability is constant the hysteresis loss per unit of volume is less in the hard than it is in the soft material for the same flux density.

Design of the Coils.

In order to take advantage of the constancy in permeability and the low hysteresis loss with small magnetizing forces, the coils were designed so that for the range of speech currents the magnetizing force corresponded to that of the initial part of the magnetization curve. In a standard design of coil the magnetizing force corresponding to an average telephone current of one milliampere is of the order of 0·01 gauss.

In addition to the magnetic requirements for the core-material, its electrical resistivity is also of great importance.

Originally cores of hard-drawn wire were used. Hard material is preferable to soft as the variation in permeability is less, especially at the beginning of the magnetization curve: also the hysteresis loss in these circumstances is smaller. In a standard coil the magnetizing force with one milliampere is about 0·01 gauss. Electric resistivity is also important. The frequency of speech currents is about 800 per sec., and with low resistivity eddy current losses are excessive. Hence iron wire of 0·004 in. diameter was used, separate convolutions being insulated.

The Need for Stability and Constancy.

With the introduction of repeaters requirements as regards stability and constancy became more stringent, and air gaps were introduced at right angles to the path of the flux. For various reasons the symmetrical placing of such gaps is important. The making of such fine hard drawn wires required diamond dies, the importation of which was greatly hindered by the war. Fortunately, powdered iron cores were developed to a commercial stage. The requirements of such materials are (1) a permeability at low magnetizing forces between 20 and 100, (2) material finely divided at right angles to the flux to decrease eddy currents, (3) low hysteresis loss, and (4) favourable cost of manufacture. Finely divided iron, in some cases consisting of particles treated with wax, was often proposed, and the use of particles of iron oxide was studied. In general, however, little was known of compressed material.

The iron powder used first in these investigations was mixed with a little water and heated at 100 to 150° C. until the particles had a layer of oxide on them. Finally, it was mixed with a thin solution of shellac, dried and pressed into rings under a pressure of 100 000 lb. per sq. in. Thus the desired order of permeability, between 50 and 60, was obtained. Other methods of insulation were tried, but were less satisfactory. Ultimately it was found that if iron powder was rolled in a zinc-lined drum for a few hours and then insulated with shellac solution, very tough insulation, which did not break down under compression, was obtained, coupled with a higher specific resistance. This method was eventually adopted in preparing powdered iron cores. A suitable quality of hard iron was obtained by electrolysis from a solution containing ferrous sulphate and chloride and ammonium sulphate. The deposited iron was stripped off the steel electrodes and ground fine, until 30 to 50 per cent. would pass through a 200-mesh sieve. An annealing process was also used and had an appreciable purifying effect. At the present time three grades of material, having respectively permeabilities of 50, 35, and 25 are made. Tensile strengths of the three varieties are 1 375, 925 and 375 lb. per sq. in. sp. gravity 7·1, 6·4, and 6·0. A diagram relating specific resistance to pressure for annealed and unannealed material is also given in the original Paper. At 120 000 lb. per sq. in. values of 0·007 and 0·003 for annealed and unannealed material. At 260 000 lb. per sq. in. a sp. resistance of the order of 0.001 Ohm-cm is recorded. In the original paper full data on remanence, coercive force, &c., are also appended, and magnetization curves are given. The greatest changes in specific gravity occur below 100 000 lb. per sq. in.; additional pressure while altering specific gravity but little, may double the maximum permeability. With a sp. gravity of 7·4 the specific resistance of the compressed uninsulated powder is 30 to 60 times that of solid iron. The effect of air spaces in the insulated and uninsulated varieties is notably different. The maximum permeability recorded for compressed iron is 545—as high a value as can be obtained from many grades of solid iron.

The following data are of interest:—

Kind of Material.	Permeability. Maximum.	Permeability. H = 0.
Electrolytic iron, wrought bar	7 800	250
Poor grade of cast steel, annealed ..	710	131·5
Poor grade of cast steel, hardened ..	170	58
Cast iron, annealed	620	175
Cast iron, unannealed	240	69·4
Iron powder, annealed, uninsulated, compressed with 254 000 pounds pressure	540	80
Iron powder, unannealed, uninsulated, compressed with 254 000 pounds pressure	156	52
Grade A iron-powder cores	156·5	54·8
„ B „ „ „	57·2	30·2
„ C „ „ „	48	26·3

In the final section of the article an account is given of the plant used in the preparation and compression of these powdered iron cores.

* Abstract of a Paper read before the American Institute of Electrical Engineers.

Reviews.

Die Transformatoren. By M. Vidmar. (Berlin: Julius Springer.) Pp. xvi.+702. Price 120 marks (bound).

This is an excellent book. It is also a remarkable book. The author is a professor in the University of Ljubljana, and director of the Ljubljana Engineering Works and Foundries. It interested us to discover where Ljubljana was, and after numerous enquiries we were assured that it was none other than the town known as Laibach in the old, ramshackle empire commonly called the Dual Monarchy. Thus the book emanates from a Jugo-Slav University, about 50 miles north of Fiume. Though written in German and published by a famous Berlin house, there are many phrases which one would scarcely expect in a book written by a "Reichsdeutscher," e.g., "Der Witz des Grosstransformators."

Interest is aroused in the preface, which is an essay to show the proper place of the engineer in the world. Here we have to do with an idealist, who makes no attempt to conceal his subjective standpoint. We shall now try to indicate a few of the interesting points dealt with in a treatise of 700 pages.

Generally speaking, the author's method of treatment is to start from first principles and leave off when he has exhausted the subject as far as he is able to do so. In the chapter on the magnetic circuit, among the matters dealt with are the current rush on switching in and the third harmonic of the magnetising current. When dealing with windings, additional losses with various arrangements of copper, the disruptive forces on short-circuit, pressure surges, switching phenomena and capacity are among the matters discussed. In a chapter of about 100 pages on heating, a great deal is said about radiation, conduction, convection, time-constant, intermittent working, overloads, &c. The relations between cost and efficiency and between cost and main dimensions are discussed by every writer on transformers, and the present author is no exception. The next three chapters deal with air-cooled transformers, oil-cooled transformers, and water-cooled transformers.

The problem of the large transformer appears to have a special charm for the author, and after paying his devotion to Bláthy, one of the pioneers in this work, he describes in detail the design of his largest transformer.

The following particulars of this construction of Ganz of Budapest may be of interest: Normal output 16 000 kVA, with a continuous overload capacity of 30 per cent., by increasing the cooling water from 200 to 300 litres per minute. Frequency 50 cycles per second. Pressure-ratio, 4 000/56 000 V. Total weight, 35 tons. Efficiency at normal load and unity power-factor, 98.65 per cent. The no-load current is 7 per cent. and the short-circuit pressure 5.6 per cent. In addition to this 3-phase, core-type transformer, the author works out a single-phase, shell-type, furnace transformer for 3 000 kVA and 500/60 000 A, also built by Ganz.

Enough has been said, however, to give the reader a fair idea of the contents of the book. Though objections can be taken to various arguments, we have not found anything to make the book unworthy of the serious consideration of all who are deeply interested in transformers. There is no doubt that the book will be a standard treatise for years to come. It is printed and illustrated in the excellent manner common to Springer's publications, but intending purchasers are advised to buy *bound* copies.

Stanley Parker Smith.

The Elements of Direct Current Electrical Engineering. By H. F. Trewman, M.A., and G. E. Condliffe, B.Sc. (London: Sir Isaac Pitman & Sons, Ltd.) Pp. vii.+219, 7s. 6d. net.

The authors suggest in their preface that there was a gap existing between elementary text-books on magnetism and electricity and the more advanced books which deal with the design point of view, and their aim was to bridge this gap. We can hardly subscribe to the view that the gap was as great as is suggested, for there are many text-books, bearing the too frequently used label of "Electrical Engineering," which connect the pure with the applied science. However, the authors have prepared a concise course designed for second-year university students, and presumably especially designed for their own students at the Ordnance College, Woolwich. The course assumes that the reader has an elementary knowledge of the Calculus, and no attempt has been made to avoid its use. The book is written in twelve chapters, the first four dealing with the fundamentals of electro-magnetism and induced current, after which there are chapters on instruments, storage batteries, the dynamo, the magnetic circuit, commutation and armature reaction, losses, operation of dynamos, the motor, and motor testing. Numerous examples are provided and answers are supplied. The authors ask for suggestions and the notification of errors. On page 169 it is stated that if a series dynamo be charging a battery, and the battery E.M.F. becomes greater than the dynamo E.M.F., "the current will be reversed in both armature and field, and therefore the machine will run as a motor in the same direction"! This error is not repeated in the motor chapter.

The compound wound dynamo is treated very briefly, and we would suggest a note on the paralleling and load-sharing, as this would help to indicate the reasons for the more general use of one type of winding. The word "expotential" on page 25 is an obvious misprint.

Finally, we suggest that the method of deducing the strength of the magnetic field due to a current is based on an unjustifiable assumption, namely, that the magnetic force produced by a current is automatically the same as the electric force produced by a charge.

J. Paley Yorke.

The Diagnosing of Troubles in Electrical Machines. By Prof. Miles Walker, M.A., D.Sc. (London: Longmans, Green & Co.) Pp. xi.+450. 32s. net.

During the last few years, quite a number of books have been written, especially in America, on diseases of machines and their remedies, but none that we have reviewed can approach Prof. Walker's book for real solid interest and value.

A reader has not to read far into the first chapter on "breakdown of insulation" before realising that the author is drawing on a vast experience; and then the fearful thought flashes through the mind whether any one firm could possibly survive if it encountered but a fraction of these multitudinous mishaps. Nor is the reader consoled by the author's assurance that "the accidents that can happen and the mistakes that can be made are so diverse and numerous, and the ways in which a defect in the machine can hide itself are so perplexing, that one can only hope to deal with a small percentage of the troubles and to indicate the general methods of attacking problems of the kind."

Another thought that flashes across the mind on reading of the strange things that have happened or may happen to electrical machines is the following. Granted that many of these failures belong to the troublous period of birth and infancy of many types, one still wonders whether many of these breakdowns or troubles ought to occur at all. Candidly, we think not. We have no sympathy with the American idea of rapid "antiquation." Engineers have no right to waste Nature's resources in this way—rather, they should build thoroughly reliable machines, which will only break down in case of untoward accident. Everlasting "cutting" can be carried too far, and the possibility of exact calculation ought not to be strained too much—briefly, in this respect, electrical ought not to be worse off than other machines.

The first few chapters on breakdown of insulation, over-heating, low efficiency, &c., contain a great deal of well-digested information arranged in an orderly manner. Here, of course, many standard well-known methods are included; but let not the reader think he is going to be let off with a mere list of possible faults and remedies. Dr. Walker's method is a very different one—he is concerned that the reader shall understand the cause of the trouble, and spares no pain in analysing the underlying theory. Much of the material will be found as useful for designers as for testers—indeed, the technical information is given so as to be serviceable to all.

A particularly pleasing feature about the book is the clear and fair way in which methods or arguments taken from various publications are given: the author makes the digest of the subject so thorough as to render reference superfluous. Another instance

of the wide aspect on which the book is based is evidenced by the care taken to show how vector diagrams should be used to attack problems in connection with windings and the like.

After the more general sources of failure have been dealt with, the failures which occur in the several types are treated in separate chapters. Among the more important sections may be mentioned those devoted to balancing, in which a simple theory of this important subject is included; defects in core construction; unbalanced loads; synchronising troubles, with a theory of phase swinging; symmetry of armature windings; instability of continuous-current generators; a lengthy and very valuable investigation into commutator and brush troubles, with a complete discussion of remedies; starting and other problems in rotary converters and induction motors.

The notes we made when reading the book include the discovery of very few corrections and omissions. When dealing with equalising currents in lap-connected armatures, reference might perhaps have been made to the work of Lulofs and Hawkins; while in the useful expression for finding the temperature by resistance, it would probably be better to give this for the final temperature, leaving the rise to be found by deducting the temperature of the surrounding air.

No more need be said in praise of this excellent book. There is no doubt that it will soon be as popular as its sister book on design, to which it is similar in every respect. We only wish that more authors would compel their publishers to produce artistic technical books, with good binding, large text and well-drawn diagrams, and also bind them so that they will remain open when opened, as is the case with Prof. Walker's books. The book can be strongly recommended to all who are interested in the technical side of electrical machinery. S. Parker Smith.

Switching Equipment for Power Control. Stephen Q. Hayes. (London: Hill Publishing Company.) Pp. vii. + 463. 20s.

To one familiar with Mr. Hayes' career this book is very disappointing. Of all switchgear engineers he has travelled most extensively, but he writes solely of American practice and material. During twenty-five years' connection with switchgear industry Mr. Hayes has built up an international reputation which justifies the expectation of much greater things than are exhibited in this book. The whole tone of the book suggests the salesman, and there is usually little difficulty in identifying the "manufacturers . . . descriptive matter utilised bodily," which the author acknowledges in his preface. In the reviewer's opinion there is far too much of this matter, much of which appears to have been included so as to avoid giving offence to firms competing with the author's employers.

The space is not well allocated. Five pages on instrument switches, nine pages on fuses, two and a half pages on automatic protection, twenty-six and a half pages, mostly catalogue quality, on switchboard meters, and only forty-eight pages on cubicle work and layouts.

Editorial work is conspicuous by its absence. Sentences and even whole paragraphs are duplicated (see §§2 and 5, p. 96; §5, p. 106 and the last lines of p. 107; § 1, p. 364 and § 1, p. 407). Related matter is separated. Thus one page and an illustration is given to portable sub-stations in the chapter on large panel switchboards, and another two and a half pages on the same subject appear later under circuit breaker structures. A table should have replaced a long, involved sentence, full of figures, on p. 94. The article before a noun is frequently omitted, and phrases such as " . . . currents of 600 to 1 000 at 650 V . . . " omitting the "amperes," are common.

The only notes regarding the use of reactances appear in the chapter on lightning arresters, and practically nothing is said about their application to the switching system. More attention should have been given to system connections as a whole. The diagrams of elements are often excellent, but the uninitiated are left seeking the proper method to combine these elements.

The contrast between British and American practice is emphasised by the statement that it is *customary* to omit automatic devices on a.c. generators, although *recently* a scheme of differential protection has been adopted. The latter system is given six lines, and split-conductor protection a like amount.

The sixteen pages on automatic sub-stations are of considerable interest, and among other matters of note to British engineers may be mentioned the automatic reclosing circuit breaker, the graphic recording synchroscope, which show the exact phase relationship at the instant of paralleling, the glow synchroscope for high voltages and the multiple Kelvin balance totalising graphic meter.

On the whole, the book is likely to be useful to those who want to know *what* American manufacturers are doing, without bothering about the *why*. In a future edition the author will do well to prune ruthlessly the manufacturers data pages, and to elaborate on such items as the operation of voltage regulators, means of insulation for high voltages, the application of protective relays, the action of lightning arresters, and the general substitution of definite information for vague statements.

The printing, binding and production generally is well up to McGraw-Hill standard, the only possible criticism being that a few of the blocks are too small for convenient reference.

W. A. Coates.

Wireless Telegraphy and Telephony: An Outline for Electrical Engineers and Others. By L. B. Turner, M.A., M.I.E.E. (Cambridge: University Press.) Pp. x. + 195. Price 20s. net.

The object of the present volume is to provide an introduction to wireless telegraphy and telephony which will serve as a groundwork for electrical engineers and others who already have a knowledge of electrical work, yet are unacquainted with radio developments. The book is chiefly theoretical for the first three chapters. The difference between wireless and other branches of electrical engineering is pointed out, the author always bearing in mind the object of his book. Radiation, oscillatory circuits, and methods of coupling receive attention in the second and third chapters. The fourth brings us to methods of producing high-frequency alternating currents. Spark methods are treated in an elementary manner which will be readily understood by the electrical engineer for whom special analogies are repeatedly given. Alternators and arcs are then explained. The explanation of the arc's action is such that it will leave many of the readers of this book still in the dark unless the circle is to be narrower than we imagine.

The author's comments on arc signalling are open to dispute. As Mr. Shaughnessy has recently pointed out, the double-wave method of signalling is likely to cause less interference at high speeds—the speeds of the future—than the single wave. A steady aerial load on the continuous-wave generator has many advantages in high-speed working. The author's opinion, however, of arc signalling is a high one, and he considers it to be the best available at present for high powers.

Chap. V. brings the reader to methods of detection. Simple receiving circuits are described in connection with crystal detectors. Chap. VI. brings us to the all-important thermionic vacuum tube. The author's treatment of vacuum tubes is exceedingly good. The development of the subject is lucid and logical, and, while there is no room for numerous practical examples, yet typical circuits are described and explained.

The author's remarks on p. 97 regarding the constancy of the grid current curve need some modification. He asserts that the anode potential has practically no effect on the grid currents. The following figures obtained from a similar valve will speak for themselves. When the potential difference across the filament was 4 V and the grid potential + 20 V, the grid currents obtained were: With 12 V on the anode, 3·6 milliamps; 34 V, 1·25 milliamps; 50 V, 0·75 milliamp; 90 V, 0·5 milliamp. The author's grid current curve of Fig. 61, which he says remains the same practically for anode voltages of 10 to 139, represents the grid current for grid potentials from 0-50 V. The greater the grid potential the greater the error of such an assertion.

In connection with the author's remarks on p. 141, it has been found that breaking the grid circuit is not suitable for high-power transmission. Fig. 111 omits a microphone battery. Fig. 118 shows the anode battery connected the wrong way round.

After dealing with the subject of triodes and their applications, the author gives some information regarding direction finding and the trend of modern development. He trusts, as we all do, that there will be some improvement in atmospheric eliminators. The reviewer feels that we are lacking in inventive ability if we cannot get over this trouble, and are taking the easier but probably far more expensive alternative of increasing the power of the transmitting stations. The problem can be solved if we get down to it.

Mr. Turner is to be congratulated on the production of this valuable little book. Even at its excessive price it is still not merely of great interest to the student, but also to those of wide experience who are yet anxious to see problems from a new and original viewpoint.

John Scott-Taggart.

The London County Council has made a two years' agreement with the London Electric Supply Corporation for the supply of electrical energy to the new County Hall, from July 1, 1922, on the following terms: (*a*) Lighting, 5⅜d. a unit for first 1 000 units a year for each kW of plant installed (for first year the plant to be calculated on a basis of 750 kW), and any consumption beyond at 3½d. a unit; (*b*) Power, 2⅛d. a unit for all power and heating required from July 1, 1922, to June 30, 1923. After that date the price to be increased or decreased by 0·002d. a unit for every penny a ton by which the cost to the company during the year ending December 31, 1924, of standard fuel having a calorific value of 11 000 B.th.u. rises or falls above or below the average cost to the company of such standard fuel during the year 1923; (*c*) "Stand-by" supply for lighting, 5d. a unit, the Council bearing cost (39s. 6d. a yard) of laying the cable over Westminster Bridge to provide this supply.

Protection of Electrical Apparatus.

Thermally Actuated Relays.

The load capacity of any piece of electrical apparatus is determined by the temperature limits of the materials used in the construction of the device. This characteristic sets a definite maximum load which can be applied continuously.

In many cases, this load can be considerably exceeded for short periods of time without danger to the apparatus. In other cases, a succession of short-time heavy overloads can be applied without injury, if followed by intervals of very light load, for the heat developed is integrated over a considerable period of time, and the temperature attained as a result of successive short overloads is the same temperature as would be obtained if the integrated loading had been applied continuously for that same length of time.

Induction Motor Conditions.

The squirrel cage induction motor is a typical example. Such a motor takes a rather heavy starting current, especially if it is of small size and is thrown directly on the line without starting compensators. Fuse protection is generally supplied, but in order to take care of the starting current the fuse capacity must be several times normal full-load running current. This condition results in the possibility of the motor being overloaded to a considerable extent without blowing the fuses, and, if the overload continues long enough, the motor may burn out. The fuses then only provide protection against an overload sufficiently great to stall the motor.

This condition should be protected against, and the thermal relays recently developed by the Westinghouse Electric & Manufacturing Company are applicable for this purpose.

The theory of protection demands that an instrument be provided which can be connected in electrical circuits, the instrument to have in itself small losses which are converted into heat, and the device should be so arranged that its temperature rises in proportion to the current flowing through the circuit, and also designed to embody a considerable heat capacity. The temperature in the relay will then follow approximately the temperature of the apparatus to be protected, and the relay can be adjusted so that it will open the circuit when a predetermined temperature is reached.

The relay may be arranged with or without a pointer to indicate its own temperature continuously, and, therefore, the temperature conditions of the protected apparatus, thus giving an idea of the amount of load which has been placed on the apparatus and the increase in load which may be safely applied.

In designing the thermal relay it was necessary to obtain a heat sensitive material which would have sufficient power to operate a

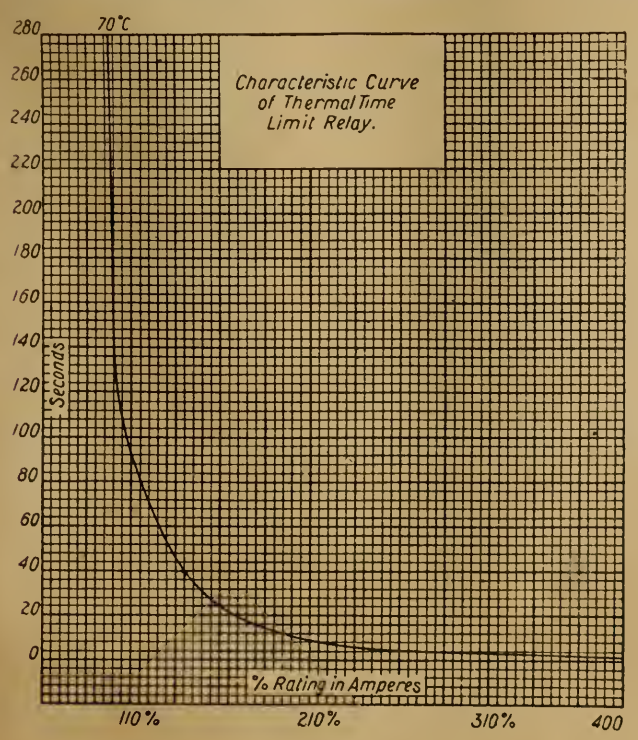

Fig. 1

contact and still accurately follow changes in temperature. A high grade of thermostatic metal was found satisfactory for this purpose. In order to obtain the greatest simplicity of design, this same material is used as the resistor or heat developing element, as well as the heat sensitive element.

Operating Mechanism.

The operating mechanism of relay consists of a number of sheets of thermostatic metal arranged in series or in parallel, and with varying resistance, according to the desired current-carrying capacity. A contact is attached to one of the elements, and is normally held with an initial tension against the stationary contact. At the proper temperature the bending tendency of the thermostatic metal takes up this initial tension and the contacts open, thus opening the holding coil of a small circuit breaker to open the main circuit.

Fig. 1 shows a characteristic relay curve. At room temperature the relay may be arranged to carry continuously in the neighbour-

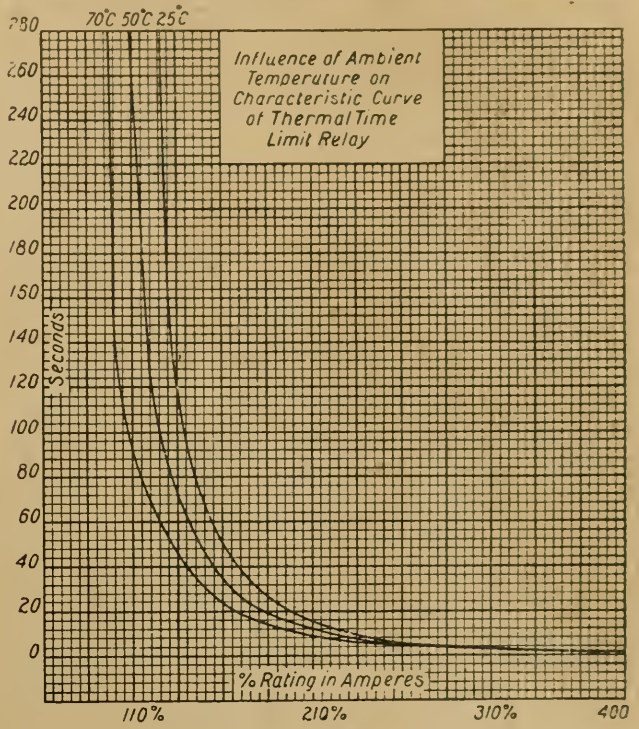

Fig. 2.

hood of 110 per cent. of its rated capacity. If the current exceeds this value, the relay will operate with a time element, as shown by the curve. Fig. 2 indicates the effect of change of external temperature, the various curves being marked to show the temperature at which the determinations were made. It will be noted that the change in external temperature only changes the capacity of the relay by a small value. The amount of this change depends on the operating temperature of the relay, the higher the operating temperature, the less influence.

This change, however, is in the proper direction to give protection to apparatus operating in conditions of elevated temperature. If the relay carries less than its rated current for a time, or after operating has not fully cooled to room temperature, and an overload occurs, the contacts will open in less time than indicated by the curve in Fig. 1, but since the cause of this condition has also elevated the temperature of the protected apparatus, the added measure of protection is in the right direction.

Metric System for Engineers.*

This book gives a full and practical explanation of the metric system of measurement in so far as it is met with in engineering calculation and measurements. It is intended to be of use to draughtsmen, mechanics and others who have to deal with calculation and measurement on the metric system, and we may say at once that it is clearly and carefully written and distinctly justifies its place in the series of "directly useful" books.

In dealing with length and area and volume measurement, attention is given to the measuring devices in use—micrometers and planimeters, for example—and calculations in connection with screw-cutting and gear wheels are treated at some length. Mass and weight, force, velocity and acceleration are treated, followed by the derived units of measurement, such as torque, work and power. The C.G.S. system of absolute units and the practical derivatives are carefully explained, and throughout the book worked examples are provided in plenty.

There are thirty-four excellent tables of equivalents, which sum up the deductions arrived at in the various chapters, and some conversion charts which may hang up in the office are supplied in the wallet at the back of the book.

Though the author surveys briefly the various arguments for and against the compulsory adoption of the metric system, he does so very honestly and does not use his book as a pulpit for propaganda work.

There are twenty-eight illustrations, and the general get-up of the book is excellent. J. P. Y.

*Metric System for Engineers. By C. R. Clapham, B.Sc. (London: Chapman & Hall.) Pp. xii. + 181. 12s. 6d. net.

Industry in Spain in 1921.

In his report on the INDUSTRIES AND COMMERCE OF SPAIN for the year to December, 1921, Capt. V. de B. Charles, Commercial Secretary to H.M. Embassy, Madrid, states that the year under review could hardly be described as encouraging to British exportere. High costs of production, high freights, and a high exchange rate too often proved an excessive handicap against the low production costs, low freights, and low rate of exchange of Germany, France, and Belgium. With a further obstacle to overcome in the form of an increased tariff, Great Britain had been engaged in an uphill struggle against heavy odds. Under these difficult conditions a welcome enterprise had been shown on the part of individual manufacturers by their efforts to meet the Spanish buyer halfway. This new spirit of flexibility was appreciated by the Spaniard, and would undoubtedly bear fruit when conditions improved. At equal prices British goods were still preferred owing to their reputation for quality. In fact, within reason they often found a market even at higher prices.

Imports.

An advance has been made in the import of British textile machinery, though Germany and France both gained a considerably larger share of the total trade than they had last year. Great Britain also supplied the greater part of the multi-tubular cylindrical steam generators, though here again the preponderance of British imports was not so pronounced as it was a year ago, Belgium and Germany having secured an increased share. In semi-fixed steam and gas engines Great Britain captured substantial orders from the United States of America, but was overtaken and left far behind by Germany. In fixed machines under 10 tons Great Britain just retained the lead. Cranes, another preponderantly British import, were bought in increasing quantities from France and the United states. In pumps Great Britain fell back from the first place to the third, behind the United States of America and Germany. Agricultural machinery also showed a marked falling off. This is an important market, which, it is suggested, it would well repay British manufacturers to study. Germany again prevented Great Britain from securing the lead in dynamos, motors and switchboards between 401 and 2 500 kgs. in weight, for which the demand was doubled. The British figures, nevertheless, showed an appreciable improvement. In telegraph and telephone apparatus British manufacturers gained more trade, which the United States of America lost, though Germany was more successful still. In cables, both electric and haulage, the same thing happened—Great Britain and Germany both sold increased quantities at the expense of the United States. In machine tools the loss to the United States and gain to Germany was repeated, but in this instance Great Britain also failed to maintain last year's trade. Motor-cars were practically a dead trade since the increase in the duties in November, 1920.

Transport.

The railway problem in Spain to-day is stated to be similar to that in other countries. Operating costs long ago reached the point where freight and passenger rates must be increased, or some other form of relief discovered if the companies are to continue to run without a heavy loss. Public opinion is against any increase in rates, and if this attitude is maintained it is said that State subvention or nationalisation would seem to be the only solution.

Under the new Cabinet a scheme for the reorganisation of the railways was introduced in October last, and a special committee was appointed to consider the question, but nothing has yet been settled. The central Catalan extension is being rapidly completed, and considerable progress has been made since last year. It is proposed to operate this line electrically on account of the heavy gradients.

The absorption of the Madrid Tramway Company by a Spanish Company has naturally resulted in demands for all tramway material being placed where possible with Spanish manufacturers, but owing to the enormous increase of cost the company were unable to supplement the entirely inadequate service unless they obtained permission from the Municipality to raise the rates on certain routes. This permission has been granted, the increased rates to take effect on each line as soon as extra cars can be put on that line. Where workmen's services are concerned, however, very small increases, if any, have been adopted. Further concessions extending the various services to outlying districts have been applied for, but owing to the shortage of material and electric power it is doubtful whether these will materialise for some time to come. In other towns in Spain and the Balearic Isles considerable extensions of tram services are reported, notably a line from Granada to La Zubia, which will put the villages to the south-west of the Sierra Nevada within easy reach of Granada. There should be openings, it is stated, for British material, especially motors, when prices come down and if more moderate customs duties are arrived at.

Hydro-Electric Works.

During the year under review hydro-electric development was principally confined to installations of small horse-power, although construction proceeded on a number of important installations in different parts of the country. The new power station erected by the Ebro Company at Camarassa, to the north-west of Barcelona, where the plant, which is one of the largest—if not the largest—in Spain is now in operation, giving 150 000 H.P. to the industry of Cataluña. The Hidroeléctrica Española, the second most important company in Spain, have nearly completed construction on their station at Dos Aguas, the junction of the rivers Jucar and Gabriel, to the south-west of Valencia. This station will give some 100 000 H.P. when completed, and will help to improve the inadequate power and light service of Madrid, where the demands have increased so enormously in the past few years that the existing stations are quite insufficient to meet the requirements. The problem in Madrid is very acute, and it appears within the bounds of possibility that a large steam power station will have to be erected to make Madrid independent of power stoppages due to an inadequate rainfall. The enormous potential horse-power of the Ebro and Duero rivers are still unharnessed, although it is said that the international difficulties have nearly been overcome and development is now not likely to be long delayed.

Luminous Signals for Power Stations.

The illustration below shows the latest luminous signal apparatus manufactured by SIEMENS BROTHERS & COMPANY. The increasing size of central power stations and the extensions to smaller stations which have been necessitated by the greater consumption of electricity for light and power, have rendered necessary the provision of means for enabling engineers in charge of switchboard attendants to signal orders to engine drivers both rapidly and efficiently. The Siemens luminous signalling apparatus fulfils this purpose, as it enables such orders to be transmitted with certainty. The apparatus acts in a positive and reliable manner by causing luminous signals to appear and, at the same time, calling attention by an aural signal.

The complete equipment comprises a transmitting apparatus, a receiving apparatus, and a Klaxon horn or other electric calling device. The transmitter—which can be supplied either in a pattern designed for attachment to a wall or suitably mounted on a column, as in the illustration—is enclosed in a cast-iron case having eight circular

TRANSMITTING AND RECEIVING APPARATUS.

windows, on which the orders sent appear by illumination. As shown in the illustration, the transmitter is actuated by means of a movable handle. The receiver consists of a sheet-iron case with a glass front, upon which the orders received also appear by illumination. A push button switch is provided at the side to enable the engine driver to acknowledge the signal. If desired, this switch can be installed at any convenient position apart from the receiver. An order sent by actuating the transmitter handle is immediately illuminated on the transmitter as well as the receiver, and the call will sound at the receiving end.

The luminous signal will remain visible both on the transmitter and on the receiver, and the aural signal will continue until the engine driver acknowledges the signal by operating the press button switch. As soon as this button is pressed the lamps are extinguished and the circuit to the aural signal is broken. This obliteration of the signal at the transmitting, as well as the receiving, end serves as an indication to the sender that the signal has been received.

The whole apparatus is of simple design, and is very strong, all parts being substantially constructed and of simple size.

AN ELECTRO-MAGNETIC SAFETY CATCH for railway carriage doors has been invented by Messrs. A. Crankshaw and T. Markland, of Wigan, who have obtained protection rights. By this device immediately the guard of a train closes the door of his van every carriage door on the train is automatically locked, and cannot be opened until the guard's door is unfastened. This patent can also be used by householders in conjunction with a bell-push.

Italy in 1921.

The same uphill struggle to bring INDUSTRIAL CONDITIONS in Italy back to the normal is reported by H.M. Commercial Secretary at Rome (Mr. J. H. Henderson) in his annual review on the commercial, industrial, and economic situation, as by the Commercial Secretaries of other countries. The Budget deficiency, the adverse balance of trade, taxation and labour disputes were among the chief factors which had to be dealt with. Though not rosy, the outlook for 1922 is said to be brighter.

British Trade with Italy.

The aspect of the Italian market at the end of 1921, from the point of view of British trade, was stated to be distinctly unfavourable. One merchant put it that "most British business for many months past has consisted in collecting old debts, or trying to collect them, with as little sacrifice as possible, rather than resort to lengthy law suits." Another estimated that the stock which he used to sell in one year would now, at the present rate of demand, take over five years to dispose of. With some exceptions, of which the most notable are textile machinery, tinplate machinery, machinery accessories such as belting, and English cloth, there was practically no demand for most of the British products which previously had a sale in the country. In the case of coal, England's principal export to Italy, there was recently a slight revival.

In some cases this state of trade is attributed to the high prices asked for British goods, prices which, it is stated, would limit the demand even if there were no question of exchange. The failure of British exporters to study the conditions of the market is also given as one of the reasons why British trade is not more flourishing. In the opinion, however, of local observers, by far the most important factor is that of exchange. It is becoming common to agree in the contract on a maximum rate of exchange, giving the buyer the faculty of paying either at this rate or at such lower market rate as may be current when payment is due. To the extent to which the conditions of business permit, this method is strongly recommended to the attention of British exporters, since it is a very popular one with the Italian buyer and is a strong inducement to him to do business.

Foreign Competition.

England's principal competitors at present in the Italian market are Germany and America, and of these the former is by far the more formidable on account of the advantage she possesses in depreciated currency. During the first half of 1921 the volume of trade between Italy and Germany was practically the same as between Italy and France. Germany thus took the third place along with France among the countries with whom Italy trades, as compared with sixth place in the corresponding period of the previous year. Moreover, the volume of German trade was three-quarters that of Great Britain, as compared with one quarter in 1920.

Railway Electrification.

The position of railway electrification at the end of last year is summarised as follows :—

1. *Lines which are working at present, in all about* 650 *kilometres.*—Turin-Trofarello-Chieri (completed in 1921); Turin-Pinerolo-Torrepelice and Brichevasio-Barge (completed in 1921); Turin-Susa (completed at the end of 1920); Turin-Modane and Bussoleno-Susa; Genoa-Busalla-Ronco; Genoa-Mignanego-Ronco; Genoa-Savona-Geva; Milan-Varese-Porto Ceresio; Monza-Calolzio-Soncino-Colico.

2. *Lines which are now being electrified.*—Ronco-Alessandria-Asti-Trofarello, to be finished in 1922; Novi-Tortona-Voghera; Ronco-Arguata-Tortona—(direct line)—Alessandria-Tortona; Genoa-Spezia-Pisa-Leghorn; Firenze-Pistoia-Bologna; Firenze-Faenza-Bologna.

Good progress was made during the year on these lines, and lately especially so on the Bologna-Pistoia-Florence and the Bologna-Faenza-Florence lines, and also as regards the construction of the material required for electrification generally.

3. *Lines which will be electrified in the near future.*—(*a*) Directed by the administration of the State railways :—(Direct line) Rome-Naples; Parma-Spezia-Fornovo-Borgo S. Donnio; S. Stefano-Sarzana; Piacenza-Voghera; Stradella-Bressana; Genoa-Ovada-Alessandria; Voghera-Milan-Chiasso; Uasmate-Bergamo-Bugamo-Ponte S. Pictio-Colobio; Bologna-Verona-Trento-Brennero; Triante-Opcina-Postuma; Trieste-Monfalcone-Gorizia. (*b*) By private enterprise :—Milan-Piacenza-Mestre-Venice; Mestre-Portoguaro-Monfalcone; Viareggio-Lucca-Pistoia; Pisa-Lucca-Castelnuovo-Garafagnana; Pisa-Empoli-Florence

4. *Experimental lines.*—Rome-Tivoli; Rome-Anzio-Nettuno; Benevento-Fozzile; Cagliasi-Monte Poni-Oristano.

When all these lines have been completed, the following lines, which are included in the general programme, will be electrified :—Turin-Milan-Verona-Vicenza-Padua; Savona-Ventimiglia; Florence-Chiusi-Rome; Orte-Foligno-Ancona; Faenza-Ancona-Castellammare Adriatico; Tivoli-Salmona-Castellammare Adriatico; Naples-Battipaglia-Paola-Reggio Calabria; Paola-Coscenza; Salerno Macato-S. Severino-Benevento; Torre Annunziata-Castellammare di Italia-Gragnano.

Hydro-Electric Power Stations.

The progress made during 1920-21 on the hydro-electric power stations for use in connection with these lines was as follows :—The Melezet was completed. The work on the Bardonecchia station, which uses the water power of the Rochesmolles, was brought to an advanced stage. A start was made on the central station of Saviana and Costrolo on the Reno and Linrentra near Bagni della Poretta, and also on the station on the Sagittario near Anversa Scanno.

Water Power.

In 1915 there were 329 establishments of over 300 H.P., which developed a total force of 935 000 H.P. In 1920 there were 383 similar establishments developing 1 152 120 H.P., and 54 (359 210 H.P.) were under construction. There were also 300 establishments of under 300 H.P., representing a total force of 300 000 H.P. In addition to these there are several large schemes in hand which will not be completed for some time. These include the artificial lakes in the valleys of the Reno and the Imentra, in the Bologna district, which will be used in connection with the electrification of the trans-Appenine railway between Emilia and Tuscany; similar work in the Abruzzi; the Silani lakes in Calabria, and the Tirso lakes in Sardinia. These schemes are calculated to produce 700 000 H.P. The artificial lake at Tirso, it is stated, will have a capacity of 416 million cubic metres, and will be the largest in Europe and the third largest in the world.

New Electricity Companies.

The principal companies founded during the first half of 1921 included E. Breda (Milan), with a capital of 60 000 000 lire; Euganea di Elettricita di Venezia, and Elettricita del Veneto Centrale (Padua), each with a capital of 10 000 000 lire.

Telegraphs.

Almost every commune with a population of over a thousand has a telegraphic service. The Government are proposing to lay cables connecting Rome with Messina, Catania, and Syracuse, and also between Ravenna and Trieste, and between Genoa and Nice, which it is hoped will be completed by the summer. In 1918-19 Italy possessed 3 981 kilometres of cable, in 1920-21 4 904 kilometres, and in 1921-22 there will be more than 6 000 kilometres. Telegraphic communication between Italy and abroad is in the hands of foreign companies. This is considered to be a danger to Italian political and economic independence. It is expected that this will in part be remedied by the laying of Italian national cables to South America and to Greece. Powers to undertake this work were conferred on the Government by a decree dated Aug. 20, and the schemes are under active consideration. For the construction of the South American cable a company is being formed with a capital of from 75 to 80 million lire gold, subscribed principally by Italian residents in Brazil, Argentine, Uruguay, Chili, and Peru. The cable will be 13 000 kilometres long, and it is hoped that it will be completed in three years.

Wireless.

Italy possesses a regular wireless service with her colonies and with ships, and in 1920-21 three million words were transmitted or received. It is the intention of the Government to develop and extend this service to foreign countries.

Telephones.

The question of telephones is stated to be urgent on account of the insufficiency of the service. The total number of town subscribers is 120 000; public call offices, 3 000; trunk lines, 40 000 km.; and trunk calls less than 10 000 000 a year, almost all of which are accounted for by the public authorities and the Press. The unsatisfactory condition of the Italian telephone service is the subject of constant complaint. It used to be attributed to the incapacity of the private companies, but to-day two-thirds of the telephones are operated by the State, and still more than half of the communes in Italy are without telephonic communications.

The Government have been authorised to expend 150 million lire on telegraphs and telephones, the expenditure to be spread over four years. The immediate programme as regards telephones is :—(1) The completion of the automatic exchanges in the principal towns; (2) the laying of new lines to carry the increased traffic; (3) the connection of 409 important towns with the trunk lines; (4) the re-establishment of direct telephone communication with the principal cities in Central Europe; (5) the improvement of audibility between the extremities of Italy; (6) the completion of the laying of trunk line cables between Milan, Genoa and Turin; (7) the erection of wireless stations.

The expenditure on the telephone service in 1920-21, without making allowance for depreciation and interest on capital, was 74 million lire, against a return of 68 million.

Presentation to Mr. J. D. Morgan.

At the annual meeting of the South Midland Centre of the Institution of Electrical Engineers, Mr. R. A. Chattock (chairman of the Centre) presented to the hon. secretary, Mr. J. D. MORGAN, on behalf of the members, a silver coffee pot and milk jug of the Georgian period, as a mark of their appreciation of his services, and of the esteem in which they held him as a fellow-member of the Centre. Mr. Chattock stated that Mr. Morgan took up his duties as hon. secretary just over ten years ago. During his period of office the membership of the Centre had increased from 450 to 795. In addition, a sub-centre at Loughborough had been formed, and also the Local Student's Section, which was proving very valuable to the younger members of the profession. Mr. Morgan was now devoting himself to some very special scientific research work, and it was on this account (and so that he might devote himself wholeheartedly to it) that he found it necessary to relinquish the honorary position which he had held for so long.

Parliamentary Intelligence.

Grampians Electricity Bill.

The Select Committee of the House of Commons which has been considering this Bill passed the preamble, with certain reservations, on the 4th inst., and the clauses were settled on Tuesday.

Engineering Details.

Mr. Basil Mott, consulting engineer, said that Loch Ericht was so situated in relation to other lochs and streams of the scheme that it could be utilised as a good reservoir for impounding water. The River Tay had not only the largest drainage area in Scotland, but its head waters were so placed as to render its development for hydro-electric power eminently suitable. The water could be used five or six times over at the various falls. Altogether 417 square miles were laid under contribution by the whole scheme. Loch Ericht could be reservoired without inundating any land of much agricultural value. By damming each end of Loch Ericht the storage capacity of the loch would be 80 000 000 000 gallons. When completed the Loch Garry reservoir would have a storage capacity of 410 000 000 and Loch Rannoch 1 600 000 000 cubic feet. The latter would be useful as an adjunct, because it would enable the storage of flood water which came down in wet seasons. In time of spate the double power-house below Rannoch would be used, and that at Ericht would be closed down.

Mr. J. Hall Rider, consulting engineer, said that by supplying 118 000 000 units of electricity he estimated they would save 160 000 tons of coal per annum on the first part of the scheme, while on the whole scheme they would save 436 000 tons per annum. The overhead transmission system would be about 165 miles, but in the first stage it was not proposed to go further than 10 or 15 miles south of Perth. In the first instance, it was only proposed to reach Perth and Dundee. The total expenditure for the first section would be £2 603 000, and for the whole scheme £4 500 000. On the completion of the first stage, if they assumed a sale of 170 000 000 units per annum, the cost per unit would be 0·3 996d.; but the price charged to the consumers would be higher, because of other charges to be taken into account. At Dundee the cost of production in May, 1920 (exclusive of capital charges), was 1·14d. per unit, and at Perth the working costs were 1·83d. per unit in 1921. Excluding Edinburgh and Glasgow, which were special cases, the cost of production under the Grampian scheme would be lower than any of the existing steam stations after capital costs were included.

Sir Henry Babington Smith said that Mr. Pease, deputy chairman of Lloyd's Bank, and the Duke of Atholl were to be added to the list of first shareholders, the latter being desirous of being associated with a movement that would develop the Highlands. The Credits Facilities Committee would be prepared to recommend a guarantee on debentures, provided the scheme satisfied the Electricity Commissioners and the Bill was passed by Parliament. The guarantee would be of considerable advantage, but they would have to raise their £1 000 000 capital before they could get the guarantee.

In reply to the Chairman, Sir H. Babington Smith said negotiations were in progress with financial houses, and, in his opinion, the Ericht scheme, which was the larger one, would be the best to carry out first.

Mr. Alex. Newlands, chief engineer to the Highland Railway Company, said he had no authority from his directors to speak as to their intentions with regard to electrification, but he had gone into the question from the point of view of figures only. For the railway from Perth to Inverness (118 miles) the estimated demand, calculated upon summer traffic for 1920, would be 4 500 h.p. on an average, the peak demand being 13 000 h.p. He was unable to say whether it would be economical or not to electrify the railway without full details of the present costs. Apart from the question of costs, electrification would enable the company to run heavier trains and at a higher rate of speed. The Highland system was largely single lines, and at the moment the maximum carrying capacity had been reached. If more business was to be dealt with the question of doubling part of the line at least would have to be considered.

Committee's Findings.

Major Ormsby Gore said that in view of the fact that all opposition had been withdrawn, the Committee were willing to pass the preamble, provided certain alterations were made in Clauses 8 and 9 of the Bill. They could not depart from the usual practice that statutory companies in which the capital was limited by statute should be enabled to get further capital without recourse to Parliament, and they thought that the capital should be provided collectively by share capital and borrowing powers to meet the estimated cost of the first stage of the scheme. The Committee were impressed by the evidence that the two power stations on the Ericht and the Tummel were to be the main sources of power and that they should be proceeded with as a whole. The scheme was more likely to be a success, and to attract customers if the whole of that first stage was definitely authorised and proceeded with. The cost of that first stage was given as £2 600 000. The Committee felt, therefore, that the authorised share capital, together with the borrowing powers, should meet that amount at least. If it had not been for the letter of the Trade Facilities Act Advisory Committee, the Committee could not have seen their way to authorise the issue of debenture stock to an amount exceeding one-half of the ordinary share capital. The Committee were prepared to accept, in view of all the circumstances, a suggested amendment to Clause 9, with the additional proviso that the company should not be able to raise by debentures or mortgages, even with the consent of the Electricity Commissioners, an amount more than the equivalent of the ordinary paid-up capital. That was to say, the Committee gave the company powers to borrow without the consent of the Electricity Commissioners half the amount of the ordinary share capital, and a further half with the consent of the Electricity Commissioners.

The Bill was reported to the House on Tuesday.

Post Office Estimates.

In explaining the Post Office estimates in the House of Commons on Thursday last, Mr. F. G. Kellaway, Postmaster-General, said that in 1920-21 the deficit on the Post Office commercial account was £7 300 000, but in 1922-23 he estimated on present charges a surplus of £9 300 000. But for last year's increases in postal charges the deficit, instead of being £1 800 000, would have been £5 000 000. The improved position was entirely due to the drastic reductions of expenditure, amounting to £10 650 000. Last year the staff was 191 000; to-day it stood at 185 000

The collection of letters on Sundays would be restored on May 28, but he did not propose to reinstitute the delivery of letters on Sunday. The charge for inland letters not weighing more than 1 oz would be reduced from 2d. to 1½d., the rate for letters over 1 oz. remaining as at present. On letters to the United States and all parts of the Empire the rate would be reduced from 2d. to 1½d. for those not over 1 oz., but for those over 1 oz. the present charge would remain. These concessions would cost £3 800 000 and £150 000 respectively for a full year. The postcard rate would be reduced from 1½d. to 1d., costing £600 000. The printed paper rate would go down from 1d. to ½d., costing £1 640 000, but he stipulated that printed papers, unless posted by 3.30 p.m. in London, would not be entitled to be dealt with that day.

Telephone Tariff Changes.

During the past year the number of telephone stations had increased by 16 691, and on March 31 was 995 242. The total number of new subscribers was 75 500, and the number of cessations was 64 000, of which 29 000 were due to the increased tariff. During the year 530 rural call offices had been opened at post offices, and 3 290 had been opened on rural party lines. In submitting proposals for the reduction of charges, he did not propose to proceed on the principle recommended by the Select Committee of an all-round percentage reduction. He would make a reduction of telephone rental to private users of £1 10s. a year, making the rental in London £7, in Birmingham, Liverpool, Glasgow and Manchester £6 10s., and in the rest of the country £6. The cost of the concession would be £200 000 in a full year and £160 000 this year. There would be a reduction of the local message fee from 1½d. to 1¼d., which would cost £440 000 in a year and £350 000 this year. He estimated there would be an increase of 5 per cent. in the number of calls. He also proposed to lower the extra mileage charge on private wires and at terminals from £10 to £8, at a cost of £120 000 this year. The principal proposal in regard to trunk calls was that there should be a substantially cheaper rate for calls between 2 p.m. and 7 p.m. The average reduction of the rate would be 25 per cent. He proposed to abolish the local fee on all trunk calls over 1s. 6d. in amount, and to make modifications below that charge. The present charges for telephone facilities in country districts were undoubtedly almost prohibitive, and amounted in many cases to a rental exceeding £20. That was due to the heavy capital cost in connection with most rural extensions. He proposed that where not less than eight subscribers could be got, the installation rental should be £8 per subscriber, and the local and trunk fees according to the ordinary tariff. The cost of a night service, if required, could be met by additional charges. He did not propose in future to require any guarantee for a junction line unless the capital cost exceeded £1 000. Where fifteen or more subscribers were obtained, the service would be provided at £7 10s. for business houses or £6 for residential lines within a mile radius. He was unable to adopt the recommendation of the Select Committee on Telephones that the telegraphs and telephones should be united, as it would be extremely expensive.

Wireless "Broadcasting."

Referring to the question of the broadcasting of wireless messages, or radio-telephone broadcasting, Mr. Kellaway said that the system had a great vogue in the United States, where there had also been a considerable increase in the number of transmitting stations, and the result of that increase had been chaos. He hoped we should be able to learn from the experience of the United States, and that we would have a reasonable service without causing interference either with the commercial use or the Government use of the wireless or with the facilities open to each other. He would allow a limited number of radio-telephone broadcasting stations. The country would be divided, roughly, into areas centring upon London, Cardiff, Plymouth, Birmingham, Manchester, Newcastle, Glasgow or Edinburgh (but not both), and Aberdeen, and one or more broadcasting stations would be allowed in each of those areas. Permission for those stations would only be granted to British firms who were *bona-fide* manufacturers of wireless apparatus. It was impossible for him to grant all the applications for the right of transmission, but he would ask the various firms who had applied to come together at the Post Office and co-operate, so that an efficient service might be rendered, that there might be no danger of monopoly, and that each service should not be interfering with the efficient working of the other. The stations would be limited to a power of 1½ kW, and furnished with wave lengths which should not interfere with other services. The normal hours for broadcasting would be

from 5 p.m. to 11 p.m., except on Sundays, when there would be no limit. There would be certain regulations in regard to the character and class of news which these agencies could transmit.

West Indies (Cables).

In reply to Mr. GIDEON MURRAY (House of Commons, May 4), who asked the Secretary of State for the Colonies what progress had been made in connection with making provision for an efficient telegraph service from Great Britain to, and between, the various British West Indian Colonies upon the termination of the present agreement with the West Indian and Panama Telegraph Company, Mr. WOOD said that negotiations were still in progress for the construction of a new cable from Bermuda to Barbados and beyond, but he was not in a position to make any statement on the subject at present.

Great Eastern Railway (Elcctrification).

Replying to Mr. MALONE in the House of Commons last week, Mr. NEAL said he was aware of the congestion on certain routes of the Great Eastern Railway, and he had been in consultation with the company and had informed them that the Trade Facilities Committee were prepared to consider an application from them for assistance in raising capital for electrification work, but he understood that they did not propose to make such an application.

Coal Mines (Safcty Appliances).

In reply to Mr. CHARLES EDWARDS (House of Commons, May 1), Mr. BRIDGEMAN stated that it was impossible for the Government to test the numerous patent safety appliances, as the only real test of the efficiency of such appliances lay in experience of their behaviour over an extended period under actual working conditions.

Dartford Light Railways Order.

The Minister of Transport has confirmed the DARTFORD LIGHT RAILWAYS (AMENDMENT) ORDER, 1922, authorising additional borrowing powers for the purposes of the light railways authorised by the Orders of 1902 and 1903, and has issued an Order authorising the construction of light railways in the borough of Plymouth.

Legal Intelligence.

Tramway Arbitration Appeal.

Last week a Divisional Court (Lush and Greer, JJ.) heard a motion by West Bromwich Corporation to set aside an award by Sir Lynden Macassey in an arbitration between the South Staffordshire Tramways (Lessee) Company and the Corporation.

Mr. DISTURNAL, K.C. (for the Corporation) said that the arbitrator had made a series of declarations after his award, and it was contended he had no jurisdiction to do so. The matter arose out of a lease granted by the Corporation to the company of the tramways within their area. The Corporation undertook to keep in repair the tramways and the roads between the tracks and 2 ft. on either side of the rails. There was a covenant under which the lessees (the company) agreed to contribute to the net cost, plus a percentage for overhead charges, of the renewals. They undertook to pay that sum annually to the Corporation for the net cost of the track renewals as distinguished from the track and the adjoining pieces of the road. There were agreements entered into from time to time varying that stipulation in the lease. Ultimately there was an agreement in 1917 under which the Corporation were to keep the tramway in the condition it had been during the war and the company should contribute £1 500. The arbitration arose in connection with the question, whether or not the Corporation had perfomed their obligation in keeping the tramways in repair in accordance with the agreement.

The company sent in particulars of damage they said they had sustained, but the arbitrator found that they were not entitled to any of the damage claimed, and gave them 40s. nominal damages for what he held were breaches of covenant as against the Corporation, and the 40s. had been tendered to the company in the course of the proceedings. The arbitrator then made a series of declarations for which one could not see the necessity. He made a declaration that the Corporation had broken their covenants, and he found the damages were represented by £2, and he also made a declaration in respect of all matters which another arbitrator must take into consideration in considering what further sums the company should pay by way of contribution to the Corporation in respect of repairs to the line. In the document which varied the lease there were certain fixed periods and an arbitration clause under which an arbitrator could be appointed, in default of agreement to say, notwithstanding the terms of the lease, what should be paid as the annual contribution to the Corporation for repairs, but he had made a declaration which would bind any other arbitrator.

Mr. TYLDESLEY JONES, K.C., having argued in favour of the award,

Mr. JUSTICE LUSH said the only question was whether on the pleadings the parties consented to enlarge the dispute, but he did not think they did. It would be better to remit the matter to the arbitrator to expunge from the award so much of it as related to declarations of the future. He was not surprised that the arbitrator was in doubt as to what issues were raised on the pleadings or what disputes were referred to him.

Mr. JUSTICE GREER agreed, and the award was accordingly remitted.

The "Telur" Stop Clock.

The "Telur" stop clock for controlling the length of telephone conversations on trunk calls has recently been produced by JAMES MCMILLAN & COMPANY. The dial is divided into twelve minutes. The clock is started by pressing the handle to the left, and a bell rings at three-minute intervals, or any other period which may be

THE "TELUR" STOP CLOCK.

specially required. It is stopped by pressing the handle to the right, and it can be restarted from this position by pulling out the handle from the right-hand position. To start the clock from zero the handle is pressed over to the left.

The illustration shows the clock as supplied for giving alarm by bell, but the manufacturers also supply it fitted with terminals for lighting a signal lamp at the periods required.

Induction Motor for U.S. Super-Dreadnoughts

At the East Pittsburgh works of the WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY a number of motors are being built to propel electrically the super-dreadnoughts included in the Naval programme adopted by the Limitation of Armaments Conference. Four motors are required to propel one battleship, one motor being directly coupled to each of the four shafts.

The motors are each rated at 16 500 H.P., at 227 revs. per min., and are designed for the most economical operation at two ship speeds—the battle speed of 23 knots and the cruising speed of 15 knots. This result is obtained by the use of two entirely separate stator and rotor windings in the motor. At the battle speed, one set of windings is used, and, at the cruising speed, the other set is operative. Sixty thousand cubic feet of air per minute is required to conduct away the heat losses developed in operation. This amount of ventilation air for a period of fifty minutes is equal to the weight of the motor.

Marble Firm's New Premises.

In a few weeks' time PERCY C. WEBB, LTD., marble merchants, will move to their new premises at the Marble Wharf, Verney-road, Old Kent-road, on the Surrey Canal. The wharf covers an area of nearly an acre, with a frontage of about 80 ft. to the Surrey Canal. It has a substantial building, about 161 ft. long by 62 ft. wide. This was burnt down some few months ago, and is now being reinstated. The plant from the present premises, both at Dalston and the Docks, will be moved, and, further saws, polishing machines, and cranes installed. The welfare of the staff has not be overlooked: a large mess-room is to be provided for the workmen, while a rest-room and library is allocated for the use of the office staff. When all is completed, the firm will have one of the finest marble yards in London, if not in England.

The late Mr. SAMUEL RICHARDSON BLUNDSTONE, consulting engineer, for many years editor of the "Railway Engineer," lately chairman of the Wolverhampton District Electric Tramways, Ltd., and the Dudley, Stourbridge, and District Electric Traction Company, Ltd., a member of the council of the British Electrical Federation, Ltd., a director of the Birmingham District Power and Traction Company, Ltd., of the South Staffordshire Tramways Company, and the South Staffordshire Tramways (Lessee) Company, Ltd., who died on Feb. 12 last, has left estate of the gross value of £19 334, with net personalty £18 955.

Electricity Supply.

RAWTENSTALL Electricity Department made a surplus of nearly £2 000 last year.

A profit of £4 098 has been made by DARWEN Electricity Department during the past year. Last year the profit was £3 111.

The net profit of the ROCHDALE Electricity Department for the past year is £22 649. Of this £15 649 is being placed to reserve and £7 000 is set aside for the relief of the rates.

A public inquiry is to be held at the end of this month by the Electricity Commissioners into an application by the SOUTH-EASTERN AND CHATHAM RAILWAY COMPANIES to erect a generating station on the company's land known as Angerstein's Wharf, Charlton, Kent.

The British Insulated & Helsby Cable Company have applied to HUYTON-WITH-ROBY Urban Council for permission to : (1) change the declared pressure of supply at consumers' terminals from 100 V to 115 V, or, alternatively in special cases, to 230 V; (2) change their systesm of supply from single-phase at 100 frequency to single-phase at 50 frequency.

The feeder line from Hereford to Lydbrook, in the FOREST OF DEAN, has been completed, and the Hereford Electricity Committee are now supplying electricity in bulk to several industrial undertakings. It is anticipated that within the next twelve months the revenue from the Lydbrook line will be sufficient to justify the formation of a rural electricity scheme, by which the villages along the route will be able to be supplied with electricity.

The new generating sets which have been installed at the Montague-street SALVAGE DEPOT, BIRMINGHAM, in connection with the refuse destructor, were set in motion last week by the Lord Mayor (Ald. David Davis). The generating plant has been installed at a cost of £9 000, to utilise the steam raised by the burning of house refuse in the destructor which would otherwise go to waste. The current generated is sufficient to run the whole of the plant, for lighting the depot, and for charging the accumulators of the electrical vehicles used by the department.

New Schemes and Mains Extensions.

DONCASTER Town Council has applied for a loan of £32 522, for mains extensions, sub-stations, transformers, switchgear, services, and meters.

ORMSKIRK Council has appointed Mr. J. Scott to prepare an electricity scheme (in conjunction with the Liverpool Corporation) to submit to the Electricity Commissioners.

DOVER Town Council has applied for a loan of £600 for a superheater, and £1 200 for underfeed stokers, required at the Electricity Works, in order that Kent coal may be burnt exclusively.

SAFFRON WALDEN Town Council have appointed a committee to consider the expediency of establishing municipal electricity works. There are at present thirteen private plants in the town, and it is suggested that there would be a good general demand if the Council undertook the supply.

Electric Traction.

The accounts of DARWEN tramways for the past year show a loss of £201.

OLDHAM Corporation Tramways Department made a profit of £18 000 during the past financial year.

The accounts of RAWTENSTALL (Lancashire) Tramways Department for the past year show a surplus of over £4 000.

EDINBURGH Town Council have approved the draft of a Provisional Order to authorise certain tramway extensions, &c.

The accounts of ACCRINGTON (Lancashire) Tramways Department for the financial year just ended show a profit of £4 484.

The Ministry of Transport has rejected the application of the HULL Corporation for a Light Railway Order extending the tramways to Hessle, a scheme which was estimated to cost nearly £70 000.

The BURY (Lancashire) Corporation's tramway services have involved heavy losses during the past financial year. On the Bury service the deficit is £12 460, and on the Radcliffe section it is £2 856.

An expert report on the future of the CROYDON MUNICIPAL TRAMWAYS advises the leasing of the undertaking either to the L.C.C. or the South Metropolitan Electric Tramways Company, or both combined.

BURNLEY Town Council are applying for sanction to borrow £49 950, less £9 450 sinking fund contributions, for the relaying of tram tracks to the extent of over 9 000 yards on Padiham-road, Manchester, and Rosegrove routes.

WEST BROMWICH Town Council have decided to reconstruct the tram track from Carter's-green to the Birmingham boundary at a cost of £81 000, and to renew parts of the track from Carter's-green to Wednesbury and Tipton at £17 000.

THE LONDON ELECTRIC RAILWAY COMPANY AND THE CITY AND SOUTH LONDON RAILWAY COMPANY give notice of an application to Parliament for powers to raise additional capital by borrowing and creating second debenture stock, for extension of time for construction of works, and others matters.

Personal and Appointments.

LORD DERBY has accepted the presidency of the B.E.A.M.A. in succession to Lord Ampthill.

Mr. B. HUDSON, of Aldershot, has been appointed shift engineer at the Southport Electricity Works.

Prior to taking up his post as street lighting inspector under the Cardiff City Council, Mr. FRANK MARSH, for nine years foreman at Curran's Engineering & Foundry Company, Cardiff Docks, has been presented by the directors and employees with a gold watch.

Swindon Town Council has reduced, as from March 31 last, the salary of the electrical engineer, Mr. A. NICKLIN, from £500 to £425 a year, and that of the tramways manager, Mr. T. MEDCALF, from £520 to £494. Mr. Nicklin, who is suffering from a nervous breakdown, has been granted a month's leave of absence.

HACKNEY Establishment and General Purposes Committee recommend that the 10 per cent. addition for the increase in the cost of living included in the scale of salary payable to Mr. L. L. ROBINSON, borough electrical engineer, adopted by the Council on March 10, 1920, be discontinued, and that in future the salary of Mr. J. R. BOWDEN, deputy electrical engineer, be subject to a quarterly adjustment of 2 per cent. for each 15 points variation in the cost of living index figure as laid down in the schedule.

Mr. H. H. LANCASTER, Executive Officer of Blackpool Corporation Tramways, has been chosen out of fifty-eight applicants to succeed Mr. C. I. Baker as traffic manager. The position carries a salary of £400 with bonus, which must not make more than £500. Mr. Lancaster is a native of Blackpool, and entered the service of the Tramways Department in 1902. His father, the late Mr. James Lancaster, was at that time the general manager. After seven years Mr. Lancaster accepted the position of traffic assistant manager to the West Ham Corporation under Mr. H. E. Blain, where he acquired a wide experience of traffic arrangements. He returned to Blackpool to take up the position of executive officer in 1910.

Mr. HENRY JACKSON has resigned his position with the London & North Western Railway Company, having reached the age limit. Mr. Jackson was telegraph superintendent and electrical engineer to the Lancashire & Yorkshire Railway Company for 32½ years, and was transferred to the North Western Company when the amalgamation took place. He commenced his career with Tyer & Company in 1877, and in 1884 was appointed electrical engineer to the Furness Railway Company, and in these early days, in addition to railway telegraph work, had experience in electrical lighting of docks, petroleum storage, and ship lighting. In 1889 he was appointed to the position on the Lancashire & Yorkshire Railway which he has just resigned. He was chairman of the Railway Telegraph Superintendents' Conference in 1899, and again in 1915, for the duration of the War.

Catalogues, Price Lists, &c.

The L.F.A. (LONDON FACTORS & AGENTS, LTD.) have issued their May price-list of electrical accessories.

A new abridged net price-list (No. 95) of electrical accessories has just been issued by ELECTRICAL COMPONENTS, LTD.

ERSKINE, HEAP & COMPANY have just issued three new illustrated publications (pamphlets S.D. 1, A.T. 1, and R.S. 1), dealing respectively with their oil-immersed Star Delta, Auto-Transformer, and Rotor starters.

The "Stannos" concentric system of main distribution, which is being adopted in many of the housing schemes now in progress, and which is well known to readers of THE ELECTRICIAN, is the subject of Pamphlet 130 F recently issued by SIEMENS BROTHERS & COMPANY.

We have received from TROST BROTHERS a pamphlet describing the "Rotameter," an instrument for measuring and regulating the rate of flow of gases and liquids in distillation, absorption, reaction, mixing, &c.; measuring the consumption of air in compressed-air tools, of gas in stoves, engines, &c., petrol and fuel-oil consumption in internal-combustion engines; correct proportioning of gas mixture in oxy-acetylene welding, in mixed gas narcosis; as maximum demand meters, &c. For laboratory and research work instruments can be supplied to give accurate readings down to one hundredth of a cubic ft. per hour, and for industrial uses up to 100 000 cubic ft. per hour. The scale can be graduated to read in cubic ft., gallons, litres, lbs., &c., per hour or per minute. Pressures up to 120 lbs. per sq. in. and temperatures up to 220 deg. C. can be dealt with.

At Warrington last week, Mr. J. H. Brooking, general manager of the St. Helen's Cable & Rubber Company, was fined £5 and ordered to contribute two guineas towards the expenses of the R.S.P.C.A. on a charge of STARVING A CAPTIVE RAT. In order to test complaints that rats gnawed particular kinds of rubber insulation for cables, the rat had been caught and put in a cage, with three pieces of cable smeared with oil of linseed. It was given water once a day, and once a small piece of bread, which it ate ravenously. The animal lived under these conditions from Sunday to Thursday, when it died. Defendant advertised the result of the experiment, and the society were inundated with protests. Although a rat was only vermin, defendant became liable for ill-treating it in captivity. Mr. Steele, for the defence, admitted a technical offence in the interests of science.

Business Items, &c.

Mr. J. W. Russell, electrical engineer, of 49a, Fore-street, Hertford, and Watford, has opened a branch business at Ware.

The British Thomson-Houston Company have transferred their Swansea office to larger premises at Madza House, 7, Melbourne-place.

John Marsden & Sons, electrical engineers, of Huddersfield, have removed their business from Aspinall's-yard, Market-place, to 1, Upperhead-row.

The Hart Accumulator Company, Ltd., Stratford, London, has just opened a branch office at 6, Bridge-street, York, under the management of Mr. R. H. Rawlinson. A depot for the repair of storage batteries is also being prepared at the same address.

Mr. E. S. Spencer, of 80, Deodar-road, Putney, S.W. 15, informs us that he has resigned the managing directorship of the Aqua Electric Company, Ltd. He holds several inventions relating to water heaters, and would like to get into touch with any concerns interested.

Royce, Ltd., have just received an order from Kerr, Stuart & Company, of California Works, Stoke-on-Trent, for four Royce standard three-motor overhead electric travelling cranes, each of 40 tons capacity, and fitted with a 10-ton auxiliary lifting barrel, for export to India.

Mr. Richard Fitzhenry, formerly with the English Electric Company, Siemen's Works, Stafford, has been appointed commercial and technical representative for Callender's Cable & Construction Company, for cable joint boxes and junction boxes, and all cable accessories in the London district.

Johnson & Phillips, Ltd., of Charlton, London, S.E., whose Australian branch office is in Sydney, N.S.W., would be glad to hear from other British manufacturers desirous of Australian representation, whose products could be sold in conjunction with their own to mutual advantage. Their Australian manager is at present in London, and interviews could be arranged with interested applicants, by appointment.

We are informed that the Lassen Meter & Engineering Company, Ltd., has been acquired by James Gordon & Company, Ltd., of Windsor House, Kingsway, W.C. 2. Mr. J. J. Lassen has accepted the position of joint managing director, and will personally conduct the section of the business dealing with boiler efficiency appliances and instruments. The latter company also specialise in the design and manufacture of water power plant.

With a view to demonstrating the utility and consistent results produced with the Wilde-Barfield electric furnace, demonstrations will be held at the premises of J. H. Holmes, Portland-road, Newcastle-on-Tyne, for a week, starting on Monday next. Invitations are extended to anyone who may be interested, and visitors are asked to bring small samples for treatment. Further information can be obtained from either the Newcastle Electric Supply Company, or Prangnell Partners, 47, Pilgrim-street, Newcastle.

Mr. S. C. Hurry has been appointed sales engineer to the Jackson Electric Stove Company. Mr. Hurry joined the company on demobilisation in December, 1919, as assistant sales engineer. He has always been closely associated with electric heating and cooking developments. He started his training at the West Ham Corporation Electricity Department, before the favour "Sales Department" was instituted, and was afterwards at Torquay and Sheffield Electricity Departments, where he assisted in popularising domestic electricity

Institution Notes.

Mr. G. Thompson has been elected chairman and Mr. H. E. Dance vice-chairman of the Liverpool Students' Sub-Centre of the Institution of Electrical Engineers for the session 1922-23.

Under the auspices of the I.E.E., and in connection with the Dublin May Agricultural Show, Mr. R. Borlase Matthews is to repeat the paper, "Electro-Farming," which he read recently in London. This lecture will be given at 8 p.m., on the 16th inst., at Leinster House, Kildare-street, Dublin.

An invitation has been transmitted to the Iron and Steel Institute by Mr. L. Greiner from the Association of Engineers of Liége to participate in an International Congress which will be held at Liége in celebration of the seventy-fifth anniversary of the association, from June 11 to June 16. Members desiring to attend the Congress should communicate with Mr. O. Lepersonne, the general secretary of the Association of Engineers of Liége, 16, Quai des Etats-Unis, Liége. The latest date for the return of the forms is May 15.

The sixty-ninth anniversary festival dinner of the London Association of Foreman Engineers was held on Saturday at the Cannon-street Hotel, London, the chair being taken by Mr. F. W. Bellamy. The association has a membership of over 700 foremen, managers, and employers connected with the engineering industry, and its objects are purely educational and benevolent. The chairman, proposing "Success to the Association," referred to the aggressive tactics of the extremists in the engineering shops. No body of men, he said, had need of more tact to preserve the balance between the employers and men than the foremen. Some day they might have a less bitter dividing line between Capital and Labour. Mr. Austin Hopkinson, M.P., responding to the toast of "The Engineering Industry" (proposed by the Rev. J. A. S. Bullock), said that when the engineering trade was in trouble, as it was to-day, they as employers must consider whether there might be any fault with themselves, and should try and get a sympathetic view of what was going on in the minds of the workers.

At the annual meeting of the Iron and Steel Institute last week the new president, Mr. Francis Samuelson, announced the award of the Bessemer Medal for 1922 to Prof. Kotaro Honda, of the University of Sendai, Japan, who, he said, had established the theory of molecular magnetism based on the measurement of the change of volume in the steel when magnetised. The recipients of the Andrew Carnegie Research Scholarships for 1922 are: Mr. Arthur Bradley, who holds the D.Sc. (London) degree in Physical Chemistry, £100, to assist in studying the carburising and decarburising effect of different gases on iron and steel; Mr. Algernon L. Curtis, £100, to carry on researches in steel moulding sands and their behaviour under high temperatures; Mr. Owen W. Ellis, lecturer in metallography at the University of Toronto, £100, for studies in the effect of constitution on the malleability of iron and steel at high temperatures; Dr. J. Newton Friend, lecturer at the Birmingham Technical School, £100, to continue his corrosion tests on a large scale; Mr. Arthur M. Parkin, of Sheffield University, £100, for studies in the metallurgy of tungsten; Mr. Gosta Phragmen, of Stockholm, £100, to study the specific weight of molten metals by a new method; Mr. W. E. Williams, a graduate of the University of North Wales, £100, to study the application of X-ray spectography to the examination of the structure of steel.

Telegraph and Telephone Notes.

It is reported that the Soviet Government has approved the project of granting the Indo-European Cable Company a concession of the cable running through the territory of the Soviet Republic linking up with the cables of the company in other countries.

The amalgamation is announced of the three principal German cable companies, the Deutsche Atlantische having absorbed the Deutsche Süd Amerikanische and the Ost Europaische companies, at the same time raising its capital to 40 000 000 marks [nominally two millions sterling].

Although there was a decrease during the past year of over 3 000 000 in the number of passengers carried on the Bournemouth Corporation tramways, the annual report shows that a profit of £159 has been made, against a deficit in the previous year of £17 000. The small profit, despite increased fares, was due to reconstruction on main lines, fewer car miles run, the coal strike, trade depression, &c. The total traffic receipts showed an increase of £10 524, and working expenses were about £5 866 less.

Prices of Metals, Chemicals, &c.

Tuesday, May 9.

		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£63 15 0	£0 15 0	—
Electro Wirebars ..	„	£67 0 0	10 0	—
H.C wire, basis	per lb.	0s. $9\frac{15}{16}$d.	—	—
Sheet	„	0s. $9\frac{7}{16}$d.	—	—
Phosphor Bronze Wire (Telephone)				
Phosphor-bronze wire, basis	„	1s. $1\frac{15}{16}$d.	—	—
Brass 60/40—				
Rod, basis	„	0s. 7d.	—	—
Sheet, basis	„	0s. $8\frac{3}{4}$d.	—	—
Wire, basis.....	„	0s. $9\frac{1}{4}$d.	—	—
Pig Iron—				
Cleveland Warrants .	per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 SWG	„	£18 0 0	—	—
Lead Pig—				
English	„	£25 10 0	10 0	—
Foreign or Colonial ..	„	£24 7 6	7 6	—
Tin—				
Ingot	„	£149 10 0	—	£2 2s. 6d.
Wire, basis	per lb.	0 2 $0\frac{3}{4}$	—	$\frac{1}{4}$d.
Aluminium Ingots	per ton	£120 0 0	—	—
Spelter	per ton	£27 2 6	5 0	—
Mercury	per bottle	£11 0 0	—	—

Salammoniac.—Per cwt. 65s.-60s.

Sulphur (Flowers).—Ton £10 15s.
„ (Roll-Brimstone).—Per ton £10 15s.

Sodium Bichromate.—Per lb. 5$\frac{1}{2}$d.

Sodium Chlorate.—Per lb. 3$\frac{1}{2}$d.

Sulphuric Acid (Pyrites, 168°).—Per ton £9.

Copper Sulphate.—Per ton £26 10s.

Boric Acid (Crystals).—Per ton £60

Rubber.—Para fine, 10$\frac{1}{2}$d.; plantation 1st latex, 8$\frac{1}{2}$d

The metal prices are supplied by British Insulated & Helsby Cables, Ltd, and the rubber prices by W. T. Henley's Telegraph Works Company.

Companies' Meetings, Reports, &c.

Siemens Brothers & Company announce a final dividend of 1s. per share, free of tax, making 10 per cent.

The Western Union Telegraph Company has declared a dividend of 1¾ per cent. on the common stock for the quarter, payable on July 15th.

Callenders Cable and Construction Company recommend a dividend of 15 per cent. (3s. per share, of which 1s. per share was paid on November 2) for 1921.

The directors of the English Electric Company recommend a dividend of 5 per cent. (less tax) on the ordinary shares, for the year 1921, payable on May 31.

The Lancashire Dynamo and Motor Company have declared a dividend of 1s. 3d. on the ordinary shares, making 2s. per share (10 per cent.), free of tax, for the past year.

The net profit of the Hart Accumulator Company for 1921 was £47 134, making with the balance of £25 616 brought in £72 750. The directors recommend a dividend of 11 per cent., subject to tax, on the ordinary share capital, carrying forward £54 341.

The receipts of the Cuba Submarine Telegraph Company for 1921 totalled £65 974, and expenses amounted to £33 009. After providing £8 502 for income tax and £9 334 for account of excess profits duty, there remains £15 127, plus the difference in exchange of £6 959 and £26 645 brought forward, making £48 732, less £15 000 added to general reserve. The directors recommend a final dividend on the ordinary shares at the rate of 5 per cent. per annum, and a bonus of 4s. per share, free of tax, carrying forward £16 532, subject to excess profits and other duties.

The accounts of Pinchin, Johnson & Company for the year ended December last, after providing for all expenses, depreciation, and taxation, show a net profit of £45 924, which, with £10 588 brought in, make available £56 512. Interim dividends on preference and ordinary shares absorbed £21 875, and the directors recommend payment of the half-year's dividend on the preference shares, a final dividend of 2½ per cent. on the ordinary shares (making 7½ per cent. for the year, against 15 per cent. the previous year), that the sum of £1 500 be written off for preliminary expenses of the new capital issue, and £16 512 be carried forward.

After charging administration expenses and including £2 305 brought forward, the accounts of the Bath Electric Tramways Company for the year ended December 31 last show an available balance of £17 433, from which the following amounts have been deducted :—£5 449 for interest on four and a-half per cent. first mortgage debenture stock, £1 000 for sinking fund, and £3 750 for dividend on preference shares, leaving a balance of £7 234. From this the directors have transferred £5 000 to contingencies and renewals account, and recommend that the balance of £2 234 be carried forward to provide for contingencies and replacements.

The total revenue for the year 1921 of the Gateshead and District Tramways Company amounted to £141 803. After deducting all expenses chargeable to revenue, including provision for renewals (£3 000), there remains a balance on the year's working of £43 818. To this is added £2 018, brought forward from 1920, making a total of £45 836. The directors recommend that £3 173 be placed to sinking fund for redemption of mortgages; to dividend for the year on £12 610 6 per cent. preference shares (on account of which 3 per cent. has been paid), £757; to dividend for the year on £120 000 5 per cent. preference shares (on account of which 2½ per cent. has been paid), £6 000; to dividend on the ordinary shares at the rate of 10 per cent. (on account of which 4 per cent. has been paid), £13 500, leaving £22 407 to be carried forward. The expenditure on capital account during the year amounted to £49 416, making the entire capital outlay upon the undertaking £412 342.

The report of the English Electric Company for the year ended December 31, 1921, shows that the net profits, after crediting dividends received from subsidiary companies, and amounts transferred from reserves previously set aside and no longer required, and after charging all expenses, amounted to £317 423. The amount brought forward from last year was £46 236, making a total of £363 659. After charging debenture interest £52 533, interest on 8 per cent. secured notes £100 000, trustees' fees £360, and preference dividends £41 914, there remains a balance available for appropriation of £168 852. The directors recommend the transfer to reserve for contingencies of £60 000, and a dividend on the ordinary shares (payable May 31, 1922) of 5 per cent. (less tax), absorbing £53 253, leaving a balance to be carried forward of £55,599 (as compared with £46 236 last year). Stocks of materials, &c., held by the company and its subsidiaries have been written down to current market values, or less.

The chairman of the Calcutta Electric Supply Corporation, Ltd., Lord Meston of Agra and Dunottar, K.C.S.I., who presided over the annual meeting on Tuesday, stated that the increase of capital expenditure from about £1 750 000 to nearly £2 250 000 reflected payments for new plant now on its way to India, which should shortly be producing increased revenue. The receipts from the sale of current showed a gratifying increase, being £414 000 in 1921 against £330 000 in 1920. The number of units sold had grown by only 11 per cent., and the surcharge mainly explained the balance. The continuing rise in the price of coal and in wages, coupled with the higher Indian taxation, had, however, more than absorbed the proceeds of the small surcharges. The net profit amounted to £217 000, against £263 000 in 1920. They had obtained welcome relief in the withdrawal of excess profits duty, and were able to maintain the dividend at 10 per cent. for the year, plus a bonus of 1 per cent., on a considerably increased share capital. The new capital had not yet earned its quota of revenue, but would commence to do so in the current year. Already there was a large and satisfactory increase of units sold. Ample provision had been made for depreciation and renewal of plant, and they had added substantially to the reserve and insurance funds. The past year was far from being free of difficulty; labour troubles occurred, but were wisely and successfully handled, and they had a competent and loyal staff. There were troubles over coal as to both quantity and quality, and increased expenses drove them to revise the scale of charges for power. Industrial unrest in this country had caused lamentable delay in the supply of new generating plant, of which they were in urgent need. Nevertheless, they closed the year in a stronger position than when it opened, and Major-General Mahon's timely visit to Calcutta went far to consolidate the good feeling between the Corporation and the Calcutta public. The demand for further services grew unceasingly, and they were only at the threshold of their possibilities.

New Companies.

G. Edward Carr.

G. Edward Carr, Ltd. (181 547). Private company. Reg. May 4. Capital, £12 000 in £1 shares. To adopt an agreement with G. E. Carr, and to carry on the business of electricians, manufacturers and repairers of and dealers in mechanical and electrical appliances and lamps, armature winders, &c. Subscribers: G. E. Carr, G. Y. Gray. Registered office: 560, Shields-road, Newcastle-on-Tyne.

Russell Electrical Appliances.

Russell Electrical Appliances Company. (181 431). Private company. Reg. April 29. Capital, £2 000 in £1 shares. To acquire and work a patent manufacture of electric meters under Electric Meter Patent No. 4 368/22, of which L. T. C. Russell is the sole patentee, &c. Permanent directors: L. T. C. Russell, W. G. Dewsbusy, and E. W. Jones. Secretary: Iden R. Reed. Registered office: 60, Queen Victoria-street, E.C. 4.

Woodstock Electric Light.

Woodstock Electric Light Company, Ltd. (181 541). Private company. Reg. May 4. Capital, £5 000 in £1 shares. To carry on business as indicated by the title, and to adopt an agreement with the Woodstock Electric Light & Power Company. Subscribers: G. W. Smith, J. H. Dew. Solicitors: Julius, Edward & Julius, 8, Old Jewry, E.C. 2.

Grosvenor Clark Electrical, Ltd.

Grosvenor Clark Electrical, Ltd. (181 548). Private company. Reg. May 4. Capital, £1 000 in £1 shares. Electrical engineers, manufacturers, and agents for the sale and purchase of electrical fittings and appliances, &c. Permanent directors: W. P. Grosvenor, J. A. Clark, W. Clement Drew. Secretary: W. Clement Drew. Registered office: 3-4, Great Winchester-street, E.C. 2.

Edmund Nuttall, Sons & Company.

Edmund Nuttall, Sons & Company, Ltd. (181 501). Private company. Reg. May 3. Capital, £100 000 in £1 shares. To take over the business of public works and general contractors carried on by E. Nuttall and J. Nuttall as "Edmund Nuttall & Company," to construct and equip railways, tramways, &c. First directors: E. Nuttall and J. Nuttall. Solicitors: Allen, Whitfield & Hodgson, 65, Princess-street, Manchester.

Holes, Ltd.

Holes, Ltd. (181 508). Private company. Reg. May 3. Capital, £1 500 in £1 shares. To adopt an agreement with S. H. Hole and C. Hole, and to carry on at Bursledon, Hants., or elsewhere the business of general engineers, manufacturers or repairs of all types of steam, electrical, or internal combustion engines or machinery, &c. First directors: N. H. Everitt, S. H. Hole, and C. Hole. Qualification: 100 shares. Registered office: 61, Union-street, Ryde, I.W.

Sunbeam Light Company.

Sunbeam Light Company, Ltd. (181 492). Private company. Reg. May 2 Capital, £250 in £1 shares. Agents for and dealers in electric lamps and light fittings, gas shades and fittings, oil and others lamps, &c. Life directors: A. P. H. van den Dorpel and Mrs. C. M. Thoenes. Registered office: 155, Praed-street, Paddington, W.

Welwyn Garden City Electricity Supply.

Welwyn Garden City Electricity Supply Company, Ltd. Reg. May 1. Capital, £25 000 in 23 500 preference shares of £1 each and 30 000 ordinary shares of 1s. each. First directors: Sir Theodore G. Chambers, J. R. Farquharson, C. B. Purdam, and Capt. R. L. Reiss. Secretary: F. J. Osborn. Solicitors: Grundy, Kershaw, Samson & Company, 6, Austin Friars, E.C. File number is 181 468.

Stamford Engineering Company.

Stamford Engineering Company, Ltd. (181 461). Private company. Reg. May 1. Capital, £1 000 in £1 shares. To acquire the business carried on by D. Stevens at 400, Hoe-street, Walthamstow, as the "Stamford Engineering Company," and to carry on business as general, electrical, and hydraulic engineers, &c. First directors: D. Stevens, Mrs. R. Stevens. Registered office: 400, Hoe-street, Walthamstow, Essex.

Tenders Invited and Accepted.

UNITED KINGDOM.

York Corporation. May 23.—Extension of electricity sub-station, Lendal-bridge York. Particulars from the City Engineer, Guildhall, York.

Kirkcaldy Electricity Works. June 5. Steam turbine three-phase alternator, condensing plant and piping. Particulars from Kennedy & Donkin, 17, Victoria-street, Westminster, S.W. 1.

Nottingham Corporation. June 9.—Manufacture, delivery, and erection at North Wilford Power Station of (Sec. D.) six fuel economisers, four steel chimneys, six induced draught fans, &c.; (Sec. E.) e.h.p. remote controlled main switchgear, &c.; (Sec. F.) three electric centrifugal pumps; (Sec. J.) one 75-ton overhead electric crane, one 10-ton and one 5-ton hand cranes; (Sec. K.) two 750 kW rotary converters, one 35 kW motor generator booster, &c. Particulars from Preece, Cardew & Rider, 8, Queen Anne's-gate, Westminster, S.W. 1.

Preston Electricity Undertaking. June 14.—Supply and erection of boilers, stokers, economisers, fans, chimneys, steam and feed piping and feed pumps. Particulars from the Town Clerk, Town Hall, Preston.

AUSTRALIA.

Victorian Government Railways. July 5.—* Supply and delivery of an industrial storage battery truck and battery charging equipment (Contract No. 35 028).

NEW ZEALAND.

Public Works Department. July 4.—* Manufacture, supply, and delivery, c.i.f. Auckland, of three 1 320 kVA single-phase transformers, complete with accessories (Section 56).

Willesden Urban Council have accepted the tender of British Insulated & Helsby Cables for twelve months' supply of cables.

Lambeth (London) Guardians have accepted the tender of the Express Lift Company for dismantling an existing lift and supplying an electric lift at Brook-street Infirmary, Kennington, at £953.

London County Council Education Committee have accepted tenders of A. Hawkins & Sons, at £718 10s., for wiring the Belleville-road school, and at £718 15s., for wiring the Wormholt-road school.

Battersea (London) Council have accepted the tenders of Ferranti Ltd., Chamberlain & Hookham, and Reason Manufacturing Company for meters for six months, and Dussek Bitumen Company for box compounds and bitumen composition for twelve months.

Stepney Borough Council have accepted the following tenders:—Sutton & Company, for the supply of one mile three-way 4-in. conduits, at £891; Burroughs Adding Machine, Ltd., for an electrically-operated adding machine, at £233 10s.; A. Reyrolle & Company, for 28 h.t. switches for Limehouse Generating Station, at £83 each.

Leyton Urban Council have accepted the tenders of Bruce Peebles & Company and A. Reyrolle & Company for motor converters and armour-clad switchgear, W. T. Henley's Telegraph Works Company for e.h.t. cable, Union Cable Company for tramway feeder cable, and Hackbridge Electric Construction Company for transformers.

The Philadelphia Electric Company has placed a large contract with the Westinghouse Electric & Manufacturing Company for air blast transformers, which includes sixteen 3 750 kV-A, single-phase transformers for operation at 60 cycles, with a total capacity of 60 000 kV-A. The total cost of the transformers will be approximately $100 000.

Books Received.

"Practical Engraving on Metal." (London: Percival Marshall & Company.) Pp. 141. 1s. 6d. net.

"Essais des Machines Electriques." By C. F. Guilbert. (Paris: J. B. Baillière et Fils.) Pp. vi.+522. 45 frs.

"Die Elektrotechnik und die Electromotorischen Antriebe." By Wilhelm Lehmann. (Berlin: Julius Springer.) Pp. v.+451. M. 96.

"Dynamo Design and Construction." By A. H. Avery, A.M.I.E.E. (London: Cassel & Company, Ltd.) Pp. 263. 6s. net.

"Die Drahtlose Telegraphie und Telephonie." By Dr. P. Lertes. (Dresden and Leipzig: Theodor Steinkopff.) Pp. xi.+152. 3s. 9d. net.

"A Dictionary of Applied Physics." Vol. I. Edited by Sir Richard Glazebrook, K.C.B., D.Sc., F.R.S. (London. Macmillan & Company, Ltd.) Pp. ix.+1 067. 63s. net.

"Maintenance and Repair of Electrical Measuring Instruments." By H. G. Yarrill. (London: Percival Marshall & Company.) Pp. 78. 2s. 6d. net.

"The Beginners Guide to the Miscroscope." By Chas. E. Heath, F.R.M.S. (London: Percival Marshall & Company.) Pp. 120. 1s. 6d. net.

"The Principles Underlying Radio Communication." (Second edition.) Radio Pamphlet No. 40. Signal Corps, U.S. Army. (Washington: Government Printing Office.) Pp. 619. $1.00.

** Particulars from the Department of Overseas Trade.*

COMMERCIAL INTELLIGENCE.

County Court Judgments.

[Note.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

ARROTA ELECTRICAL & MOTOR ACCESSORIES COMPANY, LTD., Charles-street, Louth, electrical and general engineers. £17 6s. Mar. 8.

BLAGDEN, Geo., 62, Weston-street, Sheffield, electrical engineer. £46 14s. Feb. 24.

JEFFERYES, A. N., 8, Denman-place, Piccadilly, W. 1., electrician. £21 17s. 10d. Jan. 30.

PAIN, J., 105, High-street, Hythe, electrical engineer. £19 10s. 4d. Mar. 2.

SEACOMBE, Jas., 98, Trevor-terrace, North Shields, electrician. £64 12s. 1d. Mar. 3.

THOMAS & EVANS, 4/7, Salubrious-place, Swansea, electricians. £59 16s. 6d. Mar. 8.

Bill of Sale.

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1822 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

ROBERTS, John Estall, 56, Garmoyle-road, Sefton Park, Liverpool, electrical engineer. May 6. £50.

Deed of Arrangement.

ROGERS, William, 136, Woodfield-street, and Dolcader House, Cwmbath-road, both Morriston, Swansea, electrical contractor. Filed, May 3. Trustee, S. E. Clutterbuck, 31, Queen-street, Cardiff. Liabilities unsecured, £667; assets, less secured claims, £323.

Mortgages and Charges on Limited Companies.

[Note.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

ELECTRICAL ENGINEERING (WEST BROMWICH), LTD. Registered April 21, £1 100 mortgage, to T. A. Nightingale, Bilhay-street, West Bromwich, iron merchant, and another: charged on land with Heath-cot., 402, High-street, West Bromwich. *Nil. Jan. 13, 1921.

MIDLAND COUNTIES ELECTRIC SUPPLY COMPANY, LTD. (late TRAMWAYS LIGHT & POWER COMPANY, LTD.), London, E.C. Registered April 27, trust deed dated April 25, 1922 (supplemental to trust deeds dated Feb. 26, 1914, Nov. 15, 1915, and April 14, 1919, securing £375 000 debenture stock); charged on 305 918 shares fully paid of £1 each and £56 785 5 per cent. debenture stock of the Derbyshire & Nottinghamshire Electric Power Company; 24 823 shares of £10 each fully paid in the Nottinghamshire & Derbyshire Tramways Company; 241 preference shares of £10 each and 6 747 ordinary shares of £10 each fully paid and £32 950 4½ per cent. first mortgage debenture bonds of and in the Leamington & Warwick Electrical Company Limited. *£344 150 (debenture stock), £200 000 (notes). March 15, 1921.

NORTHAMPTON ELECTRIC LIGHT & POWER COMPANY, LTD. Registered April 29, trust deed dated April 11, 1922, securing £40 000 debenture stock and premium at the rate of 5 per cent (no present issue); general charge. *£110 000. March 10, 1922.

Satisfaction.

MINEHEAD ELECTRIC SUPPLY COMPANY, LTD. Satisfactions registered April 28, £5 000, registered Dec. 9, 1907; and £5 000, registered Dec. 31, 1909.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Company Winding-up Voluntarily.

ANGLO-MEXICAN ELECTRIC COMPANY, LTD. R. R. Skelsey appointed liquidator. Meeting of creditors at 47, Parliament-street, Westminster, S.W. 1, Wednesday, May 17, at 3 p.m. Particulars of claims to the liquidator by June 1.

Liquidator's Notice.

ELECTRELLE, LTD.—Particulars of claims to T. R. Lawley, 24, Fountain-street, Manchester, the liquidator, by June 19.

Bankruptcy Information.

BATE, Douglas Clavell, 16, John Dalton-street, Manchester, electrical manufacturer and supplier. First meeting, May 17, 3 p.m., Official Receiver's Offices, Byrom-street, Manchester. Public examination, June 30, 10 a.m., Court House, Quay-street, Manchester.

Notices of Dividends.

BENNETT, William, Back Sitwell-street, Derby, electrical contractor. Amount per £, 1s. 1½d. First and final. Payable, May 10, 4, Castle-place Nottingham.

RAWSTHORNE, Thomas, 67B, Paradise-street, West Bromwich, Stafford, electrical engineer. Amount per £, 3s. 1½d. First and final. Payable, May 17, Official Receiver's Office, Ruskin Chambers, 191, Corporation-street, Birmingham.

Notices of Intended Dividends.

CAMP, William, Carr-lane, Slaithwaite, near Huddersfield, under the style of WILLIAM CAMP & COMPANY, electrical engineer. Last day for receiving proofs, May 20. Trustee: W. Durrance, 12, Duke-street, Bradford.

ROTHWELL, Peter, 64, Higher Bridge-street, Bolton, in partnership with Peter Ashworth Rothwell (a minor), under the style of P. A. ROTHWELL & COMPANY, electrical engineer. Last day for receiving proofs, May 13. Trustee, J. G. Gibson, Byrom-street, Manchester.

Partnerships Dissolved.

BARTLETT, Ernest William, and CROCKER, Stanley Cuthbert, electrical and mechanical engineers, 1, Pembroke-terrace, Cardiff, under the style of the HEATH ELECTRICAL & MECHANICAL ENGINEERING COMPANY, by mutual consent as from April 11, 1922. Debts received and paid by S. C. Crocker, who will continue the business.

BIBBY, Joseph, and MOTTERSHEAD, Fred, electricians, &c., 40, Park-green, Macclesfield, under the style of BIBBY & MOTTERSHEAD, by mutual consent as from March 31, 1922. Debts received and paid by J. Bibby.

BILL, William Harry, and BERRY, James Henry, electrical engineers and manufacturers' agents, at 18 to 26, Constitution-hill, Birmingham, under the style of BILL & BERRY. By mutual consent as from March 25, 1922.

DENYER, Frank, and HAYLER, Albert Waldegrave, electricians 89, Sackville-road, Hove, Sussex, under the style of DENYER & HAYLER, by mutual consent as from April 27, 1922. Debts received and paid by A. W. Hayler.

VISSENGA, John Williams, VANSON, William David, and NEWTON, Robert, electric welders, Queen Anne-road, Maidstone, under the style of the MAIDSTONE ELECTRIC WELDING COMPANY, by mutual consent, as from April 29, 1922. Debts received and paid by J. A. Robertson and W. D. Vanson, who will continue the business.

Bankruptcy Proceedings.

COOKSON, Eugene, trading as W. TURNBULL & COMPANY, at the Express Magneto Repair Works, Blackpool. Gross liabilities are stated to be £932 and the deficiency £630. At his public examination, held recently at Blackpool, debtor attributed his failure to expenses incurred in renovating business premises, pressure by creditors, and money paid for vacant possession of premises. The Official Receiver said debtor filed his petition owing to execution having been levied upon his effects. He was 23 years of age and unmarried, and before branching out in trade he was in the Army. On demobilisation he worked for a firm of electricians for three or four months, and in May, 1919, started on his own account. He then had £30 or £40 as his Army gratuity. He had three removals from premises, and at the time of the last one he had practically no capital, but he borrowed £375 from his friends, £50 of which had since been repaid. For the six months ending September, 1921, he made a profit of £25. He first became aware of his insolvency in March this year.

DICKEN, William John, trading as W. DICKEN & SON, 2, Upper High-street, Bargoed, Glamorganshire, electrical engineer. At his public examination this debtor, whose statement of affairs showed a deficiency of £130, stated that he commenced business at his present address in October, 1920, with about £550 free capital, his savings. The business had not paid from the outset, and as a result of the heavy outgoings and depression in trade, combined with the slump in prices, he had been unable to recover his position. He became aware of his position in January last. The examination was closed.

MAXIM LAMP WORKS, LTD., 75, Canonbury-road, Highbury, N. Under a winding-up order made against this company the statutory meetings of the creditors and of the contributories were held last week at the Board of Trade Offices, 33, Carey-street, W.C. A statement of affairs showing the position as at the date of the appointment of the receiver for the debenture-holders on July 28 last was presented, in which the liabilities were returned at £11 050, of which £4 987 were expected to rank, while the assets were estimated to realise £3 579, and consisted of the estimated surplus to come from the securities held by creditors regarded as fully secured. After payment of the preferential claims, £77, and of the loans on debenture bonds, £3 000, there was a sum of £502 available to meet the claims of the unsecured creditors, who were accordingly faced with a deficiency of £4 485. The company has created mortgages or charges, and on July 28 last Mr. Alfred Tosh, 75, Canonbury-road, N., was appointed receiver under powers contained in a debenture issued in July, 1918. The company was formed to acquire the business carried on by the receiver for the debenture-holders of the Maxim Lamp Works Electrical Company, Ltd., of Shernall-street, Walthamstow. The meetings resulted in the liquidation remaining in the hands of the Official Receiver. Appended is a list of the principal creditors: Duram, Ltd., London, £22; Edison & Swan Electric Company, Ltd., London, £87; General Electric Company, Ltd., London, £240; Imperial United Lamp Company, London, £474; Rose Bros., London, £10; Swan Electrical Company, London, £393; Stella Lamp Company, Ltd., London, £43; Scientific Metals Company, Ltd., London, £528; Tomey, F., & Company, Ltd., Birmingham, £261; Vactite Wire Company, Ltd., London, £26; Wiggins, H., & Company, Ltd., Birmingham, £12; Electric Lamp Supplies, Ltd., Birmingham, £156.

ROSLINGTON, William Henry, 240, High Holborn, W.C. This debtor formerly carried on business in partnership under the style of the GREENLING ELECTRIC SUPPLIES. The statutory first meeting of the creditors was held on Friday at Bankruptcy Buildings, Carey-street, W.C., when it appeared that in August, 1919, he became interested in a company, of which he was afterwards appointed managing director, but in April, 1920, he resigned, and the company had since gone into liquidation. During the time he was with the company in question he also carried on business in partnership under the style of the Greenling Electrical Supplies, into which as sleeping partner he put £100, his partner providing the experience. They each drew £10 a week from the business from Dec. 1, 1919, until the end of the following March. The partnership, which had been verbal, was dissolved by mutual consent in May, 1920, the debtor taking over the assets and liabilities of the business, although he had since ascertained that book debts of the face value of £1 000 were irrecoverable. He afterwards transferred the business to 240, High Holborn, and converted it into a limited company, called Greenling Electric Supplies, Ltd., with a nominal capital of £5 000. As vendor he was allotted 1 000 ordinary shares in payment of stock and contracts, and he was appointed managing director of the company at a remuneration of £500 per annum, plus director's fees, £100 per annum. Preference shares to the extent of £1 000 were taken up for cash. The debtor had, however, resigned his directorship and transferred his holding in the company to another person. He attributes his failure to the long illness of his wife and heavy expenses thereof, and to the lack of trade. His statement of affairs showed liabilities £1 209 and assets nil. The meeting passed a resolution for bankruptcy and the case remained in the Official Receiver's hands.

Arrangements for the Week.

FRIDAY, May 12th (to-day).

PHYSICAL SOCIETY OF LONDON.

5 p.m. At the Imperial College of Science, South Kensington. Demonstration of Some Electrical Properties of Neon-filled Lamps, by Mr. S. O. Pearson and Mr. H. St. G. Anson.

TUESDAY, May 16th.

INSTITUTION OF ELECTRICAL ENGINEERS.
(LIVERPOOL STUDENTS' SUB-CENTRE.)

3.45 p.m. At the University, Brownlow-street, Liverpool. Lecture on "Cheapening of Electricity Supply in Great Britain," by Mr. C. H. Wordingham.

THURSDAY, May 18th.

INSTITUTION OF ELECTRICAL ENGINEERS.

6 p.m. Savoy-place, London, W.C. 2. Kelvin Lecture on "Electricity and Matter," by Prof. Sir Ernest Rutherford.

JUNIOR INSTITUTION OF ENGINEERS.

6.30 p.m. At Monico Restaurant, London. Annual Dinner.

FRIDAY, May 19th.

INSTITUTION OF ELECTRICAL ENGINEERS.
(LONDON STUDENTS' SECTION.)

7 p.m. At Savoy-place, London, W.C. 2. "The Elimination of Atmospherics in Radio-Telegraphy," by Mr. A. H. Reeves.

Recent Wireless Publications.

Set out below will be found a series of references to, and short abstracts of recently published articles dealing with wireless telegraphic and telephonic communication. In order to facilitate reference these have been grouped under a few main headings indicative of the general subject matter discussed in the articles. References to British Patents on wireless subjects will be found included in our "Patent Record," which appears each week.

The very rapid growth of the volume of radio-literature published during the last few years is rendering more and more evident the need for some universal and internationally recognised system of classifying and referring to such publications. Quite recently the Bureau of Standards at Washington put forward some suggestions and subsequently issued a revised classification scheme based on the well-known Dewey decimal classification, the class number 621 384 assigned to Radio communication in that classification being for brevity designated by the letter R, followed by additional group numbers for the various branches of radio work.

Another extension of the decimal classification system to include the various branches of radio work has also been published in France by the Institut International de Bibliographie, but the sub-groups there defined are not in agreement with those set out by the Bureau of Standards. Other classification schemes have also been used in publications in this country and elsewhere.

The index headings in the following list have been arranged in accordance with the abridged classification put forward by the Bureau of Standards, as at the present time this appears to meet as well as any the requirements of the problem. The individual references have been grouped under the main headings of the Bureau of Standard's classification, but the group number of their abbreviated classification scheme is given at the end of each reference. Where the article in question deals with several branches of radio work these are indicated as far as possible by the addition of extra classification group numbers, these extra numbers being separated from the main classification number by a diagonal stroke. Thus should the need arise, the more complicated scheme will be incorporated in subsequent lists of references, since this can be done without in any way disturbing or rearranging the class groups in which the present references are arranged.

Bureau of Standards Abbreviated Classification of Radio References.

R.000—Radio Communication.
R.050— Books.
R.060— Societies.
R.090— History.
R.100—Radio Principles.
R.110— Radio Waves.
R.120— Antennæ.
R.130— Election Tubes.
R.140— Radio Circuits.
R.150— Generating apparatus.
R.160— Receiving apparatus.
R.190— Other Radio Principles.
R.200—Radio Measurements and Standardisation.
R.210— Frequency, Wavelength.
R.220— Capacity, Dielectric, Constant.
R.230— Inductance.
R.240— Resistance, Decrement, Phase Difference, Power Loss.
R.250— Current.
R.260— Voltage.
R.270— Signal Intensity.
R.280— Properties of Materials.
R.290— Other Measurements.
R.300—Radio Apparatus and Equipment.
R.320— Antennæ.
R.330— Electron Tubes.
R.340— Electron Tube Apparatus.
R.350— Generating Apparatus Transmitting Sets.
R.360— Receiving Apparatus, Receiving Sets.
R.380— Parts of Circuits, Instruments.
R.400—Radio Communication Systems.
R.410— Modulated Wave Systems.
R.411— Spark.
R.412— Radio Telephone Systems.
R.413— Low-Frequency Modulating Systems
R.414— High-Frequency Modulating Systems.
R.420— Continuous Wave Systems.
R.421— High-Frequency Alternator.
R.422— Arc.
R.423— Electron Tube.
R.430— Interference Elimination.
R.440— Remote Control (by wire).
R.450— Linkage.
R.460— Duplex and Multiplex Systems.
R.470— Wired Radio.
R.480— Relay Systems.
R.490— Other Systems.
R.500— Applications of Radio.
R.510— Navigation.
R.520— Aviation.
R.530— Commercial and Special Services.
R.540— Private.
R.550— Time and Meteorological.
R.560— Military, Naval.
R.570— Distant Control by Radio.
R.580— Other Applications.
R.590— National Developments.
R.600—Radio Stations: Equipment, Operation and Management.
R.610— Equipment-Station Descriptions.
R.620— Operation and Management.
R.700—Radio Manufacturing.
R.710— Factories
R.720— Processes.
R.740— Sales.
R.800—Non-Radio Subjects.
R.900—Miscellaneous Radio.

Reference Index to Recent Publications.

GENERAL RADIO COMMUNICATION. R.000.

V. B. Warner. The Washington Radio Conference (*Q.S.T.*, 5, pp. 7-12, April 1922; *Popular Radio*, 1, pp. 61-63, April, 1922).
Includes details of the wavelength allocations for various radio-telephonic uses. R.000.

P. F. Godley. The Far Call (*Wireless Age*, 9, pp. 17-24, March, 1922).
Deals with the short wave Transatlantic Tests of December, 1921 R.000.

P. Boucheron. Amateurs Span the Atlantic (*Radio News*, 3, pp. 697-699, February, 1922). R.000.

E. H. Felix. Dr. Alfred N. Goldsmith on the Future of Radio Telephony (*Radio Broadcast*, 1, pp. 42-45, May, 1922). R.000.

C. Austin. The Romance of the Radio Telephone (*Radio Broadcast*, 1, pp. 9-19, May, 1922). R.000/412.

R. C. Higgy. The Successful Transatlantic Stations (*Q.S.T.*, 5, pp. 11-18, March, 1922).
An illustrated description of the successful transmitting stations in the Transatlantic signalling tests on short wavelengths. R.000/610

L. W. Austin. Long-distance Radio Communication (*Journal of the Franklin Institute*, 193, pp. 437-459, April, 1922).
A historical résumé of progress, including a number of recent signal strength measurements over long distances, and notes on the developments of high-power stations in various countries. R.000/590/270/610.

A. F. van Dyck. A Transition Period in Radio Communication. (*General Electric Review*, 24, pp. 828-832, September; pp. 884-889, October, 1921).
A general discussion of recent developments in radio apparatus as affecting the design of ship and other installations. The second instalment of the article discusses the question of high-power long-distance transmissions and also the fields of application of radiotelephony. R.000.

E. M. Marchant. Wireless Developments (*Engineer*, 132, p. 597, December 2, 1921). R.000.

H. Gernsback. The New Radio Legislation (*Radio News*, 3, p. 944, April-May, 1922). R.007.

Recommendations of the Committee of the Wireless Society of London regarding the Regulations Governing Amateur Transmission (*Wireless World and Radio Review*, 10, pp. 108-109, April 22nd, 1922). R.007.

Regulations regarding Amateur Radio Stations in France (*Radioélectricité*, 3, pp. 128-130, March, 1922). R.007.

Radio Regulation Conference opens in Washington (*Electrical World*, 79, pp. 446-447, March 4th, 1922). R.007.

G. Vallauri. Technical Discussions of the Paris International Conference on radio-communications. (*Radio Review*, 3, pp. 17-25, January; pp. 82-91, February, 1922). R.007.

The Organisation of a Radio School (*L'Audion*, 2, pp. 2-8, April 1st, 1922). R.060.

C. F. Marshall. A Chronology of Communication (*Engineer*, 132, p. 615, December 9th, 1921). R.090.

D. Jochmann. German Wireless in South-West Africa (*Telefunken Zeitung*, 4, pp. 41-48, September, 1921).
Describes the development during the period 1904-1914. R.090.

A. Rey. The evolution of physical theories since the 18th century. (*L'Elettrotecnica*, 8, pp. 664-665, November 5th, 1921). R.090.

RADIO PRINCIPLES AND THEORY. R.100.

F. Addey. Modern Wireless Telegraphy and Telephony (*Telegraph and Telephone Journal*, 8, pp. 93-99, April, 1922). R.100.

U. Bianchi. The theoretical basis of radiotelephony (*L'Audion*, 2, pp. 9-12, April 1st, 1922). R.100.

G. Malgorn. Long distance wireless transmission (*Revue Générale de l'Électricité*, 11, pp. 483-490, April 8th, 1922).
Discusses the discrepancies found between various wave-propagation formulæ. R.110.

P. R. Coursey. The Beverage Antenna (*Wireless World and Radio Review*, 10, pp. 33-35, April 8th, 1922).
Describes the mode of functioning of this antenna. R.120.

A. Marino. On radiotelegraphic antennæ for aircraft (*L'Elettrotecnica*, 9, pp. 242-247, April 15th, 1922).
Theoretically deduces formulæ for the capacity, electric field, radiation resistance, etc., of aircraft antennæ. R.120/520.

R. Schachenmeier. The Electromagnetic field of a slightly damped radiating aerial (*Zeitschrift für technische Physik*, 2, pp. 330-333, 1921).
A mathematical paper. R.120.

R. Schachenmeier. The electromagnetic field of a slightly damped radiating antenna (*Physikalische Zeitschrift*, 22, pp. 676-679, December 15th, 1921).
A theoretical paper of a highly mathematical character. R.120.

WAVE THEORY, AERIALS AND RADIATION.

J. Bethenod. On the application of counterpoises to radio installations (*L'Onde Electrique*, 1, pp. 90-95, February, 1922).
Discusses theoretically the influence of the size, height, etc., of the counterpoise. R.120.

A. Meissner. The earth resistance of Antennæ (*Jahrbuch Zeitschrift für drahtlose Telegraphie*, 18, pp. 322-338, November, 1921; *Elektrotechnische Zeitschrift*, 42, p. 1254, November 3rd, 1921; *Zeitschrift für technische Physik*, 2, pp. 328-330, 1921).
A discussion of the causes of energy dissipation in the earth at transmitting stations, together with the results of a number of measurements of effective resistances of various antennæ at different wavelengths. A brief description is given of the extensive insulated counterpoise installed at Karlsborg, in Sweden, and also of the new earth system to be installed at Nauen, consisting of a large number of properly distributed earth rods connected by overhead wires. R.120.

H. A. Brown and C. T. Krupp. The effect of pressure and gas content on the action of vacuum tube detectors (*Physical Review*, 19, pp. 278-280, March, 1922). R.130.

H. D. Arnold and H. E. Ives. The growth and decay of photo-thermionic currents from oxide coated filaments (*Physical Review*, 19, p. 248, March, 1922). R.130.

H. D. Arnold and H. E. Ives. The Growth and Decay of Photo-Thermionic Currents from Oxide-coated Filaments (*Proceedings of the National Academy of Sciences*, December, 1921; *Journal of the Franklin Institute*, 193, p. 514, April, 1922. Abstract). R.130.

P. E. Boucher. The measurement of the resonance radiation and ionisation potentials of several gases and vapours (*Physical Review*, 19, pp. 189-209, March, 1922). R.130.

E. B. Moullin and L. B. Turner. The Thermionic Triode as Rectifier (*Electrician*, 88, pp. 442-444, April 14th, 1922).

Abstract of Paper read before I.E.E. Wireless Section. R.130.

J. Marsten. Note on Oscillations of a Two-element Valve (*Radio News*, 3, p. 815, March, 1922).

A soft two-electrode valve arranged as a negative resistance. R.130.

C. Gutton. On the simultaneous maintenance of an oscillating and of harmonic circuits (*Comptes Rendus*, 174, pp 941-943, April 3rd, 1922).

Discusses the establishment and maintenance of harmonic oscillations by means of a three-electrode valve. R.130.

E. V. Appleton and B. van der Pol. On the Form of Free Triode Vibrations (*Physica*, 1, pp. 327-332, November, 1921). R.130.

E. V. Appleton and B. van der Pol. On a Type of Oscillation Hysteresis in a Simple Triode Generator (*Philosophical Magazine*, 43, pp. 177-193, January, 1922). R.130.

O. W. Richardson and F. S. Robertson. Contact difference of potential thermionic emission (*Philosophical Magazine*, 43, pp. 557-559, March, 1922).

Gives experimental results. R.130.

G. G. Blake. The Modern View of Electricity and the Three-Electrode Valve (*Wireless World and Radio Review*, 10, pp. 70-73, April 15th; pp. 98-103, April 22nd, 1922). R.130.

S. Townsend and V. A. Bailey. The Emission of Electrons in Gases (*Philosophical Magazine*, 42, pp. 874-891, December, 1921).

A brief account is given of a method of finding the velocity of electrons and the application of the results obtained. R.130.

H. C. Burger. The structure of drawn Tungsten wire (*Physica*, 1, pp. 214-218, October, 1921).

Röntgen ray investigation of space lattice of tungsten before and after drawing, and also after annealing. The research was carried out at Phillip's lamp works. R.130.

W. Grösser. Thermionic valve transmitters with coupled oscillatory circuits and capacity coupling (*Archiv für Elektrotechnik*, 10, pp. 317-338, December, 1921).

A theoretical investigation of the frequencies and decrements in both cases, and their application to the phenomena of phase reversal and discontinuities in the resonance curves. R.130/140.

B. van der Pol. Oscillation hysteresis in a triode generator with two degrees of freedom (*Tijdschrift van het Nederlandsch Radiogenootschap*, 1, pp. 125-147, December, 1921).

A theoretical and experimental investigation of the phenomena in a generator with coupled oscillating circuits; the coupling being by means of condensers. R.130.

A. Boutaric. The Emission of Electricity by Incandescent Bodies (*Scientia*, 30, pp. 189-194, September 1st, 1921).

An historical résumé of the early discoveries of the emission of electricity by heated bodies is followed by some remarks on the value of *e/m* for electrons. R.130.

E. L. Chaffee. Detection Co-efficient of Thermionic Valves (*Physical Review*, 18, pp. 152-153, August, 1921).

A mathematical expression is derived for the detection co-efficient, taking into account the grid circuit effects as well as the plate circuit rectification. Experimental results agreed with the theoretical expressions. R.130.

E. W. B. Gill. Comparison of processes of Ionisation which give rise to currents in Gases (*Philosophical Magazine*, 42, pp. 852-856, November, 1921). R.130.

Alberti and Zickner. Wave form and phase in valve oscillators (*Elektrotechnische Zeitschrift*, 42, p. 1252, November 3rd, 1921; *Physikalische Zeitschrift*, 22, p. 652, December 1st, 1921).

Abstract of Paper describing experiments at Reichsanstaldt. Lissajous figures were obtained by means of a Cathode Ray Oscillograph. The various characteristics were investigated at wavelengths between 1 and 18 kilometres under various conditions. R.130.

N. H. Williams. Phase relations in Coupled Circuits (*Physical Review*, 19, p. 275, March, 1922). R.140.

B. L. Stephenson. Resistance-Capacity Amplification (*Wireless World and Radio Review*, 10, pp. 18-19, April 1st; pp. 46-47, April 8th, 1922). R.140.

S. Butterworth. Eddy-current losses in cylindrical conductors and the A.C. resistance of short coils (*Transactions of the Royal Society*, 222a, pp. 57-100, September 9th, 1921). R.140.

E. F. Clark. Harmonics (*Wireless World and Radio Review*, 10, p. 145, April 29th, 1922). R.140.

A. L. Narayan. Mechanical Illustration of Three Magnetically Coupled Oscillating Circuits (*Philosophical Magazine*, 43, pp. 575-580, March, 1922). R.140.

A. L. Narayan. Coupled vibrations by means of a double pendulum (*Philosophical Magazine*, 43, pp. 567-574, March, 1922).

Galvonometer mirrors mounted on the pendulums are employed for indicating the oscillations. R.140.

K. Rogowski. The valve oscillator with mixed primary and secondary grid coupling (*Elektrotechnische Zeitschrift*, 42, p. 1250, November 3rd, 1921).

A study of the discontinuous resonance curves obtained when the grid is coupled both to the inductance in the anode oscillatory circuit and to the inductance of a secondary oscillatory circuit. R.140.

K. H. Warfvinge. Integral effect of two coupled oscillation circuits (*Arkiv för Matematik, Astronomie och Fysik, Stockholm*, 15, pp. 1-19, 1921). R.140.

F. Harms. Coupled oscillatory systems with self-excitation (*Annalen der Phusik*, 66, pp. 25-49, October 27th, 1921).

A mathematical investigation of the conditions for the building up and maintenance of oscillations in coupled pendulums with back coupling, followed by a consideration of the valve oscillator with coupled circuits. R.140.

P. R. Coursey. C. W. Reception viewed from another standpoint (*Wireless World and Radio Review*, 10, pp. 127-129, April 29th, 1922). R.160/360.

F. Luchsinger. An investigation of the Carborundum Detector (*Physikalische Zeitschrift*, 22, pp. 487-491, September 1st, 1921).

No trace of electrolytic decomposition could be observed even with currents of 0.1 ampere. The rectification persisted in liquid air, and also when crystal was white hot. R.160.

I. B. Crandall and D. Mackenzie. Analysis of the Energy Distribution in Speech (*Physical Review*, 19, pp. 221-232, March, 1922). R.190.

N. C. Krishnaiyar. On the amplitude of vibrations maintained by forces of double frequency (*Philosophical Magazine*, 43, pp. 503-510, March, 1922).

A mathematical article. R.190.

A. Gibbs. Effects of Aurora on Telegraphs, Telephones, and Wireless (*New Zealand Journal of Science and Technology*, 4, 1921; *Post Office Electrical Engineers' Journal*, 15, pp. 39-42. April, 1922.—Abstract). R.190.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Complete Specifications.

146 997 Hogan, jun., J. L. Method of and apparatus for receiving radio-signals. (27/11/16.)
147 029 British Thomson-Houston Co., Ltd. Electric systems for the transmission of power, and multi-speed induction motors suitable for use therein. (31/5/17.)
147 533 Radio Corporation of America. Wireless signalling apparatus. (2/4/15.)
147 759 Latour, M. Telephone and the like systems. (25/6/15.)
147 793 Apple, V. G. Electric-current controlling devices. (17/1/19.)
147 853 Ges. für Drahtlose Telegraphie. Cascade high-frequency amplifiers. (22/7/18.)
148 314 Huth Ges., Dr. E. F. Manufacture and operation of vacuum tubes. (30/3/18.)
148 318 Huth Ges., Dr. E. F. Reels and the like for winding and unwinding aërial conductors. (16/1/18.)
148 446 Ges. für Drahtlose Telegraphie. Generation of high-frequency currents. (19/1/15.)
148 481 Majestic Electric Development Co. Electric heaters and the like. (26/12/17.)
148 529 Silbermann, H. Slip-pieces for bow collectors for electric vehicles. (1/9/15.)
148 976 Signal Ges. Electro-magnetic sound producers and receivers (14/8/18.)
150 354 Thompson, H. H. Electric arc lamps. (26/3/18.)
150 990 Union (Firm of). Automatic electrical chain-welding machine (2/9/19.)
151 003 Bisch Akt.-Ges. R. Magneto-electric ignition apparatus. (30/8/19.)
151 253 Soc. Anon. pour l'Exploitation des Procedes M. Leblanc-Vickers. Dynamo-electric machines. (18/9/20.)
152 001 Tanaka, T. Manufacture of electric rotating machines. (11/7/19.)
152 036 Ges. für Drahtlose Telegraphie. Means for receiving wireless signals. (8/10/19.)
152 617 Elektrische Gluhlampenfabrik "Watt" Akt.-Ges. Process for fastening the electrodes in vacuum tubes, more especially in Röntgen tubes. (18/10/19.)
153 004 Schmierer, M. Luminous electric discharge tubes for the production of illuminated signs and the like. (25/10/19.)
153 563 Western Electric Co., Ltd. Repeaters for multiplex signalling systems. (31/10/19.)
154 884 Ges. für Drahtlose Telegraphie. Transmission of high-frequency oscillations over high-power conductors for high-frequency telegraphy and telephony. (1/12/19.)
157 063 Electric Outlet Co. Inc. Electrical connecting and supporting devices. (10/1/20.)
157 095 Goosman, J. Electric gas lamps with glow discharge. (8/1/20.)
158 859 Hübener, H. Link-connecting piece especially for electroliers. (11/2/20.)
158 909 Soc. Materiale Elettro Trazione. Industrial process of and apparatus for the internal electro-plating of insulators. (12/2/20.)
164 009 Latour, M. Electro-magnetic wave-signalling systems. (8/12/15.) (Addition to 147 462. Divided Application on 147 462.)
166 521 Akt.-Ges. Brown, Boveri, et Cie. Mercury-vapour pumps for high vacua. (17/7/20.) (Addition to 165 400.)
170 612 Legge, W. A. Electric switch fuses. (29/4/20.)
170 614 Pouchain, A. Electrodes for electric batteries and accumulators. (3/5/20.)
170 615 Pouchin, A. Negative electrode for electric accumulators. (3/5/20.)
170 618 Pouchain, A. Electric accumulators. (27/5/20.)
170 619 Taylor, A. M. Electrical power transmission systems. (12/6/20.) (Patent of Addition not granted. Cognate Application 17 480/20, 22 617/20, 28 923/20, 31 156/20, and 2/21.)
170 634 Macrorie, A. K., Airey, H. Morris, Shearing, G., & Mullard, S. R. Insulation and support of thermionic valve electrodes between which a high potential difference exists. (10/7/20.)
170 643 British Thomson-Houston Co., Ltd. (General Electric Co.). Electric welding apparatus. (21/6/20.)
170 656 Marconi's Wireless Telegraph Co., Ltd. (Goldsmith, A. N.). Wireless telegraphy and telephony. (22/7/20.)
170 663 Cleaver, R. L. Dynamo-electric machine group. (24/7/20.)
170 692 Bowman, F. H., & Aspden, R. L. Transmission of power in and to the electrical equipment of motor-vehicles, aircraft, and the like. (6/8/20.)
170 701 Railing, A. H., & Angold, A. E. Means for charging portable electric accumulators. (11/8/20.)
170 716 Prentice, H. B. Ceiling roses, cut-outs, connectors, rosettes, and similar electrical fittings. (17/8/20.)
170 724 Zuckschwerdt, F. Electric switches. (20/8/20.)
170 728 Fawssett, E. Method and apparatus for the measurement of the temperature of electric cables. (23/8/20.)
170 730 British Thomson-Houston Co., Ltd. (General Electric Co.). Amplifying systems for electric currents. (23/8/20.)
170 735 Burns, P. C. Telephone desk sets. (7/9/20.)
170 738 Schlegell, F. von. Construction and regulation of electric arcs. (10/9/20.)
170 745 Rogers, T. W. (Krupp Akt.-Ges. F.). Electric switch devices. (21/9/20.)
170 746 British Thomson-Houston Co., Ltd. (General Electric Co.). Regulating systems for alternating current circuits. (22/9/20.)
170 748 Thompson, J. L. Storage battery testers. (27/9/20.)
170 751 Amberton, R. Casings, mountings, and connections for electrical instruments, such as ammeters. (30/9/20.)
170 756 Crust, R. Electric junction box. (8/10/20.)
170 768 Ham, A. W. Bases of trolley poles for electric traction. (2/11/20.)
170 784 McCrudden, H., & Callenders Cable & Construction Co., Ltd. Junction boxes for electric cables. (20/12/20.)
170 809 Turquand, F. J. Secret magnetic locks for electric battery lamps, more particularly for use in mines. (23/1/20.) (Divided application on 17 077/20.)
170 873 Damey, C. A. Electric fly switches. (29/4/20.)

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CONTENTS.

Notes of the Week.

An Interesting Scottish Water Power Scheme.

The Grampians Electricity Bill, the most important private measure of the Session, has emerged successfully from the Committee stage in the House of Commons, and we congratulate the promoters upon their diplomacy and tact in getting rid of the powerful opposition of the fishery and landed interests which at one time threatened to wreck the scheme. By judicious concessions the various opponents were induced to withdraw their petitions, with the result that the Bill is now proceeding as an unopposed measure. The powers sought include authority to use the water power of Lochs Rannoch, Ericht, Tummel and other lakes and rivers in the Grampians for the generation of electricity and to supply electricity in bulk, and also in retail, for power and lighting over a wide area. Four power stations are scheduled, but the scheme will be developed in sections, and the first power house will be probably erected at Loch Tummel.

Unusual Financial Provisions.

The Bill is also interesting on account of the proposed method of raising capital. The complete scheme is estimated to cost £4 500 000, but it was proposed to raise at the outset only £1 000 000 as share capital and £2 000 000 or £2 500 000 by debentures. This unusual method of finance, this unprecedented amount of borrowed capital, was severely criticised by members of the Committee, but as the promoters had secured from the Committee under the Trade Facilities Act a promise of a guarantee of the principal and interest on £2 000 000 of the debentures, it was ultimately decided to alter the clause by permitting the company to raise £1 750 000 in ordinary shares and £1 750 000 by borrowing. Of the latter £850 000 can be raised without the consent of the Electricity Commissioners, but their sanction must be obtained before the remainder can be borrowed. This seems to us a reasonable compromise under the circumstances, and will, we hope, ensure the passage of the measure through the House of Lords without further opposition.

Is State Guarantee Justified?

We do not appreciate the attitude of Mr. Briggs, M.P., one of the members of the Committee. He objects to a State guarantee in favour of a private enterprise, apparently because the commercial future holds a certain amount of risk. But the Trade Facilities Act was passed for the specific purpose of encouraging railway companies, electricity undertakings and others to carry out useful public works in order to increase employment, and we can conceive no scheme to be of greater public importance and utility than the Grampian Company's project. It will enable 50 000 or 60 000 E.H.P. to be developed from water power which is at present running to waste; it will assist by economising coal, by introducing new industries in the Highlands, by providing cheap power for operating the local railways, and in other ways. In our opinion there are few schemes more worthy of Government assistance than the Grampian hydro-electric project, which seems to contain no greater element of risk than some of those already approved by the Trade Facilities Committee. We are not enamoured of Government trading, but in certain cases, and the present is one of them, financial assistance might well be given for a limited period.

Three Important Wireless Points.

A second reading of Dr. W. H. Eccles' recent Paper on "Imperial Wireless Communication" clearly brings out three points. The first is that nothing is being

done to materialise an Imperial scheme except to talk about it. And to those who know the history of the attempts to bring a world-wide wireless communication into being, and who will recall the many Commissions and Committees which have reported and passed away and the expert knowledge which has been tapped and spilt, may well begin to wonder whether anything ever will be done. As in many other things, Great Britain was the first country successfully to achieve wireless communication. But now we are falling behind in the race, and shall continue to recede unless the problem is tackled in a more enterprising and broad-minded spirit. Government ownership and private monopoly are equally bad solutions, but something might be done with a combination of the two.

Patents and Progress.

The second point is the burning patent question. Dr. Eccles clearly brought out that the resources necessary for building the Wireless Chain do not all lie in one set of hands. For instance, probably the most vital patent of all, Fessenden's heterodyne patent, is owned by the Metropolitan Vickers Co., who are not usually looked upon as wireless people at all Again, Mullard silica valves are now in course of construction which will have about ten times the rating and about the same size as the largest Marconi valves; so there is freedom that way as well. C. F. Elwell has equipped many of the largest stations in America and Europe with masts and general wireless equipment; so there is no monopoly there. And altogether, as we pointed out last week, there is still that freedom of development which is essential for the good of so young an industry and science as wireless communication.

Is 2 000 Miles Enough?

The third point is that of range. Dr Eccles thinks that a 2 000 mile range is sufficient. The Marconi Company would have the range increased. But it is significant that no station of the size required under the scheme has yet been built even for the shorter of the two ranges, and the important question also arises whether it is economically sound to build a station which could maintain so long a maximum range as that suggested by the Marconi Company throughout the twenty-four hours. To do so would cost three times as much as to erect one of the official 2 000 mile stations, if it could be done at all, and would not offer any great practical advantages when it had been done, though it would perhaps be a magnificent gesture. On the other hand, the official relay stations will be utilisable for both long distance and local traffic, and will also be amply large enough to radiate a sufficient amount of energy for reception at practically every part of the earth at all times. If therefore, as seems probable, any advance is made with the design and construction of atmospheric limiting devices, the hours of working per day will be increased without the tremendous cost and added interference of the "super" station. But all these points are really insignificant so long as the Government shows reluctance to do anything. Mr. Kellaway has exhibited courage over the postal rates. Let him do the same with Imperial wireless communication. It is work that is long overdue. At present the position is most unsatisfactory, and Dr. Eccles' Paper and the discussion thereon have not improved it—unless it is by showing us how profound is the disagreement between acknowledged experts.

Improving Electric Traction Equipment.

It is axiomatic that electric traction must stand or fall on the economic results it brings in its train. These economic results will, we hope, be higher in many ways than the level we have reached to-day. One method by which this can be achieved is by an examination of all possible ways of improving the electrical equipment, whether it be on the locomotives, in the collecting arrangements or in the sub-stations. The Paper which Mr. Roger T. Smith read before a recent meeting of the Institute of Transport, and of which we publish an abstract elsewhere in this issue, is therefore opportune. Mr. Smith not only analyses the costs of employing present-day apparatus, but indicates ways in which that apparatus is being and may be improved so as to attain those results which we have just described as essential.

Railways and Electrical Manufacturers.

We are glad, moreover, to find him reiterating a point which he has made before. It is none the worse for reiteration, for it is in truth of the very greatest importance. In effect Mr. Smith asks whether it would not be better for the railways of this country to give a fair trial to the policy of helping to build up the manufacture of electric traction equipment by commercial firms rather than to try and manufacture that equipment for themselves, as they have done to a large extent in the past in the case of other engineering material. It seems to us that it is very much worth while. Not only would it help British firms to create and develop both home and foreign trade and all that that implies, but it would place at the disposal of the railway companies all those fruits of research and experience which are only attainable by those whose work it is to design and manufacture for a number of varying conditions, an experience which cannot be obtained by the railway electrical engineer, whose business is chiefly with maintenance. While therefore we have the greatest admiration for the work of British railway engineers, as evidenced in that almost perfect machine the modern steam locomotive, we hope that that policy of which that machine is the outcome will not be followed when a conversion to electric traction is undertaken. New ideas require new methods!

The Engineering Dispute.

Though at first sight the Court of Inquiry into the engineering dispute seems to have failed, owing to the lack of goodwill and good sense between the parties concerned, the prospects of a settlement of what has been a most disastrous misunderstanding are brighter as we go to Press than they have been at any time since the lock-out started. The fact is that Sir W. Mackenzie's report, if it did nothing else, at least raised in the minds of both disputants qualms as to the possibility of maintaining their stubborn attitude to the bitter end (whatever that is), and this combined with the war-weariness and disappointments which are the inevitable accompaniment of such occurrences, have induced a frame of mind which leads us to hope that some formula, bridge or datum will be found for getting out of the difficulty.

The Effect on Trade.

How necessary this is has probably been brought up to most of our readers in one or other forcible and unpleasant way. And the trade returns for April only emphasise the

disaster which has been gratuitously brought upon us Imports at 80½ millions are seven millions less than in the previous month, total exports are down by 10 millions, and exports of merchandise of home production by 9 millions. Exports of British manufacture were only 44 millions as against 51½ millions in March, and for this machinery with a decline of £1 600 000, and vehicles with a decline of £3 300 000, were largely responsible. The stoppage has indeed done harm from which the industry with which we are most concerned will be a long time in recovering. Its present state is pitiable, and makes the widespread assurances that trade is reviving seem cynicism of the worst kind in the ears of engineers.

An Important Development.

In a preceding paragraph we remark that the name of the Metropolitan Vickers Electrical Company is not much associated with wireless work. But that is to be changed, for we are now able to announce that that well-known concern is entering this field in conjunction with the Radio Communication Company, of London, and is taking active steps towards the manufacture of wireless receiving equipment. It will be remembered that the Radio Communication Company was formed in 1919 to conduct business in connection with the establishment of radio telegraph and telephone installations, and is well known for its important work in this connection during the war. The company is also connected with the Indo-European Telegraph Company and the Eastern Telegraph Company.

Wireless at Trafford Park.

Mr. A. P. M. Fleming, the manager of the Metropolitan-Vickers Company's research and education departments, has been for some time in touch with the Postmaster-General with reference to the establishment of broadcasting stations. The precise areas to be covered by the different stations have not yet been defined, but there is little doubt that the Metropolitan-Vickers Works at Trafford Park will form the site for the Manchester district station, and a second station will probably be located at Slough, other stations being projected as they are required. Immediately details respecting the sites and areas to be covered are settled it is expected that the work will go ahead quickly and the manufacture of receiving sets is already being pushed forward. It will be recollected that the Metropolitan-Vickers Company is technically very closely associated with the Westinghouse E. & M. Company, of Pittsburgh, which was the pioneer of radio broadcasting in the United States, and among the first of the companies to undertake the extensive manufacture and distribution of cheap equipments for the reception of broadcasted news, musical programmes, weather reports, etc. The Metropolitan-Vickers Company will therefore be able freely to draw upon this unique experience, and this together with the technical experience of the Radio Communication Company, and its own selling, manufacturing and research organisation, should place the Company in a favourable position in entering this new field. Further developments will be awaited with interest.

Illegal Connections to Supply Mains.

A number of charges of stealing electricity and of making unauthorised connections to the mains of supply authorities have been before the police courts of late, and the question arises whether the penalties for an offence, which is evidently on the increase, are sufficiently severe to act as a deterrent. We reported two cases a fortnight ago in The Electrician and one in the issue before that. Two of the parties were fined, one £5 and the other £50, but it is doubtful if courts of petty sessions can appreciate the situation, or realise the damage that may be done by these illegal connections, because the penalty seldom exceeds £5.

The Law on the Subject.

By Sec. 23 of the Electric Lighting Act of 1882, any person who maliciously or fraudulently abstracts, causes to be wasted or diverted, consumes or uses any electricity is guilty of simple larceny, and punishable accordingly. It is not always easy to prove felonious intent against a householder who employs a contractor and relies on him to make the connection to the mains, and, moreover, the expense and trouble of prosecutions are so great that usually recourse is had to the limited summary jurisdiction of magistrates. Consequently, charges of illegal connection are brought under sections of the Gasworks Clauses Acts, 1847 and 1874, which have been incorporated in the Electric Lighting Act, 1882, and which limit the penalty to £5 for each offence, though the undertakers may also recover the amount of any damage sustained by them.

An Inadequate Punishment.

This is an inadequate punishment, for an unauthorised electricity supply connection may be far more serious in its consequences than the tapping of a gas main, as it might blow a fuse and lead to many neighbouring consumers being deprived of electricity. Serious cases of fraud on supply authorities should be sent to the Quarter Sessions, where heavier penalties could be inflicted, and we also think the law should be altered to enable undertakers to charge the consumer with the value of the maximum amount of electricity which the lamps and other current-consuming devices on his premises could have consumed. Contractors who lend themselves to these illegal acts should equally be penalised, so that a stop may be put to dishonest and mischievous practices.

The Rivals.

The recent debate in the House of Lords on the Electricity Supply Bill brought out a question of principle in regard to legislation for the rival industries—electricity and gas. Lord Newton, it will be remembered, put forward an amendment in the interests of gas companies which Viscount Peel suavely but summarily disposed of, explaining that it has not been customary to allow gas companies a *locus standi* on Electricity Bills simply on the ground of competition, or to allow them the right to veto electricity supply. The gas companies, in their view of the present Bill, are evidently more optimistic as to the benefits of electricity supply legislation than a certain section of the electricity supply industry itself. This reminds us of a semi-obsolete provision in the Electric Lighting Act of 1882, which probably most people have forgotten. Everyone at that time was exceedingly optimistic as to the vast conquest which electricity would make when once suitable legislation was provided (they have learnt better since), and the framers of the Act of 1882 anticipated an early demise of their gas rivals in certain localities. Under Section 29 of the 1882 Act, Parliament therefore very considerately provided that in any area where electric light ousted its rival to such an extent that the supply of

gas was unremunerative, the gas company could make application to the Board of Trade to be relieved of its obligations to supply gas in such areas, and the Board of Trade was empowered to give them such relief. But only in one or two small areas have gas companies hauled down their flag, though many of them have obtained electricity supply powers in order to keep out rivals. Usually where a gas company supplies gas and electricity it will be found that, owing to the novercal attitude of the company, no attempt is made to push the use of electricity, and this side of the business is in a chronic state of bankruptcy. If, however, our good friends, the gas industry, feel alarmed at the present legislation, they have the comfort that the 1882 Act provides for their respectable and dignified obsequies.

A New Zealand Electricity Scheme.

INTERESTING particulars of the progress made in the evolution of the national scheme of electricity supply for the Dominion of New Zealand are given in the annual report for 1921 of the Chief Electrical Engineer, Mr. L. BIRKS. Drawn up in 1916 by Mr. E. PARRY, the scheme was based on the gradual development of the water power available in both islands and the estimated demand was put at 0·2 H.P. per head of the population per annum. In order to supply this power for the North Island a complete interconnected scheme was laid out, consisting of 1 112 miles of main transmission lines and 309 miles of branch lines. The pressure adopted was 110 000 V for main transmission and 33 000 V for branch lines, except the Waikato branch, where a pressure of 50 000 V was already in operation from the Horahora station. The system is to be connected up and fed from three main hydro-electric stations—viz., Mangahao River (24 000 H.P.), Waikaremoana (40 000 H.P.) and Arapuni (96 000 H.P.), but the ultimate capacity of these stations will be 322 000 H.P. and the transmission lines are to be connected up to three existing plants of 12 000 H.P. at Horahora, New Plymouth and Wairua Falls. The cost of the whole North Island system was originally estimated at £7 303 042, but this figure will be exceeded by over 50 per cent., and already authority has been given to raise £9 322 500. And the ultimate cost of the schemes for the Dominion will be over £20 000 000.

Progress During 1921.

During the past year the Horahora plant and main transmission line to Waihi (50 miles) were purchased for £212 500 and it is proposed to extend the generating plant by two units of 2 600 H.P. each, bringing the total capacity of the plant to 13 600 H.P. Supply was commenced in Cambridge, Hamilton and Paeroa; lines were erected to Te Awamutu and Te Aroha, and the necessary material was ordered for the first of the 110 000 V main lines to Auckland, which is now receiving a temporary supply from Horahora. Some progress was also made with the Mangahao station, but tenders for the plant were not invited until the end of the year in order to obtain the advantage of lower prices. During the current month, however, the Metropolitan Vickers Electrical Company secured this important contract, which includes three 6 000 kVA and two 3 000 kVA water wheel generators, switchgear, transformers, &c. In addition, the approach roads and bridges at Waikaremoana are being constructed and power house surveys made, and at Rotorua the surveys have also been completed. The total expenditure on all the North Island projects at March 31, 1921, was £457 974, compared with £201 723 in the previous year.

South Island Scheme.

No comprehensive plan has been drawn up for the supply of the South Island, but sufficient information is now available to enable the general outlines to be laid down for the Canterbury, Otago and Southland portions of the Island. The scheme will consist ultimately of a completely inter-connected transmission system on somewhat similar lines to the North Island and supplied from four or five main power houses and two or three subsidiary sources. As the population in the South Island is more concentrated round certain definite centres and as the transmission pressure already adopted for the Lake Coleridge and the proposed Southland system is 66 000 V, it is proposed that this shall be the standard employed. This is stated as being the highest pressure for which pin insulator construction is reliable, and will effect a saving of £400 per mile in first cost, compared with the 110 000 V suspension insulator type. For Canterbury, Otago and Southlands 759 miles of main transmission lines are suggested, but a few isolated districts will be dealt with separately. The various power boards or retail authorities will be supplied in bulk from the main lines; sub-stations will be located at intervals of 20 to 60 miles, according to the demands, and from these sub-stations supply will be given to the power boards at 11 000 or 33 000 V.

Financial Results.

Some particulars are given of the operating results of the Horahora and Lake Coleridge undertakings, the two main Government supply systems, and of the local electric supply undertakings. The capital outlay at Horahora was £249 745; the total costs were £21 004; the revenue amounted to £14 663, and there is an accumulated debit balance of £8 464. The total units sold were 15 376 000, of which the Waihi Gold Mining Company took 14 477 387. On the Lake Coleridge scheme the capital expenditure was £499 957 (against £422 076 in the previous year); the year's revenue was £51 373, working expenses came to £21 341, capital charges to £18 639, and after allowing £7 946 for depreciation there was a net profit of £3 447. The total units sold were 31 402 351 (compared with 28 017 976), costing 0·366d. per unit, but the price received was 0·288d. from Christchurch City Council (14 700 000 units), 0·294d. from the tramways (6 379 717 units), 0·553d. from wholesale consumers and local bodies (10 051 734 units) and 1·58d. per unit from retail consumers, who took only 270 000 units. The power house maximum showed an increase of 6½ per cent., the output an increase of 10 per cent., and the load factor improved from 59·9 to 61·4 per cent.

Low Prices General.

The prices charged seem to be low and they compare favourably with the best of the British undertakings. Yet a profit was made on the year's working, and no doubt better results will be shown when the system is fully developed.

A new 3 000 kW generating set was started up, and various extensions of the transmission lines, distributing networks and sub-station equipment were carried out during the year. The total connected load (34 277 kW) increased by 12½ per cent., and the very high diversity factor (5·1) is

attributed to the encouragement of off-peak loads. The transmission line insulators have given indications of progressive deterioration and during the latter part of the year breakdowns occurred, but a rigorous overhaul and replacement of defective insulators have effected a pronounced improvement. Of the fifteen councils and public bodies taking energy in bulk and retailing it to the public, nine made an aggregate profit of £11 821 and six recorded a total loss of £725. This seems satisfactory, especially as those which made a loss were all small and undeveloped undertakings.

Local Supply Systems.

Apart from the two Government hydro-electric works, there are 55 supply stations in the Dominion. The total capacity of these 57 stations is 49 630 kW of main plant and 5 831 kW of subsidiary plant. There are 26 hydro-electric stations of 23 895 kW (48·1 per cent. of the whole); 10 steam-driven of 21 820 kW (44 per cent.), 19 gas engine stations of 3 195 kW (6·45 per cent.) and two oil engine stations of 720 kW (1·45 per cent.). Seven additional licences for local distribution and one licence for bulk supply were issued during the year and construction is in hand, but only slight additions were made to the total plant capacity. It has, however, been decided to put in new plant of 45 000 H.P., at an estimated cost of about £1 600 000, and work on these extensions is proceeding.

Consumers and Units Sold.

Pending the completion of the large Government hydro-electric stations some of the existing smaller plants are being linked up and it is hoped that this will enable the various authorities to carry on until the larger sources of power are in operation. At the end of the year there were 73 151 consumers, compared with 58 449 in the previous year; the total length of "reticulation" lines is 2 260 route miles and of transmission lines 360 miles. The units generated by the 57 power plants amounted to 149 476 379, of which 124 446 459 were sold. The units sold per consumer, after deducting the tramway supply, were 1 246, or 133 per head of the population. These figures are above the average for British provincial undertakings, and when the sparsely populated, rural character of many of the supply areas in New Zealand is taken into account, the record is quite good.

The Agricultural Demand.

Dairy farming is, and promises to remain for some years, the main industry of the Dominion. Consequently, the future of electricity supply is bound up with the extension of the distributing system into the dairy districts. The organisation of electric power boards is proceeding in a satisfactory manner and four new boards were formed in 1921, making fourteen in all and covering nearly 19 000 square miles, or over 18 per cent. of the total area of the Dominion. The importance of the dairy demand is seen from the fact that there are about 40 000 milk suppliers, and in April 1920 nearly 9 000 of these were using milking machines, requiring 2 to 3 H.P. each; and according to Mr. BIRKS the number is increasing at the rate of 16 per cent. per annum. The total demand for milking alone will thus run into tens of thousands of horse-power, and will constitute a large proportion of the total demand for hydro-electric power in the Dominion.

Economics of Country Lines.

It is calculated that there will be a revenue of £24 to £30 from the average dairy farm for milking machines alone. This figure will justify the laying of a supply line, and when once electricity is available on the farm it is probable that it will be used for lighting, ironing, cooking, heating and power generally. In view of the difficulty of making country lines remunerative, tests were recently carried out on five typical plants in the Canterbury district in order to determine the power required to drive the average plant and the consumption of energy over a season. A 3 H.P. motor was employed, but as the tests indicated that a 2 H.P. motor would have been sufficient for at least four of the test installations, 2 H.P. motors have been installed on several similar and even larger plants, with satisfactory results.

Standardization of the Milking Machine.

This size is in fact being standardized for milking machine drives generally. The results of the tests are set out in a table in a paper by Mr. BIRKS, which has been reprinted from the "New Zealand Journal of Science and Technology," and the conclusions to be drawn from the table are: (1) The low power required; (2) the high value of the idle current and the consequent high value of kilovolt-ampere demand; and (3) the power taken is very variable and apparently depends more on the efficiency of the plant and method of use than on the actual number of cows milked.

Milking Demand an Ideal Load.

From the point of view of the supply authority the milking load is said to be ideal, as the heaviest load occurs in the summer, when no overlapping of lighting and power peaks of the main system is likely, and it tapers away almost to zero for the three worst winter months, when the general demand is highest. Even in summer the milking plant is finished before 8 a.m., and is not required again until 5 p.m.; thus the industrial or day peak is not interfered with, and it allows an undertaking to work on a higher diversity factor, produces a better load factor and tends to flatten out the daily load curve, at the same time yielding a substantial revenue. Once electricity is available in the milking shed it will also be used for heating water and other purposes, and in the opinion of Mr. BIRKS the most effective application of electric power to milking machine work will consist of a small self-contained outfit comprising the electric motor, a vacuum pump, a cream separator, a small water supply pump and 10-gallon hot water cistern, with the necessary switchgear, all mounted on a compact hardwood base plate, suitable for moving about.

A Contrast.

Units such as these are said to be required by the thousand in the dairying districts of the Dominion, and British manufacturers who are in a position to supply them might well take note of the fact, as there is no part of the Empire so favourable to British manufactures than New Zealand.

This is sufficient to show that they are optimists in New Zealand, and are not oppressed by doubts as to the financial results which will be obtained from the widest possible use of electricity on farms.

In general, therefore, it may be said that electricity supply is being conducted on modern lines in the Dominion, and in some respects is in advance of what has been done in this country. One of these seems to be the whole-hearted efforts that are being made to establish a wide-spread system of electricity supply on most modern lines. It is significant that it is in the newest countries that the public good is the first endeavour and that only in the older kingdoms is obstructionism permitted to hold sway to any extent.

Some Notes on the Theory of Phase Meters.

By G. W. STUBBINGS, A.M.I.E.E., A.Inst.P.

The author considers in detail a theory of single phase and three phase meters which is on simpler lines than the usual analytical treatment. The resultant rotating field, pulsating fields, frequency errors, accuracy and the advantages of balanced load power factor meters are discussed.

The present paper is an attempt to put forward a brief account of the theory of phase meters which will be on simpler lines than the usual analytical treatment, whilst being somewhat more rigorous than the perfunctory treatment generally accorded to this subject.

The Single Phase P.F. Meter.

The single phase power factor meter is the simplest instrument of its class for a preliminary elementary consideration. The moving element of this instrument consists of two coils spaced at right angles and pivoted without control, these two coils being of similar size and number of turns, and traversed by equal currents proportional to the voltage of the supply, one of these currents being in phase with, and the other displaced in phase by 90 degrees from this voltage. The fixed coil of the instrument is traversed by the current the phase of which is to be determined. The moving element gives rise to a uniform rotating field. If time be reckoned from the instant that the direction of the rotating field coincides with the axis of the coil in the non-inductive pressure circuit, and θ be the angle between the axis of this coil and that of the fixed coil measured in a direction against the rotating field, the position of the rotating field with respect to the fixed coil at any instant will be $(pt-\theta)$. The torque on the moving system is therefore proportional to

$$iv \cos(pt-\varphi)\sin(pt-\theta)$$

or to $$iv\{\sin(2pt-\varphi-\theta)-\sin(\theta-\varphi)\}$$

Since the moving system is without control it will take up a position such that the average torque is zero. The average value of the first term in the above expression being zero, this condition is given by $\sin(\theta-\varphi)=0$ or $\theta=\varphi$ The angle between the axes of the fixed coil and the non-inductive coil of the moving system will therefore be equal to the phase angle of the current with respect to the voltage.

An Alternative Consideration.

An alternative method of deducing the foregoing result is to make use of the elementary proposition that a field oscillating according to the simple harmonic law can be resolved into two equal fields rotating in opposite senses. These rotating components coincide in direction when the resultant field passes through its maximum values. According to this conception the non-inductive coil of the moving system of the power factor meter gives rise to two rotating fields. The reactive coil will similarly have two rotating components. The current in this coil being displaced 90 degrees in phase with that in the non-inductive coil, at the instant the two rotating components of this latter coil coincide in direction the two components of the field due to the reactive coil will be spaced 90 degrees from it. The angular spacing of the components of this field with respect to the coil producing it will, of course, be in opposite senses, since these components are rotating oppositely. One of these components will, therefore, coincide in direction with the similarly rotating component of the non-inductive field, whilst the oppositely rotating component of the reactive field will be 180 degrees displaced from the similarly rotating component of the other coil, and these components will cancel each other.

Uniform Resultant Field.

The total resultant field will, therefore, be uniform in magnitude, and will have a constant angular velocity. The fixed coil will likewise give rise to two rotating components, the one of which rotating in the opposite sense to the field due to the moving system will not be competent to produce any average torque. The component which rotates in a similar sense to that of the pressure field, has its direction coinciding with the axis of the fixed coil when the current passes through its maximum value. At the instant therefore that the pressure field coincides in direction with the axis of the coil connected in the non-inductive circuit, the similarly rotating component of the current field will be at an angle φ from the axis of the fixed coil, φ being measured against the direction of rotation for a lagging current and *vice versa*. If θ have the same meaning as before, at the instant considered, the angle between the direction of the two fields is $(\varphi-\theta)$, and since they are rotating uniformly at the same angular velocity, this angle remains constant. The torque on the moving system being proportion to $\sin(\varphi-\theta)$ this system will take up a position such that this torque is zero and the direction of the two similarly rotating fields is coincident.

Case of Two Coils at 90 deg.

The resultant rotating field produced by a set of coils in a power factor meter is not in constant in magnitude, nor uniform in angular velocity. The extremity of the resultant flux vector describes an ellipse which in limiting cases becomes either a circle or a straight line. The properties of an elliptical field can be briefly noticed by looking at the simple case of two coils spaced 90 degrees apart, carrying unequal currents displaced 90 degrees in phase. If x and y are the instantaneous values of the two pulsating fields, the locus of the extremity of the resultant flux vector is given by

$$y=b\sin pt \qquad x=a\cos pt$$

whence $$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1.$$

The angle described by the resultant flux vector is given by

$$\tan\beta=\frac{b}{a}\tan pt.$$

The magnitude of the resultant flux is $F=(x^2+y^2)^{\frac{1}{2}}$.

The angular velocity of the resultant vector is given by

$$\frac{d\beta}{dt}=\cos^2\beta\,\frac{pb}{a\cos^2 pt}$$

or, since $$\cos^2\beta=\frac{a^2\cos^2 pt}{F^2}$$

$$\frac{d\beta}{dt}=\frac{pab}{F^2}$$

The rate of increase of the area swept out by the flux vector is

$$\tfrac{1}{2}F^2\frac{d\theta}{dt}=\frac{pab}{2}$$

The movement of the rotating resultant is such that the flux vector describes equal areas in equal times. The angular velocity is thus less than the average when the direction of the resultant is in the neighbourhood of the stronger coil and greatest when passing the axis of the weaker.

Torque on the Moving System.

The torque on the moving system of a power factor meter which generated such an elliptical field would have the average value of

$$iF\sin(pt-\varphi)\sin(\beta-\theta).$$

The direct calculation of the value of θ which makes this average value zero, is troublesome, but by resolving the pulsating fields into rotating components, the calculation is much simplified. Considering the case just discussed. if $2a$ represents the maximum value of the pulsating fields due to the non-inductive coil of the pressure, and $2b$ that of the reactive coil, the two fields differing in phase

by 90 degrees; the components rotating in one sense will reinforce, and those rotating in the opposite sense will oppose each other. The values of these components will be respectively $(a+b)$ and $(a-b)$. The rotating components of the field due to the current coil will, at the instant the stronger pressure field coincides in direction with the axis of the non-inductive coil, be distant from the axis of the series coil by an angle φ measured against the direction of rotation of each field. If the angular displacement of the moving system as previously defined be θ, then at this instant the angular distance between the pairs of similarly rotating components will be $(\varphi-\theta)$ and $(\varphi+\theta)$ respectively, and the torques produced by these pairs of components will be opposite in sense, and the resultant torque is

$$(a+b)\sin(\varphi-\theta)-(a-b)\sin(\varphi+\theta).$$

When this torque is zero

$$\tan\theta=\frac{b}{a}\tan\varphi.$$

Nature of the Frequency Error.

This expression gives the nature of the frequency error for a single phase power factor meter having the reactive circuit in the form of a condenser. The phase displacement in such a case will be very nearly 90 degrees, and the effect of frequency is only to alter the value of the current in the reactive circuit.

When the reactive circuit of a single phase power factor meter is inductive it is not usually possible to obtain a much greater phase displacement than 80 degrees. If the actual angle be $(90-\alpha)$ degrees, and the maximum values of the two fields be equal, then the component of the reactive field which tends to reinforce the similarly rotating component of the non-inductive field will be α ahead of it, whilst the oppositely rotating component of the reactive field will be $180+\alpha$ in advance of that of the non-inductive field

If a be the maximum value of the two fields, the resultant of one pair of components will be $a\cos\frac{\alpha}{2}$, which is $\frac{\alpha}{2}$ ahead of the axis of the non-inductive coil when the field of this coil is a maximum, the resultant of the other pair being $a\sin\frac{\alpha}{2}$, $90+\frac{\alpha}{2}$ in advance at the same time. The resultant torque is

$$\alpha\left\{\cos\frac{\alpha}{2}\sin(\varphi+\frac{\alpha}{2}-\theta)-\sin\frac{\alpha}{2}\cos(\varphi+\frac{\alpha}{2}+\theta)\right\}$$

When this resultant torque is zero

$$\cos\frac{\alpha}{2}\sin(\varphi+\frac{\alpha}{2}-\theta)=\sin\frac{\alpha}{2}\cos(\varphi+\frac{\alpha}{2}+\theta)$$

giving

$$\sin(\varphi-\theta+\alpha)+\sin(\varphi-\theta)=\sin(\varphi+\theta+\alpha)-\sin(\varphi+\theta)$$

and $$\cos(\varphi+\alpha)\sin\theta=\sin\varphi\cos\theta$$

finally $$\tan\theta=\frac{\sin\varphi}{\cos(\varphi+\alpha)}.$$

When $\varphi=90$ degrees, corresponding to zero power factor lagging, $\tan\theta=-\operatorname{cosec}\alpha$, and θ is greater than 90 degrees. With zero power factor leading θ is less than 90 degrees. The scale is, therefore, opened out on the lagging side and cramped on the leading side. The best compensation for the lack of quadrature of the two fields is to space the two coils of the moving system in such a manner that the backward rotating field is eliminated. If the axis of the reactive coil be $90+\alpha$ degrees in advance of that of the non-inductive coil, reckoning this angle in the direction of rotation of the principal field, the backward rotating components will be at 180 degrees and will cancel. A pure rotating field will, therefore, be produced, the axis of the non-inductive coil of the moving system being displaced α degrees from the axis of the series coil at unity power factor.

The Three-Phase Power Factor Meter.

The three-phase power factor meter for unbalanced loads utilises two rotating fields which are produced by three sets of coils, each spaced at 120 degrees, excited respectively from the voltage and the current of the three-phase supply. Assuming a symmetrical voltage system the currents in the three pressure coils will be equal, and will differ in phase by 120 degrees. At the instant that the current in one of these coils is passing through its maximum, and the two rotating components of the field that it produces coincide in direction with its axis the components of the other two coils rotating in one sense will have a phase angle of advance equal to their physical angle of lag, and will, therefore, at the instant considered coincide in direction with the similarly rotating components of the first coil. The oppositely rotating components of the second two coils will have their phase angle of advance added to their physical angle of advance and will therefore be spaced

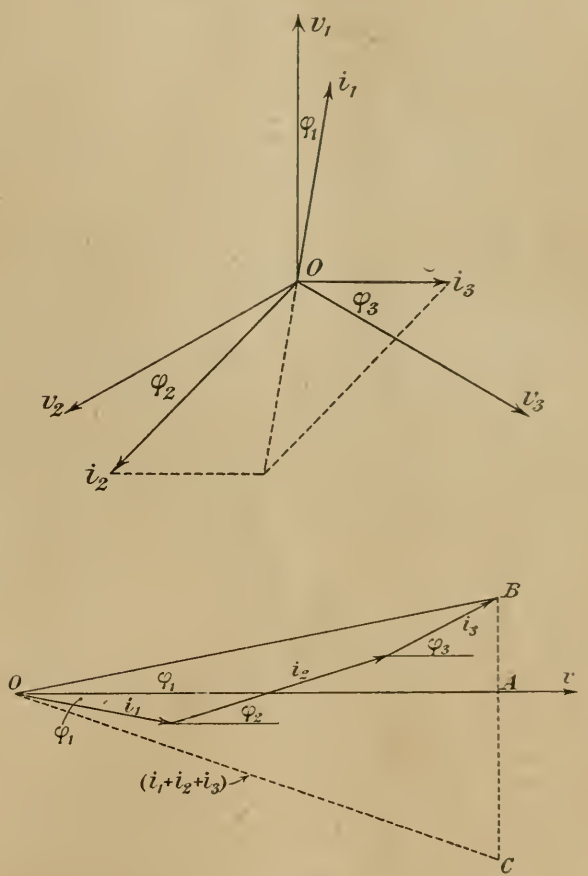


FIG. 1.

240 and 480 degrees from the corresponding component of the first coil. The three components of this latter sense of rotation will, therefore, be spaced at 120 degrees and their resultant will vanish. The voltage coils, therefore, give rise to a pure rotating field. The forward rotating components of the current coils will, due to their physical spacing, be displaced φ_1, φ_2, and φ_3, from the axis of the coil carrying the current in phase 1. The backward rotating components of the current system will give rise to no torque, since there is no voltage component of similar sense with which it can combine. If θ be the angular displacement between the axes of corresponding current and pressure coils the resultant torque on the moving system is proportional to

$$v\{i_1\sin(\varphi_1-\theta)+i_2\sin(\varphi_2-\theta)+i_3\sin(\varphi_3-\theta)\}$$

This is zero when

$$\tan\theta=\frac{\Sigma i\sin\varphi}{\Sigma i\cos\varphi}.$$

If the instrument is scaled to indicate cos θ the power factor so given is

$$\cos\theta = \frac{\Sigma i \cos\varphi}{\{(\Sigma i \sin\varphi)^2 + (\Sigma i \cos\varphi)^2\}^{\frac{1}{2}}}$$

The meaning of this value of the power factor of an unbalanced three-phase circuit is shown in Fig. 1. The upper diagram indicates vectorially the phase relationship of the circuit, the lower diagram showing the summation of the power and wattless volt amperes in each phase. OA represents the total power, and AB the wattless component. The quantity OB, which represents

$$v\{(\Sigma i \sin\varphi)^2 + (\Sigma i \cos\varphi)^2\}^{\frac{1}{2}}$$

is in general less than the actual volt-amperes Σiv. In the diagram the actual volt-amperes are represented by OC and the power factor of the circuit as given by the relation $\frac{\text{power}}{\text{volt amperes}}$ is $\frac{AC}{OC}$.

Accuracy Dependent on Voltage Balance.

The theoretical accuracy of the indication of the power factor of an unbalanced three-phase circuit as previously defined, by a six-coil power factor meter, depends upon the voltages of the three lines being balanced. It has been shown by Gifford* that such departures from balance in the voltage system as are likely to be met with in practice, affect the accuracy of indication of such a power factor meter to an extent so small as to be negligible.

Three-phase power factor meters are frequently constructed with four coils only for use in circuits that are approximately balanced. Such instruments are of two classes, the one having three voltage and one current coil, and the other, three current and one voltage coil. The type with three voltage coils has, if the voltage be balanced, a uniform rotating pressure field, and such an instrument will, it is obvious, indicate the phase angle of the particular current supplying the series coil with respect to the corresponding star voltage. The inaccuracy of such an instrument on unbalanced loads will therefore depend upon the line in which the series coil is connected.

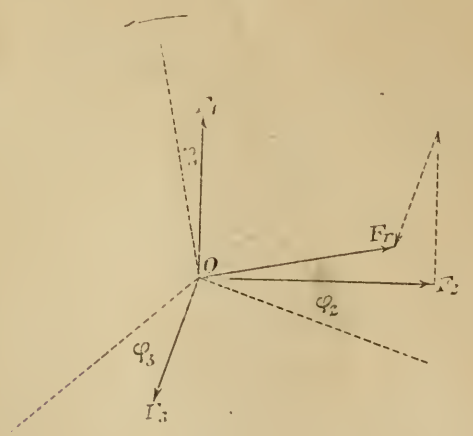


Fig. 2.

There are advantages in constructing balanced load power factor meters with one pressure and three current coils, since this type is more suitable for the inductor principle in which conducting ligaments are eliminated, and a 360 degree rotation of the moving system is possible. In such an instrument the backward rotating components of the fields due to the series coils will combine with the similarly rotating component of the single pressure field to produce a torque that will introduce an error in the indications of the instrument if the circuit is unbalanced. The nature of the backward rotating resultant field in such an instrument is worthy of note. The physical angular spacing of the coils is added to the angles of phase displacement to obtain the relative position of the three components. These components will, therefore, be displaced φ_1, $240-\varphi_2$, and $480-\varphi_3$ from the axis of reference. The spacing of these components for the circuit represented in Fig. 1 is shown in Fig. 2 by OF_1, OF_2, and OF_3. These three vectors are not in equilibrium and have a resultant F_r.

* The Electrician, Vol. LXXV., April 16th and May 7th, 1915.

Measure of Single Phase Reaction.

This backward rotating resultant field derived from the current system is evidently a measure of the single phase reaction in the alternator supplying the circuit, and of the double frequency ripple in the flow of power. It appears that in a three-wire circuit this resultant will only disappear if the currents in the three lines are equal, when the voltages are balanced. If, however, a fourth wire is provided to take a resultant out of balance current back to the neutral of the generator, a circuit can be arranged in which the pulsating component of the power disappears, notwithstanding the currents are unbalanced. Thus, a circuit in which the line currents are represented vectorially by OF_1, OF_2, and OF_3, would produce a pure rotating field, but these currents could not flow in a three-wire system, but would require a fourth wire to return to the star point of the alternator the neutral current represented by OF_r. It has been shown by Miles Walker* that the double frequency ripple in the flow of power can be eliminated in an unbalanced three-wire circuit if the voltages are unbalanced.

Four Coil Power Factor Meter in Unbalanced Circuit.

When a four coil power factor meter of the type considered is connected in an unbalanced circuit, the inaccuracy introduced by the backward rotating field will depend upon the phase from which the pressure is obtained, as the angle between this field and the similarly rotating component of the pressure field for a given position of the moving system will be different for each method of connection.

In the case of a four-wire circuit in which the backward rotating field was eliminated it appears that this type of power factor meter would give accurate readings irrespective of the actual degree of unbalance in the three lines, and of the manner in which the pressure coil was connected.

The natural scale of a power factor meter subtends an angle of 120 degrees between the points 0·5 leading and lagging. It sometimes happens that a more contracted scale than this is required for switchboard work, and with a balanced load instrument it is readily possible by increasing the ampere-turns in one of the system of three coils to produce a contracted scale in the neighbourhood of unity. The calculation of the increase of ampere turns necessary for a required contraction is easy when the method of rotating components is used. Considering an instrument with three-pressure coils, if the ampere turns in the coil in the same phase as that of the single coil be n times those of the two other coils, the phase relationships remaining symmetrical, the system is equivalent to a balanced system giving rise to a rotating field of a value $\frac{3}{2}$, on which is superimposed a pulsating field of value $(n-1)$ giving two rotating components of opposite sense, the value of each being $\frac{n-1}{2}$.

The total forward rotating field will therefore be

$$\frac{3}{2} + \frac{n-1}{2} = \frac{n+2}{2}.$$

The backward rotating field is $\frac{n-1}{2}$.

The condition for equilibrium of the moving system is therefore

$$\frac{n-1}{2}\sin(\varphi+\theta) = \frac{n+2}{2}\sin(\varphi-\theta)$$

or

$$\tan\theta = \frac{3}{2n+1}\tan\varphi.$$

* "Supply of Single Phase Power from Three Phase Systems," *Journal I.E.E.*, vol. 57, p. 109.

Reflection in Telephone Circuits.

By L. C. POCOCK, B.Sc., A.M.I.E.E.

There is probably no part of telephone transmission theory which is so little understood as the phenomenon of reflection in telephone circuits. For some reason this subject is generally treated historically; the supposedly familiar analogous phenomenon in the theory of light and sound is adduced and thence an argument from the existence of wave propagation in long conductors leads to a complex theory of reflected waves in such conductors.

History not the Best Policy.

Now, however natural this course of development may be to the mathematical physicist, it is not the one best suited to the student of telephony, especially if his first serious encounter with the theory of wave motion happens to be in telephone engineering instead of in pure physics. Such a student will probably very soon realise that in a great deal of practical calculation the first step is to replace the wave propagating conductors with distributed constants which are so fruitful of involved formulæ, by equivalent T's or equivalent π's: he will then ask what has become of the reflection effect now that there is no longer any wave propagation in time and space. It is the object of this article to answer such a question.

Let there be two dissimilar lines connected together and let them be represented at a given frequency by equivalent T's such as are shown in Fig. 1, where the Z's are not necessarily pure resistances but may be any kind of impedances.

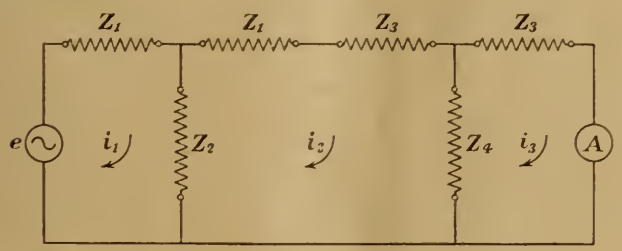


FIG. 1.

Let an E.M.F. e be applied at one end and let the other end be closed through an ammeter: the circuit equations are then as follows:—

$$\left.\begin{aligned}(Z_1+Z_2)\,i_1 \quad -Z_2 i_2 \qquad\qquad &= e\\ -Z_2 i_1+(Z_1+Z_3+Z_2+Z_4)\,i_2-Z_4 i_3 &= 0\\ -Z_4 i_2+(Z_3+Z_4)\,i_3 &= 0\end{aligned}\right\} \quad \ldots\ldots (1)$$

Here we may note that (Z_1+Z_2) is the sending end impedance of the first line with the far end of the same line open, and (Z_3+Z_4) is under the same conditions the sending end impedance of the second line; since these are characteristics of the lines we will replace them by Z' and Z'' respectively.

The equations then take the shorter form:—

$$\left.\begin{aligned}Z' i_1-Z_2 i_2 \qquad\qquad &= e\\ -Z_2 i_1+(Z'+Z'')\,i_2-Z_4 i_3 &= 0\\ -Z_4 i_2+Z'' i_3 &= 0\end{aligned}\right\} \quad \ldots\ldots\ldots\ldots (2)$$

If Δ is the determinant of these equations we find for the current sent i_1, and the current received i_3,

$$\left.\begin{aligned} i_1&=\frac{e}{\Delta}\begin{vmatrix} Z'+Z'' & -Z_4\\ -Z_4 & Z''\end{vmatrix}\\ i_3&=\frac{e}{\Delta}\begin{vmatrix} -Z_2 & Z'+Z''\\ 0 & -Z_4\end{vmatrix}\end{aligned}\right\} \quad \ldots\ldots\ldots (3)$$

Now let the applied voltage and the ammeter change places; we find for the current sent i'_3, and the current received i'_1,

$$\left.\begin{aligned} i'_3&=\frac{e}{\Delta}\begin{vmatrix} Z' & -Z_2\\ -Z_2 & Z'+Z''\end{vmatrix}\\ i'_1&=\frac{e}{\Delta}\begin{vmatrix} -Z_2 & 0\\ Z'+Z'' & -Z_4\end{vmatrix}\end{aligned}\right\} \quad \ldots\ldots\ldots (4)$$

Comparing (3) and (4) we see that the current received is the same in each case but the currents sent differ.

The fact that the currents received are the same in the two cases might be expected from the symmetry of the determinant or the law of reciprocity, which, as applied to current networks states that if a voltage e acting in a branch A of a network produces a current i in another branch B then a voltage e acting in B will produce the same current i in the branch A. A point frequently missed is here made clear, namely that although the transmission allowance of a non-uniform line is generally different in the two directions, yet for a given E.M.F. acting at either end the current received at the other end will always be the same.

The difference between the transmission allowances for the two directions evidently depends on the fact that the current sent is not the same in the two cases and thus we see that the reflection effect makes its appearance as a change in the sending end impedance of the line when the far end is connected to a different line instead of being connected to an indefinitely long line of the same kind. This will be clearer if we consider what is meant by transmission allowance and reflection loss or gain.

The Transmission Allowance.

The transmission allowance for a given piece of line is the length of standard cable (an arbitrarily defined type of cable) in the middle of an infinite standard cable in which the attenuation would be equal to the attenuation in the given piece of line if the given piece of line were placed in the middle of an infinite line of the same kind as itself. The allowance depends therefore upon the attenuation it produces when it is so connected that there is no reflection effect at the ends.

Confining ourselves to line No. 1 represented by the impedances Z_1 and Z_2 the actual attenuation is found in accordance with the above definition by putting the section considered between two long lengths of line of the same kind, and since the physical construction of the line is of no importance so long as the network representing it has the same input impedance at the frequency considered, we may evidently substitute for the long line a simple impedance Z_0 equal to the sending end impedance.

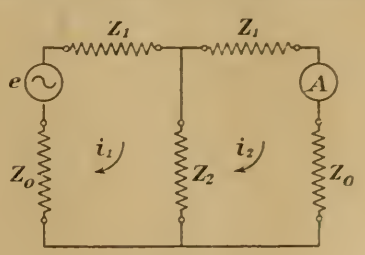


FIG. 2.

The equations are:—

$$\left.\begin{aligned} i_1\,(Z_0+Z_1+Z_2)-i_2 Z_2 &= e\\ -i_1 Z_2+i_2\,(Z_0+Z_1+Z_2) &= 0\end{aligned}\right\} \quad \ldots\ldots\ldots (5)$$

so that the attenuation

$$\frac{i_2}{i_1}=\frac{Z_2}{Z_0+Z_1+Z_2}=a$$

but if the short line is connected at its far end to some other impedance Z we find

$$\frac{i'_2}{i'_1}=\frac{Z_2}{Z+Z_1+Z_2}=a'$$

so that if r is the attenuation equivalent to the reflection effect between the line of characteristic impedance Z_0 and the line of actual impedance Z

$$r\,\frac{i_2}{i_1}=\frac{i'_2}{i'_1} \quad \text{or} \quad r=\frac{a'}{a}=\frac{Z_0+Z_1+Z_2}{Z+Z_1+Z_2}$$

whence we see that if Z_0 is greater than Z the attenuation is greater than unity so the reflection effect is a gain and if Z_0 is less than Z there may be a loss.

We also see that if the length of line for which we have substituted a T is made very long, Z_1+Z_2 approaches the limiting value Z_0; thus the typical reflection effect at the junction of two lines having impedances Z_0 and Z is $\frac{2Z_0}{Z+Z_0}$ in the direction Z_0 to Z. The reflection attenuation in the reverse direction will be different for evidently it will be $\frac{2Z}{Z+Z_0}$.

If the impedances Z and Z_0 have the same angle, $\frac{2Z_0}{Z+Z_0}$ is a real fraction, but if they have not the same angle r is a complex quantity and must for given values of $|Z|$ and $|Z_0|$ be greater than $\left|\frac{2Z}{Z+Z_0}\right|$. Hence, any difference of angle between Z and Z_0 leads to a reflection gain as compared with the reflection attenuation expressed by the modulus of r.

Separation of Reflection Effect.

Thus it is seen that the reflection effect can be separated into two parts, one depending on the ratio of the moduli of the impedances connected together is a loss in one direction and an unequal gain in the other. The other part is always a gain and depends upon the difference of phase angle between the impedances as well as the ratio of the moduli.

Secondly it has been shown that reflection has the effect of altering the sending end impedance from what it would be if the given line were infinitely long, to a value determined by the terminal impedance.

A Story of Trade.

In a recent address to the Students' Section of the Institution of Electrical Engineers Mr. J. S. Highfield remarked that true engineers always remain students because the science on which their business rests is always advancing and because all engineering work is "team work," involving a knowledge of human nature. The present time is a difficult one for everyone, and not least for students. Anxiety will remain until trade improves. The reasons for the present trade depression are many, and the subject is of vital importance to engineers. Engineering schools should pay more attention to principles of trade and commerce.

Electrical Engineering Development.

Mr. Highfield traced the development in electrical engineering from the days when electricity was studied only by a few men gifted with the love of natural science. He recalled the results of Faraday's discovery in 1832, which only led to the first useful dynamo about 1870. Modern engineering took its birth from the invention of the steam engine, but the methods pursued by early investigators were necessarily different from those demanded by the complex conditions prevailing to-day.

Trade has always been largely a matter of adventure. In early days merchants were often captains and owners of small vessels, and risked all—vessel, cargo, and life. The advances made by the engineer were rendered possible by the efforts of the successful trader who found the money, the surplus of food and goods that forms the foundation of all progress. There are two broad classes of men, the traders, the masters who bear the risks, and the salaried workers who may share the responsibility with the owners but do not run the same risks. This vast difference is not sufficiently realised. It would seem that training colleges are somewhat apt to turn out men inclined towards accepting a salary, rather than to risk all in initiating new ventures. There are countries and parts of the Empire with ample space for new adventure. One would like to see them tested by a proper colonising venture, consisting of picked men and women skilled in appropriate trades. The conception is not new; it was used centuries ago by the Greeks. The main difficulty in such cases is to find an efficient leader. An engineer's training fits him for carrying out a multiplicity of jobs, and he can render useful service in such ventures.

The Indu tries of Cornwall.

The war had damaged all business, including engineering. But there were other industries in a much worse condition. As an instance Mr. Highfield mentioned the industries of Cornwall. The mines of Cornwall date back to very early times. But even to-day there is a great element of chance in opening up new workings in tin and other metals, and the variations in complexity of different lodes are remarkable. The Cornish mines have sent skilled workers to all parts of the world. The china clay industry is another one that has fallen on bad times. This is an interesting process, of relatively recent growth. The clay is decomposed granite, originally used only for pottery, but in 150 years has grown to a business greater than the tin mining industry. The rock contains about 20 per cent. of clay substance varying in colour from pure white to yellow; besides its use for pottery the clay is used for filling paper and other fibrous and cellular materials. It is obtained in modern plant by hydraulic mining with pressure jets, and in all the processes there are fine opportunities for resource and ingenuity. All the traders are relatively poor, but the skill of the workers is great, and Cornwall and the Camborne School of Mines have sent skilled miners to all parts of the world. On these primary trades depend coal miners, rope and sail makers, shipbuilders, carriers, manufacturers of plant, and finally the electric power company. Now, owing to the failure of the tin mining, then of the export trade in china clay, all are in want. Coal is not wanted, electric power output is reduced to a point where the company cannot meet expenses, and all subsidiary trades suffer. The failure in Cornwall is not due to strikes or demands for unpayable wages. The source of their wages is so clear that the men are fully seized with knowledge of economics. They are willing to work for any living wage, but there is no one to pay it. The position is a grievous one and there is no clear remedy. Until the American demand increases there is no prospect of revival in china clay.

Adventure and Risk.

Mr. Highfield mentioned these circumstances as an illustration of the risks underlying trade, and the misfortune that may occur, in spite of honest endeavour. Generally speaking, the man who made safe investments, primarily to provide for old age, did not help trade much. The essence of trading is adventure involving risk, carried either by the man who trades with his own money or by investors in ordinary shares; When ordinary shares were in demand, then it could be said that trade was reviving.

In concluding his address Mr. Highfield suggested that a study of the history of trade was full of interest. History was taught too much in terms of the doings of kings, their ministers, and the law makers, rather than of the traders in whose interests many of the laws were made and many wars fought. The record of Simon of Montfort, the Wars of the Roses, and the laws of Henry VII and the Stuart times should be examined in the light of trade. The histories of City companies often provided interesting and even exciting reading. The lives of such men as Thomas Gresham and Cecil Rhodes afforded examples in adventure and statesmanship. It was for the young men to remain students and to add to the greatness of the Empire by facing fortune, bearing the risks, and winning the rewards, as in days of long ago.

The Anti-Dazzle Problem.

In a lecture, last Thursday, before the Optical Society on the problem of glare from motor head-lights, Mr. J. W. T. Walsh, of the National Physical Laboratory, said the number of devices to give the lamp beam the required distribution to eliminate glare—including those which were on the market—was very great. Some 2 000 had been produced over five years ago, but the problem might still be regarded as awaiting solution. The difficulty lay in the fact that, while a safe driving light required a beam of at least 3 000 c.p., it was necessary, in order to avoid glare to drivers of oncoming traffic, to reduce this to about 500 c.p. There appeared to be no really satisfactory method of escape from this position of mutually antagonistic requirements. In the United States the problem had been dealt with by confining the main part of the beam to the region below the horizontal. Mr. Walsh emphasised the desirability of uniformity of anti-dazzle legislation throughout the world, and mentioned that the International Commission on Illumination had appointed a special commission to secure this object.

Recent Improvements in Railway Electric Traction Equipment.*

By ROGER T. SMITH.

The author discusses the relative financial advantages in this country of steam and hydraulic stations and shows that generally for agricultural reasons the former will continue to be used. He gives for the first time details of a new machine for converting alternating to direct current and then brings up to date the figures for the cost of haulage by electricity and steam which he set out in his Presidential Address to the Institution of Electrical Engineers. Finally he reiterates his opinion that railway companies and manufacturers should work in the closest conjunction for the production of electric traction equipment.

Uniformity of electrical equipment on the railways of a country is of more importance than a relatively small saving to-day upon one system which might be turned by progress into an equal loss to-morrow.

The recommendations in the final Report of the Ministry of Transport Advisory Committee on the Electrification of Railways urged uniformity, and the author claims that the advantages to be derived from following these recommendations will in the long run lead to the least capital expenditure for a given group of railways and result in the least working expenses to each group. The only exception to the recommendations is the Brighton Railway, and time alone can show if the inconvenience of its isolation from through running is as free from serious objection and its economics are as sound as they appeared to the Committee to be.

Economies in Railway Electrical Equipment.

Hydro-electric generating stations will in general compare unfavourably with steam turbine stations in Great Britain. For a steam-power station with a maximum load of 100 000 kW the cost exclusive of the site is of the order of £18 per kW of maximum load, and may be less. Hydro-electric plant worked at 50 per cent. load factor requires two-thirds of an acre of water 1 ft. thick falling 1 ft. for each kW of plant installed. £20 per acre for agricultural land is an often quoted figure in this country, so that it is evident that if a steam station costs less than £18 per kW the cost in an agricultural district of the land alone required for water storage, without any hydraulic works or machinery, becomes prohibitive unless the fall of water is very considerable.

Statistics of 463 generating stations consuming coal or coke show that during the year ending March 31, 1921, the highest thermal efficiency of any station was 17·75 per cent., and the lowest coal consumption per kWh generated was 1·70 lb. The average consumption of coal per kWh for these 463 stations was 3·32 lb., the kWh generated being approximately 5 000 000 000. Electrical engineers and turbine makers together have been able to improve the thermal efficiency of large steam turbo-generators with outputs of the order of 15 000 kW to 20 000 kW until to-day station efficiencies are being obtained of 20 per cent. in actual practice, and in the newest stations an efficiency of 24 per cent. is confidently anticipated. Under test conditions thermal efficiencies of 25 per cent. have been obtained from individual turbo-generators since 1913. The thermal efficiency of a steam locomotive is believed to range from 6 per cent. downwards during the time the locomotive is actually in traffic.

Power Station Economies.

The long sequence of economies in power stations containing large units of power each of at least 15 000 kW output, has resulted in generating the kWh for an expenditure in coal of not more than 1½ lb., the coal having a calorific value of not less than 11 000 B.Th.U. and costing to-day about 8s. per ton at the pit.

Two tables, one showing typical capital and working costs for generating stations of various sizes and the other showing the cost of three-phase transmission systems for carrying the electricity to sub-stations where it can be transformed or converted for distribution are given in paper. These tables were taken from a paper read by Mr. Highfield in 1919, and have been brought up to date. After analysing these tables the author proceeded to consider whether there was any prospect of reducing the cost of transmission either by the employment of the Thury system or by the use of the "Transverter," designed by Mr. W. E. Highfield and Mr. J. E. Calverley.

The "Transverter."

The latter machine is for producing direct current from alternating current and consists essentially of a static transformer and of a fixed commutator with revolving brush gear driven by a small motor running in synchronism with the alternating current supply to the primary windings of the transformer. Secondary windings on the transformer connect to the commutator, which converts the alternating current to direct current. Several groups of secondary windings may be placed on the transformer and by connecting them to commutators connected electrically in series, high pressure direct current is produced. Each commutator in the first made machine deals with a pressure of the order of 12 500 V, so that the eight commutators provided give 100 000 V. Figures were quoted showing a saving of some 50 per cent. in a sub-station plant equipped with transverters, as against rotary converter equipment.

The inventors have allowed the transverter to be publicly mentioned for the first time in this paper, because, should the method of conversion and transmission be proved to be a commercial success, the apparatus becomes a matter of outstanding economic importance to railway electrification, as well as for the inter-connection of generating stations, and for transmission generally.

Cost of Electric Haulage of Trains.

In the author's address to the Institution of Electrical Engineers in 1919, an attempt was made to compare the costs of electric and of steam working on main line railways. The method of comparison was to analyse the locomotive working costs of one large railway which for steam working showed fair average annual costs per steam locomotive, and to couple those costs with the train mile, which is the most convenient revenue earning unit. In the anlaysis the locomotive costs were £1 240 per annum for a passenger locomotive in 1913, inclusive of 5 per cent. interest on the cost of the locomotive, and for a goods locomotive, £1 020. These costs were averaged over the total number of locomotives possessed by the railway, and not only those available at any one time for service. The locomotive costs—superintendence, running wages, fuel, water, lubricants and other stores, repairs and renewals of locomotives, including depreciation and interest at 5 per cent. on the first cost of the locomotive—per average train mile hauled during the year by the respective types of locomotives were 11d. per passenger train mile, and 2s. 0½d. per goods train mile. In 1919 the locomotive costs per passenger train mile were raised to 2s., and per goods train mile to 4s. 8d. On the assumptions made it was shown that if electric locomotives were substituted for steam locomotives, electricity costing ½d per kWh and the electric locomotive costing (as it did then) 2½ times the cost of the steam locomotive, a first charge of 5 per cent. on the cost of the electrical equipment of the line including locomotives would only allow a passenger train of the average weight of 175 tons to be hauled electrically, but would allow a goods train of 1 000 tons to be hauled electrically.

Working Costs and Revenue.

Careful consideration points to the most satisfactory unit of working costs and of revenue to be the train mile per engine hour. Both quantities can be obtained with a fair degree of accuracy. In 1920 the train miles per engine hour for all steam locomotives in Great Britain, including all shunting hours and miles as taken from the Blue Book, were: coaching 9·64, freight 3·18. The annual locomotive costs of all the engines in Great Britain—these costs comprising superintendence, locomotive running wages, coal and water lubricants and other small stores, and maintenance and renewal of locomotives—amounted in 1920 to £3 088 per engine, or per engine hour to 22s. 8d.

An analysis of the same figures arranged for main line and branch line electric locomotives moving both passenger and freight trains, gives the cost per engine hour as 25s., but this assumes that the engine hour of the steam and of the electric locomotive represents the same work done, which is not the case.

* Abstract of a Paper read before the Institute of Transport.

Comparative Costs of Steam and Electric Working.

The comparative costs as between steam and electric working where a steam railway is converted consist therefore in the capital and maintenance charges on the electrical equipment of the track and the locomotive working costs, all capital charges on the generating station and on the sub-stations (if any) being included in the cost of electricity. In a particular case in Great Britain, using round figures, the annual working cost of the steam locomotives for working 400 miles of busy single main track line for passenger and goods service with extensive sidings is estimated to be £3 200 per annum for steam locomotives and £5 700 per annum for electric locomotives with electricity delivered to the track at 0·7d. per kWh. This sum of £5 700 includes also the maintenance of the track equipment and interest at 6 per cent. on its first cost. But whereas 200 steam locomotives are required to work the existing service, only 100 electric locomotives are required to work the same service, so that for the same haulage the annual cost of electric working per existing steam locomotive is £2 850, or a saving of £350 per annum for each steam locomotive replaced.

If, however, instead of electricity being delivered to the track at 0·7d. per kWh as above, it is delivered from a generating station at 0·4d. per kWh, so that the losses, capital, and maintenance charges making up the cost of transmission are not included, nor the working capital and maintenance charges on the sub-stations, the annual working costs per electric locomotive become £4 800 or £2 400 per steam locomotive replaced. This is a saving of £800 per annum for steam locomotives replaced, out of which saving has to come an unknown amount for the annual cost of transmission and of sub-stations. The average number of steam locomotives in Great Britain per mile of single track on December 31, 1920, as taken from the Ministry of Transport Blue Book, was 0·48.

Capital Charges.

For a fairly busy line where goods traffic exceeds passenger traffic, requiring a steam locomotive to work the traffic for every two miles of single track, replaced out of revenue by an electric locomotive for every four miles of single track, the capital charges which must be met out of savings in locomotive expenses will be :—

	Single track.
First cost of electric equipment of the track consisting of 70 lb. per yard conductor rail, laid, jointed and protected against 1 500 V d.c. with bonds for both contact and for running rails, cost per mile	£2 000
First cost of sub-stations and their equipment each giving 3 000 kW at rated output and 6 000 kW on overload at 1 500 V spaced 10 miles apart, cost per mile	£2 000
Cost of transmission	Unknown
Cost per mile	£4 000

The annual saving per steam locomotive displaced is £350 per annum on the assumption that electricity is delivered to the track at 0·7d. per kWh, saving per mile, £175 ; or a saving of £800 per locomotive per annum on the assumption that electricity is delivered from the generating station at 0·4d. per kWh, saving per mile, £400.

Electrical Savings.

Where it is assumed that electricity is delivered at 0·7d. per kWh to the contact rail, including the sub-station working costs, maintenance and interest, the saving is £175 on £2 000, representing 8¾ per cent. profit on the capital over and above interest at 6 per cent. on that capital, this interest having already been included in the annual working costs. This covers the case of a railway supplying itself with electricity from its own generating station close to the track with only transmission along the track to the sub-station. Where electricity is delivered at 0·4d. per kWh from a generating station, the saving of £400 per mile of single track makes no allowance for capital charges or working costs for the transmission and sub-stations. These may be taken as follows :—

	Cost per mile of single track.
Losses in transmission and conversion, reckoned at 20 per cent.	£70
Sub-station staff and maintenance	100
Interest at 6 per cent. on cost of sub-station	120
	£290

This leaves a balance of £110 per mile of single track to pay interest and maintenance charges on the transmission and provide a profit on a capital of £4 000 additional to the 6 per cent. already charged.

Manufacture of Electric Locomotives.

A railway company of necessity maintains its own steam locomotives. The great railway companies have elected also to construct these locomotives, such work representing considerably less than half of the work of maintenance, repair and renewal. Commercial locomotive builders in this country, outside the railways have in consequence a small home market, the bulk of their business being abroad. It is generally held that in the manufacture of machinery both a home and a foreign market are necessary for the best progress and for the full development of ideas. There is no doubt that by their policy the railways have saved a certain amount of money on the construction of new locomotives and that they build machines which, designed by engineers who have to maintain them, have a long useful life.

It is, however, a matter for speculation whether, if the railways had encouraged commercial locomotive building by buying from outside, this country might not have taken the same place in the world's market in locomotive building as it has in shipbuilding and in marine engineering. It is possible that in hauling the materials required for such a world trade the railways might have gained in revenue sums compared with which the saving in the first cost of locomotives is insignificant.

The Part the Manufacturer should Play.

It does, however, seem worth while, on the eve of a demand for electric locomotives for the railways, to consider whether an organisation and workships designed for efficient and successful maintenance are the best for constructing electric locomotives, which require electrical and mechanical research of the highest order, and the employment of every advance in electrical and engineering knowledge not only in locomotive building, but in several branches of electrical engineering. Advances in the design of electrical machinery in this country are almost entirely due to electrical manufacturers and to workers in pure science and the manufacturers have spent millions of pounds in experiment and research. Railway electrical engineers in this country have not been in a position to contribute anything of importance to the research and experiment needed in the development of the electric locomotive, nor will they be able to do so if electric locomotives are manufactured in workshops organised and staffed for maintenance only. It has not been the custom for our railways to set aside regular sums for general research, although some of our locomotive departments have spent and are spending considerable sums on individual researches. The organisation for research in the electrical industry apart from railways is on a sound basis, and is more than adequate for electric locomotive building if the railways choose to use it.

It is therefore a question whether it would not pay the railways of this country at least to give a fair trial to the policy of helping to build up the manufacture of the electric locomotive in Great Britain by commercial firms, who, with an important home market as well as a foreign market, would have a chance of creating a world trade.

Electricity Supply Progress in America.

According to Statistics Compiled by the "Electrical World," 72 electric light and power, and nine electric railway companies of the United States and Canada had an output exceeding 100 000 000 units in 1921. Five United States companies supplied over one thousand million units, compared with seven American and two Canadian companies in 1920. The Commonwealth Edison Co. of Chicago, which added 40 000 new lighting consumers in 1921, now heads the list with an output of nearly two thousand million units, and is followed by the Niagara Falls Power Co. (mainly an industrial power concern, which was first in 1920), the Pacific Gas and Electric Co., the New York Edison and United Electric Light and Power Companies (grouped as one), and the Southern California Edison Co. The figures show clearly that the country has been suffering from trade depression, for companies, such as the Niagara Falls, Detroit and Montana undertakings, which supply industrial and mining areas appear to have suffered most.

The total output of the 72 light and power companies was 31 603 021 872 units, of which 3 225 939 413 units were distributed by Canadian companies. The figures of the American companies represent 65 per cent. of the total output of all public electric generating and distributing companies during 1921. The larger supply undertakings are not confined to any part of the country, but the Pacific and Middle Atlantic States have each two billion unit companies.

Short-wave Directional Wireless Telegraphy.*

By C. S. FRANKLIN.

In this paper it is proposed to give some results of investigations made with reflectors and wave-lengths below 20 metres. The investigation was commenced by Mr. Marconi in Italy in 1916.

The waves used were 2 metres and 3 metres. The only interference experienced with such waves is from motor boats and motor cars. These machines apparently emit waves from near zero up to about 40 metres in length. At Mr. Marconi's suggestion a coupled-circuit spark transmitter was developed, the primary having an air condenser and spark in compressed air. By this means a moderate amount of energy was obtained, and the small spark-gap in compressed air proved to have very low resistance. The decrement of the waves emitted was judged to be of the order of 0·03.

The receiver used was a carefully picked crystal, while the reflectors employed were made of a number of strips or wires tuned to the wave, arranged on a cylindrical parabola with the aerial at the focus. The transmitting system was arranged so that it could be revolved and the effects studied at the receiver.

Italian and British Experiments.

These Italian experiments showed that good directional working could be obtained with reflectors properly proportioned with respect to the wave-length. The attenuation over sea for the wave-length used was found to be very high, and with the apparatus available the maximum range obtained was 6 miles.

The experiments were continued at Carnarvon in 1917. With an improved compressed-air spark transmitter, a 3-metre wave and a reflector having an aperture of 2 wave-lengths, and a height of 1·5 wave-lengths, a range of over 20 miles was obtained to a receiver without a receiving reflector. The experiments at Carnarvon brought into prominence a very rapid increase in the strength of the electric field with height above the ground. The rate of increase appears to be a function of the height divided by wave-length, and while not very noticeable with waves of several hundred metres, is very marked with waves of a few metres, length.

In 1919 experiments were commenced at Carnarvon with valve transmitters, with the idea of producing a directional telephone system. Mr. R. H. White and Mr. E. Green, and, later, Mr. A. W. Hall, assisted the author in this work. A wave of 15 metres was selected, which while well within the capacity of the power valves available, allowed a simple reflector to be used without too large a structure. After some trials a single valve transmitter was arrived at taking about 200 W with a 15-metre wave, and giving 1 A in the centre of a half-wave aerial. A heterodyne receiver with supertonic beat-note was employed.

After gaining some experience, and solving many small practical difficulties, very strong speech was obtained at Holyhead, 20 miles away. The strength was such that shadows produced by small hills and buildings were hardly noticeable, unless the stations were close behind them.

In June, 1920, during this test, speech was received right into Kingstown Harbour, 70 nautical miles from Carnarvon, and the point was proved that there was no rapid diminution of strength after passing the horizon line from Carnarvon.

Range of Short Wave Reflector System.

As a result of these experiments it was decided to test the range of a short-wave reflector system wholly over land. A site was chosen at Hendon, and a reflector and transmitter for 15-metre waves erected with the reflector pointing towards Birmingham. Tests were commenced in February, 1921, from Hendon to a portable receiver on a motor car. Very good speech was received up to 66 miles, and fair speech in the neighbourhood of Birmingham. A reflector station was then erected at Frankley near Birmingham, 97 miles from Hendon, and tests were started there in August, 1921.

Transmitting Arrangements.

The transmitter consists of two medium-size power valves working in parallel. The power to the valves is usually 700 W (4 000 V, 175 mA). The aerial is rather longer than half a wave-length, and has a radiation resistance of the order of 90 O. The efficiency, input to valves to aerial power, is between 50 and 60 per cent., and about 300 W are actually radiated. With the reflectors up at both ends speech is strong, and of very good quality. It is usually strong enough to be just audible with a $\frac{1}{4}$ to $\frac{1}{2}$ O shunt across a 60 O telephone.

With both reflectors down the speech is usually only just audible with no shunt. Average measurements indicate that the energy received when both reflectors are up is about 200 times the energy received when not using the reflectors. Thus to get the same strength without reflectors as with them a 140 kW valve transmitter of the same efficiency would be required. Local measurements of the polar curves taken round the station show that the electric field in front of the station is increased approximately four times by the use of the reflector, and that the same order of increase is obtained during reception; the increase of energy received due to the use of the two reflectors should therefore be $4^2 \times 4^2 = 256$ times.

Experiments made with revolving reflectors, where it is comparatively easy to make measurements at any distance, prove that the polar curve is practically constant at all ranges.

Production of Short Waves.

The production of waves of the order of about 12 metres and upwards is quite practicable up to several kilowatts by large power valves, and it is also practicable to operate valves in parallel. With such high frequencies very large currents pass into the grid and anode; the seals through the glass must, therefore, be large. The production of a reliable transmitting valve entailed a large amount of work, and the great dissimilarity of results from apparently similar valves was very puzzling for some time. In a new batch of valves the efficiency at 15 metre wave would vary from about 60 per cent. down to 5 per cent., and if any attempt was made to push up the power on a bad valve the glass would promptly melt at some spot. The cause of the trouble has been found to be due to losses in the deposits on the glass, owing to high-frequency currents induced. Such deposits are always produced in valves during exhaustion, and vary considerably.

If a number of valves are laid successively between the plates of a small air condenser in a very high-frequency field of the order of 20 000 000 per sec. (without making any connections to the valves), the results are quite remarkable. Some produce no appreciable effect, while others at once put a big lead on the circuit, and if 200 W of high-frequency energy are available, the glass gets hot and will quickly melt at some spot. One of my assistants, Mr. E. Green, made the useful discovery that if the electric field in the neighbourhood of the valve was constrained by means of a shield, so that it was at right angles to the deposit on the glass, then this loss disappeared, and a formerly bad valve would give nearly the same efficiency as a good one. It is now therefore possible to use what are practically standard valves, and their life appears to be about the same as for lower frequencies.

Reception on Transmitting Aerial.

During the continuous-wave tests at Carnarvon it was found that reception was quite possible on the transmitting aerial while the transmitter was operating. This has been used successfully for duplexing between Hendon and Birmingham, and eliminates all switching.

The heterodyne may be either the transmitter, or an independent small heterodyne in the receiver. Both the transmission and the reception utilize the same aerial and reflector, and the transmitter is left going and can be operated while receiving.

There is no reduction in strength while the transmitter is on, but a practical trouble has appeared. Owing to the comparatively large power, strong currents are induced in all conducting structures and circuits close to the reflector and transmitter, such as the supporting towers and buildings, and every variable contact produces a noise. The elimination of all variable contacts in the neighbourhood of the transmitter has proved a work of some magnitude.

Advantages of Reflec ors.

Reflectors besides giving directional working, and economizing power, are showing another unexpected advantage, which is probably common to all sharply directional systems. It has been noted that practically no distortion of speech

* Abstract of a Paper read before the Wireless Section of the Institution of Electrical Engineers.

occurs, such as is sometimes found with non-directional transmitters and receivers.

Although the results between Hendon and Birmingham constitute a record for telephony for ratio of range to wave-length—for such results were believed to be impossible two years ago—they are only a first attempt and do not represent the best that can now be done after the experience gained. Birmingham, it is interesting to note, is 10 400 wave-lengths from Hendon.

It has thus been demonstrated that wave-lengths of the order of 20 metres are quite capable of providing point-to-point directional commercial service over very considerable ranges. Such services will be comparatively secret as compared with the usual non-directional type of transmission.

The directional effect obtained with reflectors which are large compared with the wave-length, is so good that it was suggested that it would prove very useful for position finding for ships near dangerous points.

An experimental revolving reflector was erected on Inchkeith, and tests were made to s.s. " Pharos," the lighthouse tender of the Northern Lights Commissioners during the autumn of 1920. With a 4-metre wave, spark transmitter, a reflector of 8 metres' aperture, and a single valve receiver on the ship, a working range of 7 nautical miles was obtained. The reflector made a complete revolution once every two minutes, and a distinctive signal was sent every half-point of the compass. It was found that this enabled the bearing of the transmitter to be determined within $\frac{1}{4}$ point of the compass, or within 2·8 degrees.

DISCUSSION.

The Institution lecture theatre was crowded and a very appreciative audience had the pleasure of hearing a most interesting paper, an abstract of which we give above, delivered in an unusually short space of time and of seeing some very successful demonstrations.

A tiny transmitter with reflector, was installed on one side of the lecture table, and was shown clearly to have its radiation confined to a beam directed upon the receiver on the other side of the lecture table. The radiation was shown to be absorbed by the body and by a suitably tuned coil of wire. The transmitter with its reflector were rotated several times while signals were being sent. As the beam traversed the receiver the signals were picked up and reproduced in a loudspeaker.

Many Compliments.

The discussion was largely of a complimentary nature. Mr. G. Marconi recalled his early experiments in which he showed Sir William Preece the successful transmission of short waves over $1\frac{3}{4}$ miles where a range of only $\frac{1}{2}$ mile was possible without reflectors. This was 26 years ago, and almost immediately afterwards the progress of the elevated wire system was so rapid that it took all attention.

Major R. C. Trench thought the author's claim for economy was not sustained by the power of 700 W required to telephone 97 miles. He thought the weight of the reflector made the system inapplicable to work in the field, but as the author had pointed out that the strength of the electric field increased rapidly with height above the ground the system would have some application as regards air craft.

Mr. J. E. Taylor was not new to the subject. He had advocated research on similar lines during the early days of the War on account of the need for secrecy. He looked forward to better results with even shorter waves than those employed by the author and thought that by some such reflector system wireless telegraphy would before long take the place of land lines.

Major H. G. T. Lefroy had worked on the subject in 1913, using a Hertzian oscillator for working to airships.

Useful for Marine Work.

Mr. A. Grey read a letter from the consulting engineers to the " Northern Light," expressing the opinion that for giving bearings to ships at sea and as fog signals this system promised to revolutionise present practice.

Mr. R. Carpenter enquired why radiation was not restricted in the vertical plane. He suggested that the axis of the small transmitting aerial might be made horizontal instead of vertical and that the reflector made in the shape of a parabeloid.

Prof. G. W. O. Howe referred to the enormous range of wave-lengths now covered by wireless, namely 16 octaves, from 1 metre to 30 000 metres. This was greater than the range of either the " eye " or the ear."' ' As regards the increase of field strength above the surface of the earth, he enquired whether experiments had been made to determine the nature of the field near the earth surface. He thought that the wave front would be found to be sloped and that the maximum effect would be obtained from an aerial with a corresponding slope. He did not understand why the distortion of telephony should be less when a directional system was employed.

Replying to the discussion Mr. Franklin said that attempts had been made to compare the attenuation of short-wave signals over land and sea, but the results had been inconsistent. He had in view the question of the best wave-lengths to employ and had a new valve which was suitable for wave-lengths of 20 or 30 cm. He found standard power valves satisfactory for 12 metres and had had special valves made for 2 metres. The experimental work mentioned by Mr. Carpenter had already been done. As regards the slope of the wave-front, he found this about 20 deg. with the vertical, but he did not consider that the weak signals at the earth's surface had only to do with that. He agreed that the lack of distortion was probably due to the use of short wave-lengths rather than to the directive transmission.

Recent B.E.S.A. Publications.

Among recent publications of the British Engineers' Standards Association is B.S.S. 108—1922, which is put forward as the first list of British Standard Graphical Symbols for use in Electrotechnics, and is the result of cordial co-operation between Government Departments, I.E.E. Technical Societies, Industrial Organisations and Experts interested in the subject.

While it is realised that the list is admittedly incomplete, it is felt that it will meet a long-felt need, in view of the fact that at the present time Public Departments, Manufacturers' Associations and engineers employ their own individual lists of symbols leading to obvious confusion, and an unnecessary duplication of work. The symbols should be of particular assistance to export work. A large number of them will be found in agreement with symbols used in other countries.

All publications of the B.E.S.A. being subject to periodical revision, provision has been made, in numbering the symbols, for many additions.

Two Points for Notice.

Two points especially may be noticed. In section 7, " Telegraphs and Telephones," the scheme of symbols and conventions adopted by the Post Office has been largely utilised. The symbols in section 8, Radio Communication, were prepared by a joint committee of the Post Office, Admiralty, War Office, Royal Air Force and Marconi's Wireless Telegraph and Telephone Company, Ltd. The main object before the Association has been to endeavour to draw up a list acceptable to every branch of the industry, and it is urged that every engineer should assist the work of the Association by using this list.

Annealed Copper Wires.

Another publication is Specification No. 128—1922. This specification, which gives the Dimensions and Resistances of Annealed Copper Wires, has been issued to meet the needs of the users of copper wire for winding electrical machinery and apparatus, and refers only to bare annealed high conductivity copper wire.

The values of the resistance given have been calculated from the value for the resistivity of copper laid down by the I.E.C. The resistivity of commercial copper at the present time is variable, and therefore a tolerance on the standard values of resistance of $1\frac{1}{2}$ per cent. has been adopted for use until such time as conditions in regard to copper improve.

Following the general trend of modern practice, the sizes are designated by the diameter expressed in decimals of an inch, and should be styled " British Standard Sizes " (B.S.S.) of wire.

The importance of aiming at the use of a small number of sizes by the designers of plant lies in the need for users to carry stocks of all sizes in which they are interested for rewinding purposes; therefore it is particularly important, especially for colonial and foreign customers, and for Government use abroad, that the number of such sizes be restricted as much as possible.

With a view to encouraging reduction in the number of sizes commonly used, the twenty-nine sizes which constitute the even numbers of the S.W.G. are classed as *primary standard* sizes. The remaining twenty-eight are *secondary standard* sizes, and use of the third class or *exceptional standard* sizes should, it is urged, be restricted to the utmost.

Copies of both these publications may be obtained from the offices of the Association, 28, Victoria-street, London, S.W.1.

Sir Frederick Orr-Lewis, of Montreal, Canada, founder and president of the Canadian Vickers, who died last November, has left property in this country of the value of £18 342.

Correspondence.

CHAINS OF MAGNETICALLY-COUPLED CIRCUITS.

To the Editor of THE ELECTRICIAN.

SIR,—With reference to Dr. Bellini's article in THE ELECTRICIAN for 12th instant, may I be allowed to point out that the determinantal expression for n magnetically-coupled circuits may be written in the equivalent form :—

$$\begin{vmatrix} \frac{1}{C_1}-L_1p^2 & -M^2_{12}p^4 & 0 & . & 0 \\ -1 & \frac{1}{C_2}-L_2p^2 & -M^2_{23}p^4 & . & 0 \\ 0 & -1 & \frac{1}{C_3}-L_3p^2 & . & 0 \\ . & . & . & . & -M^2_{n-1,n}p^4 \\ 0 & 0 & 0 & -1 & \frac{1}{C_n}-L_np^2 \end{vmatrix} = 0$$

which is a *continuant*, and as such can be evaluated from inspection—*i.e.*, without actually multiplying out. For, putting P_1, P_2, P_3, etc., for the quantities in the principal diagonal, and Q_1, Q_2, Q_3, etc., for the quantities in the neighbouring bordering diagonal, we may write the expression in the special notation—

$$\Delta \equiv (P_1, -Q^2_1, P_2, -Q^2_2, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . P_n)$$

and this may be developed—

$$\Delta \equiv P_1 (P_2, -Q^2_2, \quad . \quad . \quad . P_n) - Q^2_1 (P_3, -Q^2_3, \quad . \quad . \quad . \quad . P_n)$$

and so on. Dr. H. W. Malcolm has used determinants of the above type very extensively in his "Theory of the Submarine Telegraph and Telephone Cable" (Benn Brothers, Ltd.), and the present writer gave, in the "P.O. Electrical Engineers' Journal" for April last a rule based on the properties of continuants, for writing down from inspection the expansion of determinants of this type. Following out the suggestion made by Mr. L. C. Pocock in THE ELECTRICIAN of August 6, 1920, the present writer also dealt with the case of three magnetically-coupled circuits in "Electricity" of September 9, 1921, and obtained the values of the frequencies with and without a condenser in the intermediate circuit.—I am, etc.,

H. P. FEW.

Engineer-in-Chief's Office,
G.P.O., London.

HIGH VOLTAGE SWITCHGEAR DESIGN.

To the Editor of THE ELECTRICIAN.

SIR,—We have read with very great interest the article appearing in your issue of the 5th inst. on the above subject by Mr. W. A. Coates, and your editorial comments on same, and we are pleased to note that due recognition has been given to the experience of Continental manufacturers.

There is one point, however, in the article referring to insulator dimensions which we think calls for some comment and explanation. The dimensions given in Table I. are approximately the dimensions of insulators used on the Continent, but it is not said positively whether the lengths in the table are to be understood to be the spark-over distance of the complete insulator with fittings or of the bare porcelain.

The essential point for the customer is the test voltage up to break-down voltage in air. The new Swiss prescription for testing high voltage insulators demands, when test voltage $=E_t$ and working voltage $=E_w$:—

$$E_t = 1{\cdot}8 \times E_w + 20\,000 \text{ V.}$$

This results in a higher test voltage for the voltages most frequently used in England than that which English or American firms have offered up to the present. The resulting test voltage is also higher than specified either in English or American prescriptions. We may say that the insulators used by us come up to the new prescription as given above, and it may be of interest to you that it is exactly on the score of guaranteed test voltage that American porcelain manufacturers encounter difficulties, since their insulators do not come up to the requirements of the Swiss prescriptions for wet test and voltages of 44 kV or more.—We are, etc.,

For Sprecher & Schuh Co.,
J. B. RUDKIN.

London, W.C.2.
May 13th, 1922.

Morwell Brown Coal Scheme.

It is reported that the scheme for utilising the BROWN COAL DEPOSITS at MORWELL for the generation of electricity and for fuel purposes is progressing rapidly under the direction of the State Electricity Commission of Victoria. The township of Morwell is five miles from the site selected for the new power house, and, in order to avoid confusion, a new name, Yallourn, has been found for the power house and the new township which is springing up around it The principal contracts have been let for the equipment of the Yallourn power house, which will have a capacity of 50 000 kW and will contain five 12 500 kW turbo generators, one being held in reserve. The voltage of transmission will be 120 000 V.

As the power requirements of the Metropolitan area are increasing rapidly and the Yallourn power house will not be ready for two or three years, it has been decided to push on as rapidly as possible with a new power house in Melbourne, to be known as the Newport B. Station, which will later be linked up with the bulk supply. At the outset this station will have two 14 000 kW turbo-generators, one being for stand-by purposes. It is hoped that this station will be in operation by May, 1923. The Commission anticipate being in a position to supply raw brown coal from Morwell to the public next month. An inclined approach to the surface of the coal is being constructed, and two "Bucyrus" shovels, with a capacity of 2½ and 3½ cubic yards respectively, will be used for excavating both the overburden and the coal. From the open out the coal will be transported to a crushing and screening plant by a system of endless rope haulages. In view of the encouraging results obtained in other parts of the world from the use of pulverised black coal as a fuel, the Commission intend to install an experimental plant for the production of brown coal in powdered form and to investigate its suitability for boilers.

District Industrial Councils.

The second annual report of the District Industrial Council No. 5 (West Midlands Area) of the Electricity Supply Industry has been issued, and states that many matters engaged the attention of the Council during the year ended March 31. The business was conducted throughout in a spirit of reasonableness and with an obvious desire on the part of all concerned to arrive at fair decisions.

The Council is composed of twelve employers' and ten trade union representations, and Mr. R. A. Chattock was re-elected chairman and Mr. E. J. Jennings, secretary and treasurer. Seven meetings of the Council and seven meetings of the Standing Committee were held, and among the matters dealt with were (1) the change made in the constitution of the National Council by which, instead of being represented by nominees of employers' associations, the employers' side consists of representatives from the various District Councils, and (2) working conditions and wages adjustments.

Working Conditions.

The Council determined that the standard conditions were more favourable than the conditions of service obtaining in many parts of the district previously, and that such standard conditions must be regarded as a whole. It was held, therefore, that it would be wrong in principle for employers to be entitled to select the best of such model conditions and at the same time to retain certain of the former conditions that were more favourable to them.

As the result of negotiation with representatives of small undertakings (of 100 kW or less) a modified set of working conditions was approved and has now been ratified by the National Council.

Adjustments of Wages.

The District Council approved a scheme, which had been prepared in February, 1921, for the adjustment of wages to correspond with variations in the cost of living. This scheme was not confirmed by the National Council, which decided that the question was one to be dealt with on a national basis. In November, 1921, the latter formulated a slightly different scheme. From November 15, 1921, when the National Agreement was adopted, three revisions of wages have been made to date under it—viz., November 15, 1921, January 1, and April 1, 1922. The collective effect of these revisions was a further reduction of 2½d. per hour, which with the 6s. 9d. previously made, represented a total reduction in wages during the year of 16s. 6½d. per week (47 hours) or 10s. 9d. per week (48 hours).

Engineering Employees, Short Time, etc.

It has been agreed with the A.E.U. that engineering trade employees working in electricity supply undertakings shall have their rates of pay regulated by the Industrial Council for the industry. It was agreed by the Council that where there had been a reduction in the demand for electricity by reason of trade depression it was competent for undertakers to reduce temporarily the working hours in agreement with the Union representatives so as to obviate as far as possible the discharge of employees, and the undertakings concerned followed this procedure. All the employees, with few exceptions, have now reverted to full-time working.

In regard to the model constitution for Works Committees drafted by the National Council, the District Council approved in principle the setting up of Works Committees, but the Standing Committee reported that, in their opinion, the details of the constitution of such Committees should be left to the decision of the undertakings individually.

G.E.C. Fittings at Drury Lane.

The whole of the electric light fittings at the Theatre Royal, Drury Lane, which has lately been re-opened after being reconstructed and redecorated, have been designed and manufactured by the General Electric Company. In addition to the main fittings shown in the illustration, subsidiary fittings, such as "exit" signs, ceiling fittings in lobbies, police lights, etc., were also supplied by the firm. As will be seen from the illustration, the fittings are executed in the Early Empire style which is characteristic of the interior decoration of the theatre.

The auditorium is illuminated from the ceiling by a central fitting and five smaller ones of similar type. The main fitting, which is arranged for 30 lights, is 8 ft. in diameter, and weighs 15 cwt. It consists of a large upper corona surrounded by six 3-light flambeau brackets, a lower corona completing a panelled basket, the whole being carried out in cast brass finished a rich dark ormulu judiciously relieved with blue enamel enrichment. The panels are glazed with heavy cut plate glass, and the fitting is completed by a lower cut glass bowl. The impression conveyed by this fitting is one of massive form retaining the necessary spirit of delicacy and refinement which is so characteristic of this period. The five subsidiary fittings are of similar design, but are without the upper corona and brackets.

Numerous two-light flambeau brackets on the box and circle fronts give additional illumination, and between the boxes are installed four large standards on black marble bases with ormulu enrichment.

Standard for Main Auditorium Boxes.

Main Auditorium Fitting.

Bowl Pendant for Corridor.

Pendant for Boxes.

Two-Light Fitting for Circle Pilasters.

Two-Light Flambeaux for Circle Fittings.

In the boxes, bowl pendants finished dark ormulu and blue with silk cord suspension and "Equiluxo" glassware are installed. Ceiling fittings of the same type provide the main illumination for the circles, and are supplemented by three-light flambeau brackets applied to the front of decorative pilasters.

The main entrance contains a central gilt electrolier with cut plate glass panels and bowl and six outside arms carrying pendant lights. On the staircase the newel lights are rich gilt with flambeaux.

We are indebted to the proprietors of the Theatre Royal for permission to publish this description.

The Minister of Transport proposes to confirm the special order authorising the Midland Electric Light and Power Company to supply electricity in the rural districts of Atherstone, Nuneaton, Tamworth, Hinckley and Market Bosworth. Any objections must be sent to the Ministry of Transport by June 3.

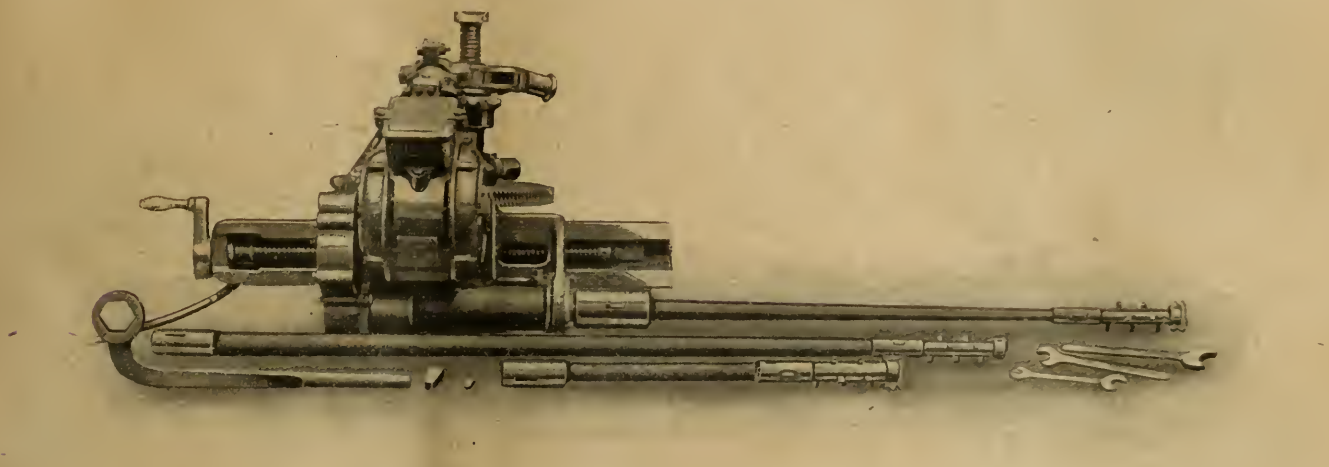
Skelton and Brotton Urban Council have decided to reduce the charges for electricity from 6d. to 5½d. per unit for lighting, and from 2½d. to 2¼d. per unit for power, cooking and heating. A discount of 5 per cent. is to be allowed on all accounts paid within 14 days.

The "Hardy-Bedford" Coal Cutter.

The patent "Hardy-Bedford" electrical coal cutting machine, recently improved by the HARDY PATENT PICK COMPANY, is claimed to be the first successful attempt to solve the problem of a light heading machine for the electric drive, but of the same weight as, and to do similar work to the small air driven percussive heading machines.

This new machine cuts the coal by rotary action. The general construction is clearly shown in the illustration. The machine itself is fixed in position and held up to its work by means of a column or standard provided with jack-screw and toothed head and foot. The power unit is a 1½ H.P. a.c. motor, which can be wound to suit the voltage, phases and periodicity of the current in use at any particular mine. The motor drives the main cutter shaft through a train of machine-cut gearing, at a speed of 350 revs. per min. In the cutter shaft are placed the cutter bars of various lengths fitted at the ends with cutting picks of special design. The whole machine is seated in a cone cup forming part of a clamp which is attached to the column. This clamp carries a worm, the teeth of which mesh with those of a worm wheel bolted rigidly on the column. The whole of this attachment is mounted on a patented ball-bearing device which allows the machine to be moved round the column with a minimum effort.

In operation the cutter bar is fed forward into the coal to a depth of from 2 in. to 6 in., and then by means of the worm handle the machine is moved round the column, cutting with the side of the cutters. An arc shaped undercut is thus made, and this increases in depth and width as the repeated cuts are effected and as each successive length of cutter bar is inserted in the main cutter shaft. The machine will cut from 12 ft. to 15 ft. in width by 4 ft. 6 in. in depth from one setting, and the height of the cut is about 3½ in. As soon as the desired depth is obtained at the centre of the working place, the operator squares out the corners of the arc-shaped cut until the undercut or channel is of uniform depth at every point. When pillars are taken out, or, in working on a longwall face, the successive cuts break into one another, a continuous undercut the whole length of the coal face, whatever this may be, is obtained.



THE HARDY-BEDFORD ELECTRICAL COAL CUTTING MACHINE

The Cutting Speed.

The cutting speed of the machine naturally varies with the hardness of the material. Speeds as high as 120 sq. ft. per hour have been attained, and under ordinary circumstances the output of the machine is approximately the same as that of a compressed air driven percussive heading machine. The whole of the machine, apart from the motor, runs in an oil bath, and is fitted throughout with ball thrust and line bearings, thus attaining economy of power in a very great measure. A percussive air driven heading machine requires 25 B.H.P. to drive it, whereas this machine, we understand does approximately equal work with an expenditure of 1½ B.H.P. The weight of the coal cutting machine proper is about 280 lb., and the total outfit weighs, packed, about 8 cwt.

A Journal of Scientific Instruments.

The INSTITUTE OF PHYSICS has under consideration the publication of a journal dealing with methods of measurement and the construction and use of instruments, to be called "A Journal of Scientific Instruments." In Germany there are some four or five journals which cover this field, and one of these, which devotes itself entirely to the subject of scientific instruments, has been of great influence in imparting a sense of the importance of scientific methods in the study of technical and industrial problems. Research workers and manufacturers in this country have long felt the need of such a journal. The journal will be managed by a committee appointed by the Institute of Physics on which the Department of Scientific and Industrial Research and the National Physical Laboratory will be represented, and the editorial work will be carried out at the N.P.L., assisted by a scientific advisory committee appointed by the Institute of Physics. It will probably consist of 32 pages, and will be published monthly at 2s. 6d. per issue. The Institute will only find it possible to make itself responsible for the journal if its financial position is secured; and as a means of ascertaining what support may be expected a specimen number for free issue is now being issued. Anyone desiring a copy of this number is asked to apply to the Secretary of the Institute of Physics, 10, Essex-street, London, W.C.2, and to enclose 6d. to cover postage.

A new Bulletin (No. 15) entitled "Street Lighting by Gasfilled Electric Lamps" has recently been issued by the GENERAL ELECTRIC COMPANY. The publication is a complete handbook on modern street lighting practice, and in addition to valuable technical data contains particulars of complete ranges of lanterns suitable for every street lighting requirement. Noteworthy features of the Bulletin are the polar curves and illumination data provided for the more important types of lanterns, and the very full instructions for calculating the size of lamp required.

Hydro-Electric Power in New Zealand.

The Minister of Public Works recently made a statement on the progress made in HYDRO-ELECTRIC POWER DEVELOPMENT IN NEW ZEALAND. He anticipated that at Mangahao 24 000 H.P. would be available by the end of next year, while works to supply 1 000 H.P. were under construction at Waikaremoana. Until better financial conditions prevailed he did not anticipate that either the main development at the latter place or the Arapuni scheme would be proceeded with. The Arapuni scheme should take precedence of all the smaller schemes in the Auckland district. The Government's commitments for hydro-electric developments to the end of the year 1923-1924 amount to over £3 500 000. The following expenditure, which includes money already spent, has been authorised for the various schemes up to March, 1924, or earlier dates:— Southland, £250 000; Lake Coleridge, £1 154 500; Horahora, £695 000; Mangahao, £1 218 000; Waikaremoana, £113 000; Otago £550 000.

Chicago Pageant of Progress.

The organisers of the CHICAGO "PAGEANT OF PROGRESS," to be held from July 29 to August 14 next, have expressed the hope that British goods will be shown at the exhibition, which is to be held on the Municipal Pier. (The pier, the construction of which cost £1 000 000, runs for a 1 000 yards out into Lake Michigan.) A similar exhibition last year was remarkably successful. The exhibition is to be divided into 16 trade sections, including automobiles, electrical industries, advertising and paper, &c. British firms will be charged the same rates for space as Chicago firms, viz.: $500 for an enclosed floor space of 20 ft. by 10 ft., including lighting and heating. Applications for space should be addressed to the Organising Secretary, "Pageant of Progress," 507 City Hall, Chicago, U.S.A.

Asbestos Woven Resistance Nets.

The illustrations show the asbestos woven resistance grids manufactured by A. Hinderlich. The net and grids manufactured by this firm are fundamentally composed of warps of specially spun asbestos, with wefts that consist of wire, flexible cable or strips made of nickel silver, constantan or chromo-nickel. Any necessary tappings required for variable resistances are woven firmly into place so that the completed unit is strong and durable. The units are constructed for temperatures up to 600°C.

Fig. 1.—Electric Fire with Three Nets.

The nets and grids can be made with wire free areas at the ends or in other parts, so that they can be held where desired without risk of the wires coming in contact with the supports. As many tappings as desired can be provided, and these are usually made of flexible wires. The resistance nets themselves are made either rigid or flexible, and impregnated or non-impregnated. The width of the units can be from ¾ in. up to 19 in., while the length may be up to 60 ft.

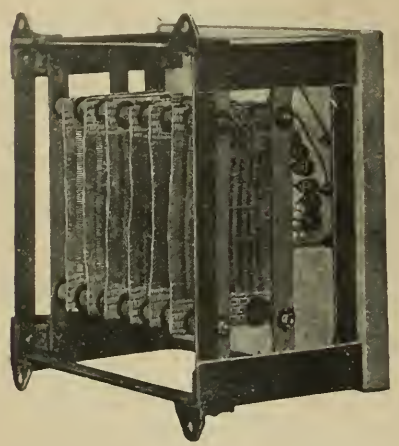


Fig. 2.—Back of Three-phase Motor Starter with Resistance Nets Built in.

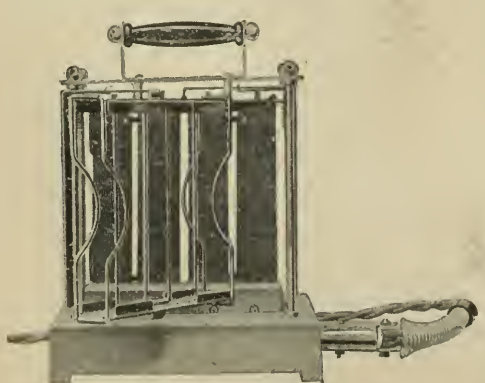
Insulating Separators.

The firm also make nets entirely of asbestos for insertion as insulating separators between adjacent current carrying nets.

The asbestos used is treated with composition, in a special manner, so as both to increase its resistance and reduce its hygroscopic nature. The insulation resistance of a cubic centimeter is 5 megohms, while the breakdown voltage through a thickness of 2 cm. was found to be 1,200 V. as a minimum. The resistances can be mounted in a large number of different ways, two of which we illustrate. The distance between two adjacent units should be from ⅝ to ¾ in. for currents up to 25 A., 1¼ in. for currents from 25 to 50 A., and 1½ in. for currents from 50 to 100 A.

A New Toaster.

Among the latest domestic labour-saving appliances to be put on the market by the Credenda Conduits Company is the "Creda" Swingate toaster, which we illustrate. The two outstanding features of this toaster are the revolving bread racks, and the ease with which the element can be replaced when necessary. The latter process occupies only a few minutes, whereas previously a very considerable time has usually been required. The toaster is supplied in all standard voltages, and has a loading of 500 W.



"Creda" Swingate Toaster.

The Consumers' Power Company of Jackson (Michigan) has 1 300 miles of transmission line, of which 526 miles are 140 000 V and the remainder 110 000 V. Thirty-one hydro-electric and steam plants are linked up.

Henley Cable Winches for India.

The cable winch illustrated is one of two designed and manufactured by W. T. Henley's Telegraph Works Co., which have recently been shipped to a large firm in India. The winches are being used in connection with the sinking of two mine shafts, where it is necessary to use motor-driven sinking pumps.

The supply cable for the pump motors was also manufactured by Henley's, and each length is 1 014 ft. and weighs 7¼ tons. It is a 0·75 sq. in. 3-core cable, rubber insulated, armoured with special high tensile steel wire, and jute braided, the over all diameter being 3⅝ in.

It was specified that the winch should be operated by hand, and it was therefore necessary to provide gearing giving a reduction of

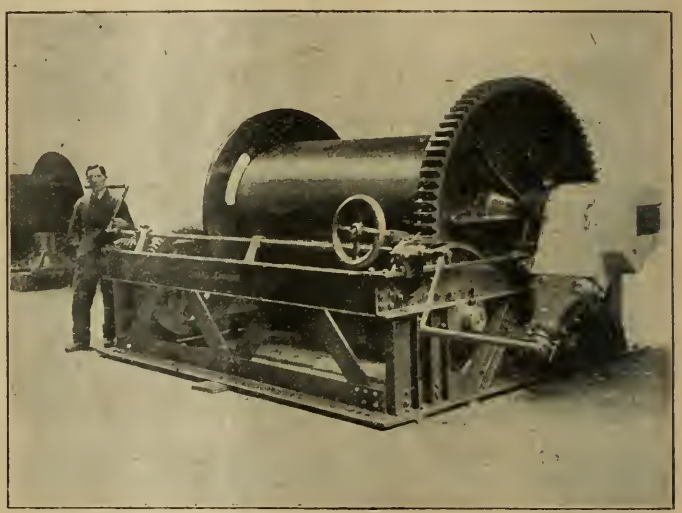


Fig. 1.—View of Henley's Mine Shaft Winch for India

524 to 1. This reduction is obtained by means of bevel, worm and spur gearing. The large spur wheel is 6 ft. 1¼ in. diameter, and, as can be seen from the illustration, is attached to one of the drum flanges.

The worm-gearing has been designed so that the angle of the worm is at the limit of its self-sustaining value, and a band brake is provided on the worm-wheel shaft so that the drum can be held in any desired position. In addition to the band brake, a ratchet wheel and pawl are fitted to prevent the drum running back when the cable is being wound up.

Method of Mounting Drum.

The method of mounting the drum is very interesting, as no shaft is used. Instead of a shaft heavy hollow cast steel trunnions are attached to the side of the drum. The necks of these trunnions run in cast iron bearings, which are supported by heavy steel framework surrounding the drum.

To enable the pump motors to be fed while the cable is being lowered, current transmitting gear has been provided, and it will be seen mounted on the right-hand side of the winch. We give a "close-up" view of this with the cover removed. Three heavy slip-rings are mounted on the end of one of the trunnions, and are supported by three insulated studs. Current is transmitted to the slip-rings by means of heavy laminated copper bands, provided with an adjustable spring tension device. The small slip-ring at the extreme end of the gear is connected to the drum and the laminated copper bands to the steel framework, so that the drum is always earthed. The cores of the 0·75 sq. in. cable for feeding the pump motors are permanently attached to the slip rings, and the cable passes through the hollow trunnion up the centre of the drum and along a hole in the opposite flange. It is next laid in a groove case in the trunnion casting attached to this flange, and is held in position by means of heavy clamps. The cable then passes through another hole in the flange and on to the barrel of the drum.

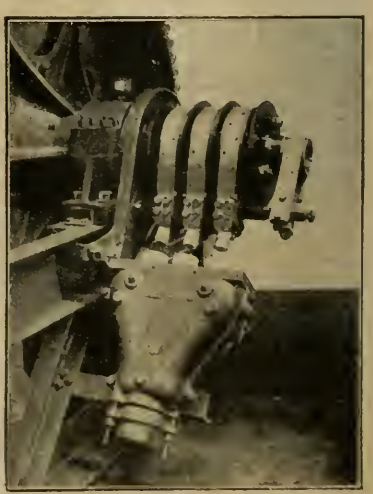


Fig. 2.—"Close Up" of Current Transmitting Gear.

An Electric Floor Polisher.

It is generally agreed among housewives that floor-polishing is the most arduous of all domestic duties, so that to many the electric polisher is a greater boon than any other electric labour-saving appliance yet invented. The ELECTROLUX polisher, which is shown in the illustration, is the smallest electric floor polisher on the market, and is claimed to be the most economical. Two sets of brushes, hard and soft, are supplied, and, as can be seen, each set is made up of two separate portions, the bristles of the

THE "ELECTROLUX" FLOOR POLISHER.

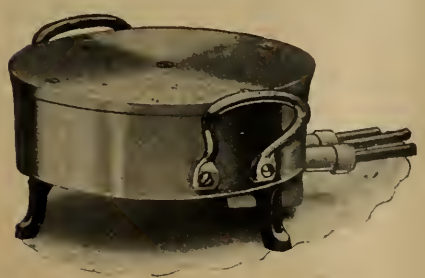
outer frame facing in the opposite direction to those on the inner block.

The method of operation is extremely simple, and the appliance is so light a child can easily use it. Before putting on the polish the floor should be rubbed over with turpentine. After this has vaporised, the polish is applied with the hard brush, and then polished with the soft brush. To change the brushes does not occupy more than a few seconds. The polisher can be worked from the lighting circuit. The loading is 140 W.

Carron Electric Cooking Appliances.

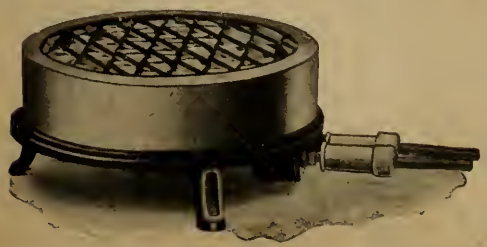
The latest pamphlet of electric cooking appliances issued by the CARRON COMPANY contains particulars of several new appliances recently put on the market by the firm. Among these are open coil boiling rings and solid type boiling plates, both of which we illustrate.

The solid top boiling plates are made in two sizes. No. 565 is 6 in. in diameter; the top is of cast iron, machined and dull nickel-plated, the casing is nickel-plated, the side handles brass nickel-plated, and the base is of cast iron. The heating elements are loaded to a maximum of from 600 to 750 W, and a porcelain metal sheathed connector, and b.c. adaptor are provided ready for connecting to the lamp-holder. No. 566 is of the same construction but measures 8 in. in diameter, and the heating elements are loaded to a maximum of 1000 to 1250 W. It is wired to two terminals, and is provided with a porcelain metal-sheathed connector, but no flexible cable.



SOLID TYPE BOILING PLATE.

No. 566 A is the same size as No. 566, but is wired to three terminals, and is provided with three single-pole connectors, arranged for three-heat control. The prices of these appliances range from 50s. to 85s.



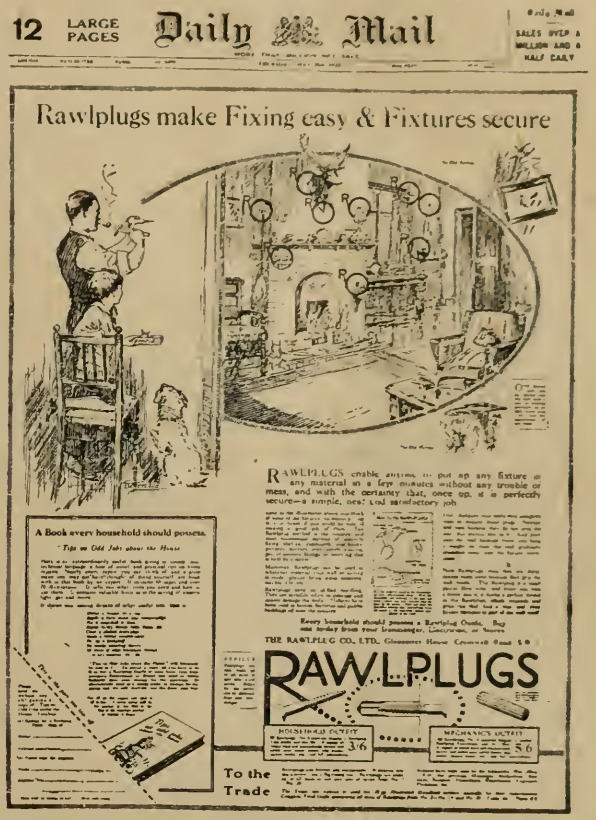
OPEN COIL BOILING RING.

The open coil boiling rings are made in the same sizes as the boiling plates, and range from 20s. to 35s. in price.

Rawlplug Enterprise.

THE RAWLPLUG CO. are having a front-page advertisement in the "Daily Mail" on Thursday, May 25.

The design, which is reproduced herewith, shows a very contented "handy man" doing a job in his house, watched by his small son—to say nothing of the dog. The appeal is clever, and the copy will send the buyer to the ironmonger or electrician for his



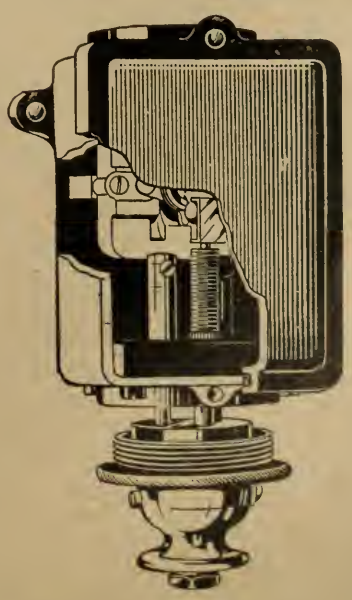
WHAT THE "RAWLPLUG" ADVERTISEMENT WILL LOOK LIKE.

supplies, which should stimulate demand, especially in view of the spring cleaning period, which the Rawlplug Co. have chosen as being notably suitable. We understand advance copies of this front page can be had on application to the company.

We congratulate the company on keeping their name before the public, which means so much in these days, and add our tribute to the worth of Rawlplugs as a labour-saving appliance.

A New Type of Switch-Plug.

The switch-plug illustrated has just been put on the market by SIMPLEX CONDUITS, LTD., to meet the demand for a thoroughly satisfactory water-tight interlocked switch and plug for use in factories, shipyards, etc. It has been designed so that the insertion or withdrawal of the plug actuates the quick make and quick break switch mechanism. This principle ensures the maximum of safety, as when the current is not required the plug must necessarily be withdrawn.



INTERLOCKING SWITCH-PLUG.

The plug is of the two-pin and earth type and is made entirely in brass; the gland fitted on the plug is suitable for twin cab-tyre cable with earthing strand. A locking ring is also provided to prevent accidental withdrawal of the plug. As will be seen, the equipment is of solid construction, and once fixed its "fool-proof" qualities should make it particularly suitable where the labour available is of a non-electrical character. With the electric drive now being introduced as the best of labour-saving methods its wide use should therefore be assured.

D

Legal Intelligence.

Dispute about Electric Light Poles.

A Divisional Court (Justices Bray and Greer) heard on Thursday last the appeal of the Rev. Edward Wm. Porter, from a decision of Judge Marchant at the Ipswich County Court that the bank into which the Ipswich Corporation, as electricity undertakers, dug six poles in Rushmere-road was not the property of the plaintiff and part of his boundary fence, but wayside greensward and part of the dedicated public highway.

Stating appellant's case, Mr. HAWKE, K.C., said Mr. Porter had brought an action for damages for trespass and for an injunction to restrain the Corporation from erecting the poles in the roadside, but the County Court Judge on April 12 last dismissed his action. The judge purported to find that the poles were put on the highway. They were erected to supply electric light to the house of a lady lower down the road. Supposing it were said, Mr. Hawke explained, that the poles were put on Mr. Porter's half of the road, there might still be something to argue, and as to two of the poles, Mr. Porter contended that if they were on the edge of the bank which constituted, with a hedge, his boundary, he had an action for interfering with his subsoil by digging 6 ft. without his consent. The other four poles were put in the bank. In the correspondence the Corporation asserted that the bank had slipped forward, helped by frost, rain and snow, and so encroached on the highway, and the poles in the bank were really put on that part of the highway on which the bank had encroached 4½ in. The plaintiff apparently was the trespasser and not the Corporation. The Corporation pleaded their statutory right as the electricity authority, and said that as to the overhead wires, the Ministry of Transport had given its consent. The judge viewed the scene, but he (Mr. Hawke) submitted there was no evidence on which the judge could find as he did.

Mr. MONTGOMERY, K.C., for the Corporation, said the important point for them was to establish that, as the electricity authority, they had power to put posts into land the surface of which was dedicated to the public as highway. Prima facie the roadway extended from the hedge on one side of the road to the hedge on the other side. He said the bank on which the hedge was placed was 2 ft. high, and, horizontally, from the line of the hedge to the edge of the grass was 2 ft. 6 in.

Mr. HAWKE asked that the case should not be sent back, but should be decided now, for life was too short to try cases twice. Mr. Porter had thrown the onus of proof on the Corporation, and they had failed to discharge it. There was nothing to rebut his evidence that the right line of bank had been adhered to.

Delivering the judgment of the court, Mr. JUSTICE BRAY said it was clear that a hedge upon a bank, with the bank, was one structure, a boundary fence. There was no evidence on which the judge could have found as he did. He found the grass was greensward, including the bank on which the four poles were placed, and part of the highway. Supposing the whole bank part of the road, no question could arise as to encroachment on the road by the bank. There could be no proper judgment except that the bank belonged to plaintiff. But it was strongly argued that what the judge found was simply that the particular points where the poles were put did not belong to plaintiff. It was not disputed that the poles were placed on the slope. The correspondence spoke of the bank creeping into the road, but the plaintiff and his gardener stated that when the Corporation men cut back the edge of the bank some years ago they provided a line which had been carefully observed ever since. The surveyor said the same, and the Corporation called no evidence to rebut this. The judge undoubtedly found, and wrongly, that the whole of the bank belonged to the highway. The judge himself viewed the bank, but he could not use the view as evidence; if he had seen anything to contradict the plaintiff's account he could have put that matter in cross-examination. The Corporation, as to the four poles, must be found to be trespassers. As to two poles, the digging for which the plaintiff said disturbed his subsoil, the lighting authority pleaded sec. 2 of the Gas Works Clauses Act, 1847, which they said entitled electric lighting undertakers reasonably to break the surface of dedicated roads. The appellant said the following proviso required that when the land of a private owner was to be disturbed his consent must first be obtained, and only the surface of the road was dedicated and not the land beneath to any extent. The proviso did not limit the powers given in sec. 6; 6 ft. was a reasonable depth for the poles, no structure beneath was interfered with, and plaintiff must lose on his contention as to those two poles. He also complained of the cutting of an Austrian pine for the electric wires, for which the Corporation said his sister gave permission; but the sister was not the owner, and when plaintiff returned home he withdrew any consent, and made it clear that he consented to nothing. Plaintiff would be given the nominal damages of 5s. for the cutting of the tree, 40s. damages for placing the four poles, and an injunction against the electric lighting authority, with costs, except that he must bear the additional costs (if any) of his plea with regard to the digging for the two other poles.

Mr. JUSTICE GREER said the digging for the two poles was done in land dedicated to the public, so the proviso following clause 6 did not apply. He was, however, a little troubled in his mind as to what would have been the effect of it if there had been a cellar or other building beneath the road into the roof of which the poles went. He referred to Thompson *v.* Sunderland Gas Company, which decided that a cellar was just as much a building, under ground, so far as electric lighting undertakers were concerned, as a warehouse was above ground.

Mr. MONTGOMERY asked for leave to appeal as the supply of electricity to a consumer was affected.

Leave to appeal was refused, but appellant agreed to a limited stay of execution.

What is Power Supply?

An action which raises an important issue for electricity supply companies and authorities came before Mr. Justice Swift on the 10th inst. The WESTMINSTER ELECTRIC SUPPLY CORPORATION sued Wykehams Studios, Ltd., for the recovery of £82 18s. 5d. for electricity supplied to the defendants for photographic purposes and for meter rent. There was no dispute as to the amount of electric current consumed, the only point being the rate of charge.

Mr. W. S. KENNEDY (for plaintiffs) said that up to May of last year the defendants were supplied with electric current on the power basis. By an agreement which was then made with the Photographers' Association a rate was arranged midway between the power and lighting charges, but defendants declined to accept the revised scale and claimed to be entitled to receive electricity at the former rates. If the contention were upheld that plaintiffs had no authority to differentiate between the various uses of power, and that, say, a big railway company must pay precisely the same for its current as, say, a consumer who had only a small lathe motor, then the supply must cease altogether, as the companies could not afford to supply electricity on those terms.

No evidence was called as it was admitted that the electricity supplied had been used for other than lighting purposes and that the figures put in were substantially correct.

For the defence, Mr. H. BLANCO WHITE said that he relied upon the case of the Attorney-General *v.* the Hackney Borough Council, and he submitted that as the supply given was for photographic arc lamps it was used for power and not lighting purposes. He contended that defendants were in the power class and were entitled to be charged not more than the least favoured of power users. What the company had done was to alter slightly their form of agreement and call it a general form of agreement for supplying electricity. The defendants originally took a supply of electricity in 1916; the agreement was terminated in 1921, and they were charged the lighting rate until Christmas, 1921, when the plaintiffs made an agreement with the Photographers' Association; the Corporation admitted that it was not a power charge at 4d. per unit. His clients were not parties to that agreement, and they said that the charge for power was 2d. or 1¼d. per unit, and as defendants were in the power class they said that they were being charged more than the maximum for power, as they were asked to pay 4d. instead of 1¼d. The Photographers' Association had admitted it was not power, and in consideration of that admission they had got a reduction of 2d., but defendants were not bound by that. He relied upon the company's advertisement that they supplied electricity for power at 1¼d. per unit.

Mr. KENNEDY admitted that the company offered to supply electricity for power at 1¼d. per unit—that was the price adopted for some cases, but not all. In each case a special charge was made. They were charging defendants the same rate as every other consumer in the district who was using the current for the same purpose under similar circumstances. There was no undue preference. In the circumstances the company were justified in charging defendants 4d. per unit.

Mr. JUSTICE SWIFT said that what the plaintiffs appeared to have done was to create a new class of consumers altogether, and to divide them into three sections—illuminating, power, and photographic—and to rate them accordingly. Had they the power to do that? As the point raised was an important one, he would take time to consider his judgment.

Right to a Trade Name.

Last week Mr. Justice Astbury heard a motion by Messrs. W. H. Dorman & Co., Ltd., for an injunction to restrain Messrs. Henry Meadows, Ltd., Wolverhampton, from using the name "Dorman" on their engines. It appeared that plaintiff company was registered in 1897 to take over the business carried on since 1872 by Mr. W. H. Dorman, who became chairman of the company. Henry Meadows Ltd., were registered in 1917. Mr. W. H. Dorman remained chairman of plaintiff company until 1911, and his son, Mr. John Dorman, was a director of it from 1898 to 1916, when he sold his shares and resigned his directorate, becoming sales manager until 1921. In September, 1921, he entered defendant company's service, becoming sales manager and a director. Plaintiff company stated, and it was not denied by defendants, that their engines were generally known as "Dorman" engines; but in March, 1922, defendants caused notices to be put in motor newspapers calling attention to an internal combustion engine made by them, described as the "Meadows-Dorman" engine, and stated to have been designed by Mr. John Dorman. They also claimed that they were entitled to use the name of Dorman for it.

After hearing counsel for the parties, his Lordship said he was of opinion there was no justification for defendant company's use of the name "Meadows-Dorman" for engines. Dorman did not form part of their title, and no business carried on by Dorman had been assigned to them. Defendants had only lately begun to advertise,

but plaintiffs had already received a letter from a firm assuming that the "Meadows-Dorman" engine was connected with them. If defendants used the description, confusion would ensue. There was no justification for the defendants' action in law, and the only question was the form of the injunction. The case was stronger than those where defendants were actually using their own name. He granted a perpetual injunction to restrain defendants from using the description "Meadows-Dorman" and from having their engines described or marked with the name "Dorman" or from using that name as part of their description without all proper precautions for distinguishing their engines from those made by plaintiffs or from leading or inducing customers to believe that their engines were plaintiffs' engines, or that there had been any amalgamation or arrangement between plaintiffs and defendants.

Re Hubert D. Carter (Bangor), Ltd.

At Bangor County Court last week an application was made for the compulsory winding-up order of Hubert D. Carter (Bangor), Ltd., electrical instrument dealers.

Mr. Burgis said the company was formed in 1920 with a capital of £5 000. The directors were Herbert and Eric Carter, the former being the promoter, and the shares were held mainly by members of the Carter family. There was also another company at Colwyn Bay, which was established in 1917 with a capital of £5 000. The Colwyn Bay Company supplied electrical appliances to the Bangor firm; the two firms had the same secretary (Mr. Rowley Redwood), the same directors, and the same auditors (Messrs. MacIntyre and Redwood). The Colwyn Bay Company had issued debentures to the amount of £2 000 to Hubert Carter. Rowley Redwood, who retired from the Colwyn Bay Company, was appointed receiver; then the Bangor Company went into liquidation, Redwood being appointed liquidator. Mr. Burgis suggested that the two companies were so closely allied that there ought to be an independent investigation. He represented Higgins, Ltd., Downes and Davies, Electrical Appliances, the General Electric Company, and another creditor with claims amounting to £360. One of the Carters had a claim for two years' salary (£978), which he was prepared to withdraw if the petitioning creditors would withdraw the demand for compulsory liquidation.

Mr. Bone, who appeared for certain creditors, assured the Judge of the honourable standing of Mr. Poppleton and Mr. Johnson, who represented other creditors, said the suggestion that Mr. Poppleton would be influenced by Redwood was absurd.

Eventually an order was made for the voluntary winding-up of the estate, the official liquidators to be Messrs. Poppleton (Birmingham) and Eaves (Manchester).

Attorney-General *v.* Oetzmann.

In this case the Ministry of Labour, on the information of the Attorney-General, sought to recover £5 from Messrs. Oetzmann & Company, being the price of a new controller drum to be used for revolving electric light advertisements supplied by the Ministry.

Mr. G. M. Hilbery (with the Attorney-General) said that the Ministry of Labour had a stand connected with the Government Instructional Factory at the "Efficiency" Exhibition held last spring at Olympia, on which was displayed a controller drum for working revolving advertisement lights. Defendants ordered one, but when the bill was sent in they refused to pay, because they alleged that it was a term of the bargain that there should be a week's trial of the drum, and they said that the apparatus was faulty.

Mr. Justice McCardie gave judgment for plaintiffs for the amount claimed. He held that there was no such term as that pleaded, and that there was no evidence to show that the apparatus was intrinsically faulty. The department could not be blamed for a very hot summer, which warped the woodwork of the sign and disarranged the apparatus so as to preclude its effective operation.

On the question of costs it was submitted that where the Attorney-General is unable to obtain judgment for more than £40 he was not entitled to any costs unless he could show that he could not have brought the action in the county court. His Lordship, after commenting on the High Court being occupied for two hours in dealing with a claim for £5, said he would fix a time for argument as to costs.

Claim for Electrical Goods.

In the Shoreditch County Court, on Friday, before Judge Cluer, Messrs. Ira Miller & Company, Ltd., sued Messrs. A. & E. Lower, of South Tottenham, mechanical engineers, to recover £7 4s. 5d., balance of an account for electrical goods supplied.

Plaintiff's Traveller said he called at the defendant's premises at Seven Sisters Road, and took orders from Albert John Lower. Accounts had been paid, but the balance was due that was sued for. In cross-examination he agreed that Mr. Lower said he had got a job on at High Wycombe, that he was a struggling man, and he could only pay on the completion of the job. His firm agreed to those terms, and the goods were supplied. Later they got a letter from the brother of Albert saying that he had heard that his brother Albert had been having some goods, but the firm were not liable.

For the defence, Albert John Lower said he at one time was manager to his brother, who was sole proprietor of A. & E. Lower.

Judge Cluer: I cannot see that the firm had to make any inquiry when the firm was "A. & E.," and they got orders from "A." Besides, here is a memorandum in which it refers to the goods supplied "to our order." Judgment was entered for plaintiffs, with costs.

Holbrook *v.* Court.

In the Mayor's and City of London Court last week J. Holbrook & Company, electrical engineers, sought to recover £69 3s. from Mr. H. J. Court, of Whyteleafe, Surrey, for an electric light installation.

The defence was that plaintiffs' representative said they had made the necessary arrangements with the local Electrical Supply Company to lay cables in defendant's road, and that they would be laid within two or three weeks. Defendant gave the order on the faith of that representation.

Plaintiffs said they did not represent that the company would lay the mains in any definite time, but they did their best to induce them to do so. Defendant replied that plaintiffs' services were useless to him as the supply was not yet in the village, because plaintiffs never got fifteen customers as arranged.

The Judge came to the conclusion that there was misrepresentation, but not fraudulent misrepresentation. He need not go into the question of whether there was any warranty or not, although he thought there was. He found for plaintiffs for the amount claimed, without costs, and for the defendant for 50 guineas on a counter-claim, with costs.

Re J. G. White & Co., Ltd.

The High Court has sanctioned a reduction in the capital of J. G. White & Co., Ltd., from £500 000 to £350 000 by writing 15s. off the 200 000 £1 ordinary shares. In 1920 the business of a subsidiary company (The J. G. White Commercial Co.) developed extensively, particularly in South America, but in the autumn of that year the company suffered severe losses by the fall in prices and in exchange. Some of the indebtedness of the Commercial Company is irrecoverable and had to be written off.

Registration of Business Names.

At Bow Street Police Court last week, Mr. Geo. Weston, who carries on business as Geo. Weston & Co., at Hounslow, was fined five guineas, with three guineas costs, for failing to register the name of the firm under the Registration of Business Names Act, 1916.

Parliamentary Intelligence.

Ayr Electricity Bill.

A Select Committee of the House of Lords, presided over by Lord Bristol, has been considering this Bill, which confers powers (*inter alia*) upon Ayr Corporation to utilise the water power of Loch Doon in the generation of electricity. Originally the Corporation desired to extend their area of supply in the southern part of the county, but this proposal was dropped, though they wish to obtain the right to supply electric power in the county if it proved desirable. The County Council withdrew their opposition on terms, but Kilmarnock Corporation, which had an agreement with Ayr for bulk supply, was given a *locus standi*.

Mr. H. P. Macmillan, K.C., who appeared for Ayr Corporation, gave a general outline of the scheme, which was promoted because of the increasing demand for electrical energy and because the present steam plant was nearly loaded to its full capacity. It was really a small and simple undertaking. The cost of the hydraulic works would be about £113 000; the power station and equipment, £43 000; the transmission system, £58 000; and general costs, £6 000, a total of £220 000. It was also proposed to increase the maximum charge to 1s. per unit, and to extend the area supplied by the Corporation, by including the southern portion of the county, with the burghs of Maybole and Girvan. The scheme would involve the acquisition of land, the erection of a power station, the turning of Loch Doon into a reservoir, etc.

Engineer's Evidence.

Mr. J. H. Rider, consulting engineer, gave technical details of the scheme, and said it was intended that a minimum of 4 000 000 gallons per day should be left in the bed of the river where it was proposed to withdraw the water for power. Arrangements might be made for a daily flow of 6 000 000 gallons, but anything beyond that would be fatal to the scheme. They could complete the works in two years from the time of starting.

Replying to Lord Novar, witness said that so far as their proposals went the scheme would be complete in itself, but that was not to say that there was no possibility of further hydro-electric schemes in the same watershed. He would foresee the time when the whole of the energy of Loch Doon would be required for Ayr.

Mr. W. A. Tait, consulting engineer, said Loch Doon was suitably situated for hydro-electric power. If the scheme were proceeded with he did not think there would be any appreciable effect on the amenity of the loch. The cost of the works were correct, and were based on 100 per cent. increase on pre-war prices. The scheme was capable of being extended in conjunction with any larger scheme that might be launched. He had seen a section of the bed of the river, and he thought that relatively small works would make a succession of pools and runs which would result in the better utilisation of the water. The scheme would be to the advantage of the mills in the vicinity of the river, because they would have a bigger storage of water and more regular flow.

On the 11th inst. Mr. Tait continued his evidence, and said that raising the dam on Loch Doon by 5 ft. would submerge about 200 acres. In the Bill the water to be reserved for the stream would be

6 000 000 gallons per day. If the dam were raised to 10 ft. it would mean an increase of £10 000 on their present estimates, and a corresponding increase on the annual charges.

Mr. Godfrey M. Taylor, civil engineer, said that, whatever compensation water was given, it must be an elastic quantity in the interests of the fish. It was for that reason that it was proposed to store 3 000 000 to 4 000 000 gallons of water for each of four successive days, and then release it on the fifth day. The storage capacity of Loch Doon, when raised 5 ft., would be 7 000 000 gallons, but under the present scheme only 5 500 000 gallons would be required.

Mr. Armistead, fishery expert, said that it was on his advice that the minimum flow of the river was fixed at 4 000 000 gallons. The river was a very fine salmon river, but its bed could be improved by making a series of pools with easy runs between. He could say that, with the works contemplated and the volume of water that was to be sent down, the proprietors on the Doon need have no fear that the stock of fish would be affected.

The Committee adjourned.

Electricity (Supply) Bill.

Mr. A. Neal, Parliamentary Secretary to the Ministry of Transport, moved the second reading of this Bill in the House of Commons on Monday. In explaining the provisions of the Bill, which has already passed the House of Lords, he said the measure proposed to complete and make workable the Act of 1919. It would give joint electricity authorities, with the approval of the Electricity Commissioners, power to borrow, and certain councils and companies interested power to lend, in respect of electricity supply works and undertakings. The measure was mainly financial, but it also contained powers to make agreements for the working of generating stations and, by consent of the authorities concerned, to extend the periods of purchase at present vested in local authorities. After referring to what was being done in other countries and to the need for economising our coal supply, he said the Bill would be of value in relieving unemployment in the best possible way.

Mr. G. Balfour moved the rejection of the Bill, mainly because, he said, he wished to secure proper and adequate control by the House over the finance of the large authorities proposed to be set up under the Act of 1919. He regarded the proposed joint authorities and the methods of finance proposed as bad public policy, which would lead, not to progress and prosperity, but to stagnation. The Bill proposed to confer powers on joint electricity authorities to borrow very large sums of money and pay interest while capital was unremunerative, and to suspend the sinking fund on unremunerative undertakings for five or six years. It also conferred certain financial powers on local authorities, which, with those conferred on joint electricity authorities, were subject only to the confirmation of the Ministry of Transport and the approval of the Treasury. He contended that financial powers should be given to the joint authorities by provisional orders, which would have to be laid before Parliament for confirmation.

Sir R. Clough having seconded the motion for the rejection of the Bill,

Sir P. Dawson said he was glad that the compulsory clauses in the Bill of 1919 were now optional, but he thought there were many clauses in the present measure which were dangerous from the point of view of the economical production of electricity. Under the Bill the main reason which now existed for local authorities producing cheap electricity would cease to exist, and instead of promoting a cheap supply it might result in a dearer one.

Mr. Myers supported the Bill, and the debate was adjourned.

German Optical and Scientific Instruments.

A Committee appointed under the Safeguarding of Industries Act is investigating the complaint made with regard to optical and other scientific instruments manufactured in Germany.

On Monday Sir Arthur Colefax (for the applicant associations) said that they would submit evidence upon a few typical standard articles, and more especially upon prism binoculars, microscopes, photographic lenses, drawing instruments, etc. The excellence of British prism glasses led the Admiralty and War Office to select them as standard articles, and at the end of the war the output capacity had considerably increased. To-day German binoculars were being sold at about one-third of the cost of similar English-made articles. He cited an instance in which £3 18s. 6d. was charged for German binoculars which before the war sold for £6 10s. British manufacturers could not possibly sell at anything like £3 18s. 6d. Apart from Government contracts for India, the British industry was practically closed down. Home manufacturers were also unable to compete with prices charged for German-made microscopes, photographic lenses, spectacles, cheap lenses and drawing instruments. In consequence some home firms were now employing less than half the number of workers they employed in 1913.

Mr. Watson Baker said that although a duty of 33⅓ per cent. had been imposed upon imported microscopes the prices of the German articles had been advanced by only 10⅝ per cent. They were hoping for an appreciation of the mark and an increase of wages in Germany. If that occurred a further duty of 33⅓ per cent. would greatly assist British manufacturers.

L.C.C. Tramways.

On the 11th inst. a Select Committee of the House of Commons passed the preamble of the London County Council (Tramways, Trolley Vehicles, and Improvements) Bill. Originally the Bill contained proposals for constructing a trolley omnibus line from Norwood Road to the Crystal Palace, but owing to the veto of Lewisham Borough Council that part of the scheme had to be dropped. The remainder of the Bill was concerned with the construction of about five-eighths of a mile of tramway along Amhurst Park, connecting the L.C.C. tramway at Stamford Hill and that of the Metropolitan Electric Tramways, Ltd. (who opposed the Bill) in Seven Sisters Road. The local authorities concerned desired that the tramway should be made, but the Metropolitan Co. opposed. The committee found that the Metropolitan Company's property would not be damaged, or in any way rendered less valuable or productive by the construction of the line.

Coal Mines (Safety Lamps).

In reply to Major Barnes (House of Commons, May 11), Sir R. Horne said that no financial assistance by way of grant or loan had been given to firms engaged in the production of safety lamps for use in coal mines for the purpose of putting down or extending their plant. With regard to Excess Profits Duty, only such allowances had been given as were authorised by the statutes relating to that duty which were applicable to trades and businesses in general, including those to which Major Barnes referred. The Commissioners of Inland Revenue were precluded by statute from disclosing information relating to the taxation of particular taxpayers.

Merchant Ships and Wireless Staff.

In reply to Mr. Maclean (House of Commons, May 15), Mr. Baldwin stated that the Merchant Shipping Advisory Committee had reported on the question of wireless watchers, and recommended that no change in the regulations was at present justified. At the same time, the Committee called attention to a lack of co-operation between operators and watchers, and to the unsatisfactory practice obtaining on some ships of taking watchers from their wireless watch for other work. Steps were being taken by the Board of Trade to effect improvement in these respects. The Committee's report was being printed.

Imperial Notes.

Coraki (N.S.W.) Council are seeking permission to borrow £6 500 for the equipment of electricity works.

The accounts of the Port Pirie (South Australia) municipal electricity department for the past year show a profit of £530. Units purchased from the Broken Hill Associated Smelters were 320 420 and sold 246 399. Income was £7 733.

The Town Clerk of Bendigo (Victoria) has written to Ballarat Council urging that the two Councils should co-operate in an endeavour to secure prompt Government action in regard to providing electricity supply at reasonable rates for consumers in country districts.

The report of the manager, Mr. Guy Allbut, on the working of the Newcastle (N.S.W.) municipal electricity undertaking for 1921, states that there was a net surplus of £10 128 os. 8d., after providing for all charges, including instalments of loans and depreciation. Revenue was £100 238, compared with £66 499 in 1920. The capital expenditure on new works was £44 173, compared with £37 062. New consumers connected were 1 997, compared with 1 325 in previous year.

The expenditure authorised to be made in the year ending June 30 next on the scheme for the exploitation of the water power of the Australian River Murray for generating electrical energy is £80 000, which will be spent chiefly on the Hume reservoir, the Lake Victoria (South Australia), storage and locks at Torumbarry and at Wentworth, near the junction of the Murray and the Darling. The full scheme will take eight years to complete, and will involve the construction of 35 locks and weirs. Work is proceeding on No. 3 lock, four miles below Kingston (South Australia).

Wireless Wave Meters.

On Monday the Royal Commission on Awards to Inventors heard a claim by Prof. J. S. E. Townsend, in respect of a wave meter. At the time the invention was made Prof. Townsend was an officer in the R.N.V.R., his duties being to instruct officers in the theory and practice of wireless telegraphy.

Mr. Whitehead, for the claimant, said the invention indicated the particular wave which an instrument was emitting when used as a transmitter or the length of the wave which the instrument was receiving when operating as a receiver.

Prof. Townsend and Prof. Whiddington gave evidence in support of the claim, the latter laying stress on the fact that the invention could be used for continuous wave work, and that it was extremely accurate.

Mr. Trevor Watson (for the Crown) said that about 2 000 of the wave meters were in use towards the end of the war, and he admitted that the instrument was the best of its kind at that time.

The Commission reserved their decision.

Electricity Supply.

WINCHESTER City Council has authorised the expenditure of £250 for the purchase of electric cookers for hiring out.

The Electricity Commissioners will hold an inquiry on the 30th inst. at LYME REGIS Town Hall into the Council's application for a Special Order to supply electricity in the borough and the adjoining parish of Uplyme.

The ELECTRICITY COMMISSIONERS WILL HOLD AN INQUIRY at the Middlesex Guildhall, Westminster, London, on May 30, at 10.30 a.m., and following days if necessary, into the application of the South Eastern and Chatham Railway for permission to establish a generating station on Angerstein's Wharf, Charlton, Kent, and into that of the West Kent Electric Company to establish a generating station at Belvedere, in the Urban district of Erith. Anyone interested in the applications of either company may attend.

At a meeting of ACCRINGTON Town Council on Monday it was stated that the revenue of the electricity undertaking had suffered as a result of the coal strike, &c., and the sale of current was down by a million units. Notwithstanding the increase in price the receipts had only increased by £3 500. Owing to the fact that generating costs had been reduced from £71 000 to £45 000 the loss last year of £8 800 had been turned into a profit of £13 790. After the appropriation of various sums they had a total profit for the year of £12 640. Until industrial conditions became more settled nothing could be done with regard to a reduction in price.

A block of twelve MODEL DWELLINGS in SHOREDITCH is to be lighted electrically by the London County Council. The Borough Council will fit the tenements for lighting, cooking and water heating, the County Council bearing half the cost (£15 each), which is claimed to be less than the charge for installing gas fittings. Electricity will be supplied at a flat rate, the average charge for a three or four-roomed tenement for lighting and water heating being estimated at 2s. a week, and for a five-roomed one, 2s. 4d. When current is not used for lighting it operates automatically for heating water. For cooking, a separate meter will be installed, and electricity will be supplied at 2d. a unit.

New Schemes and Mains Extensions.

PORTSMOUTH Town Council has received sanction to a loan of £3 000 for the extension of the engine house at the Electricity Works.

BERWICKSHIRE County Council have granted permission to the Greenlaw Electric Supply Co. to erect overhead transmission lines in the town.

CROYDON Town Council have applied for a Special Order to supply electricity to Addington at an estimated cost of £1 000. Owing to the increased demand for electricity at Croydon, £12 084 is to be expended on additional plant.

BRADFORD Corporation have decided to inaugurate a modified scheme of street lighting in an endeavour to secure further economy. Only about half the present number of lamps will be lighted, and the experiment will last for one month.

A limited company has been formed at CORWEN to carry out a combined water and electricity scheme for the town. Electricity will be generated at the Cynwyd waterfalls, about two miles away, where two turbines will be fixed, with a station in the centre of the town.

WARMINSTER Electric Supply Company have acquired an old foundry near the Market Place for use as a generating station. Arrangements have been made for the mains to be extended to the village of Sutton Veney, and it is hoped to have electricity available by Christmas.

WORCESTER City Council are making application to the Electricity Commissioners for a Special Order to enable them to supply electricity outside the boundary of the city and within a radius of three miles from the Cross at Worcester, and to supply in bulk to the Shropshire Power Company and the Malvern Urban District Council.

The Electric Supply Corporation are asking the Electricity Commissioners to rescind the HITCHIN ELECTRIC LIGHTING ORDER, 1902, and the EXMOUTH ELECTRIC LIGHTING ORDER, 1900, and to grant new orders authorising electricity supply in the respective urban districts of Hitchin and Exmouth as constituted at the date of the proposed Orders.

Alteration of Charges.

TONBRIDGE Urban Council has abolished the minimum charge of £2 per annum hitherto levied on consumers of electricity.

BROMWICH Electricity Committee recommend a further reduction of 12½ per cent. to power consumers as from the March (1922) meter readings.

SUNDERLAND Town Council has authorised the following reduced scale of charges for the supply of electricity for heating and cooking purposes, in place of the previous rate of 2½d. per unit:—Not exceeding 500 units per quarter, 2½d. per unit; 500–1 000 units, 2¼d.; 1 000–1 500 units, 2d. per unit; 1 500–2 500 units, 1¾d.; exceeding 2 500 units, 1½d.

Personal and Appointments.

PROF. R. W. CHAPMAN has been elected President of the INSTITUTION OF ENGINEERS (of Australia) for the year 1922.

SIR RICHARD GREGORY has accepted the position of President of the Decimal Association in succession to the late Lord Belhaven and Stenton.

Owing to his business premises in Packer's Row, Chesterfield, having been demolished, Mr. EDGAR R. MORRIS, electrical engineer, has taken temporary premises in Elder Yard.

SIR THOMAS HENRY HOLLAND has accepted the invitation of the Governing Body of the Imperial College of Science and Technology, London, to be Rector of the College, in succession to Sir Alfred Keogh, who will retire on September 1 next.

PROF. C. L. FORTESCUE, of the Royal Naval College, Greenwich, has been appointed to the Chair of Electrical Engineering at the City and Guilds (Engineering) College in succession to Prof. T. Mather, who is resigning at the close of the present session.

MR. J. W. BISPHAM, of the London County Council service (Technology Section), has been appointed principal of the Borough Polytechnic Institute, to fill the vacancy caused by the retirement of Principal C. T. Millis. He will take up his duties in September.

MISS A. C. DAVIES, of the Royal Holloway College, Englefield Green, Surrey, has been awarded the annual international prize of 1 000 dollars given by the American Association to Aid Scientific Research for her paper on "The Investigation of Critical Electronic Energy Associated with the Excitation of the Spectra Helium." Thirteen papers were received—from Great Britain, six; United States, five; Australia, one; Russia, one.

MR. C. MITCHELL, who recently retired from the position of works manager of the Marconi Wireless Telegraph Company, Chelmsford, after 16 years service, has been presented with an antique walnut bureau and a silver cigar case by employees who were under him ten years or over. Mr. A. Eddington, in making the presentation, referred to the great service rendered by Mr. Mitchell in being instrumental in forming the men's and girls' club rooms and the fine sports ground.

Recent appointments to the staff of the Technical College, Bradford, include Mr. R. E. STRADLING, as head of the Department of Civil Engineering, and Mr. HENRY J. B. CHAPPLE, as lecturer in Electrical Engineering. Mr. Stradling was formerly at Bristol University and is now Lecturer in Civil Engineering in the University of Birmingham. Mr. Chapple is at present undertaking post-graduate work in wireless telegraphy and telephony at the City & Guilds of London College. He was for some years engaged in practical electrical work at Portsmouth.

Business Items, etc.

Mr. Wm. H. Bill has ceased to be a partner in the firm of BILL & BERRY, as from March 25 last. The firm will be carried on as before by Mr. James H. Berry as sole proprietor, who will discharge all the liabilities.

AUTOMATIC AND ELECTRIC FURNACES, LTD. inform us that in response to enquiries, they have introduced a marine-type of Wild-Barfield electric furnace for use on board ship. This type of furnace has been inspected by Admiralty experts and passed for use on H.M. ships.

U.S.A. Electrical Manufactures.

An analysis of the CENSUS OF ELECTRICAL MANUFACTURES in the United States for 1919 appears in the "Electrical World" of April 22. A comparison is made with the position in 1914, and though both years were abnormal, it is clear that enormous progress was made in the period. The total value of the electrical products in 1919 is given as $997 968 119, against $335 170 194 in 1914, and of subsidiary products as $21 092 700, a total of $1 019 060 870, against $359 432 155. Generating plant and parts increased to $86 266 114, from $17 865 542, transformers and feeder potential regulators to $53 495 570 from $28 276 338, and motors (excluding starters or controllers) to $116 893 038 from $44 176 235. There were also large increases in the values of electric locomotives, batteries (storage and primary), carbons, searchlights, incandescent lamps, telegraph and telephone apparatus, domestic devices, switchboards, radio apparatus, &c. In fact, the only heading showing a reduction is arc lamps, though in the actual number manufactured (but not value) carbon filament lamps also showed a slight drop.

A notable feature was the increase in the size of the generating units and the demand for large transformers. Though the carbon lamp production remained stationary, the tungsten lamp output rose to 211 383 193 from 74 434 059 in 1914. The demand for domestic electric apparatus and devices is clearly shown by the fact that their value was about fourteen times that of 1914. Heaters, stoves and ranges, grills, toasters, flat-irons, vacuum cleaners, vibrators, cutters, &c., all seemed to share in the popularity of domestic appliances. Farmhouse plants and radio apparatus were also much in request.

Electric Traction.

WALSALL Town Council has decided to reduce by 20 per cent. the charge for electricity supplied to the Tramways Department.

SUNDERLAND Corporation has decided that while repairing the tramway track in Tatham-street they will provide a new interlacing line at an estimated cost of £450.

READING Corporation tramways show a net profit of £2 988 this year against a deficit of £14 023 last year. The number of passengers carried during the year was 11 349 857, a decrease of 1 326 240.

The report of Sir William Marwood and Colonel J. W. Pringle recommending the erection of CENTRE POLES in PRINCESS STREET, Edinburgh, has been issued by the Ministry of Transport as a White Paper.

BARROW Electricity Committee have notified the Tramways Committee that they are unable to reduce the charge for current for traction purposes, but for lighting the charges will be reduced from 8d. to 2½d. per unit.

The Standard Electric Co. have obtained a concession from the British Electric Federation, Ltd., for erecting illuminated signs on the electric light standards and tramway poles in SWANSEA, from which the Corporation will obtain a revenue of about £1 600 for the electricity used.

Institutions.

The annual conversazione of the INSTITUTION OF ELECTRICAL ENGINEERS will be held on Thursday, June 29, from 8.30 to 11 p.m., at the Natural History Museum, South Kensington.

The following members have been nominated to serve on the WIRELESS SECTION COMMITTEE OF THE I.E.E. for 1922–23: *Chairman*—Prof. G. W. O. Howe. *New Nominations for Membership of the Committee*—S. Brydon, J. St. Vincent Pletts, Captain H. R. Sankey, R. L. Smith-Rose. The following will continue to serve as members of the Committee: B. Binyon, R. C. Clinker, Dr. W. H. Eccles, Prof. C. L. Fortescue, G. H. Nash, C. C. Paterson, Captain H. J. Round, L. B. Turner.

In a lecture on "Brakes for Tramways and Road Vehicles," delivered last week before the YORKSHIRE ASSOCIATION OF CIVIL ENGINEERS, Mr. J. W. Dawson described the method of braking in operation at Bradford. Professor Charnock, who presided, said that nearly all tramway accidents in this country had been traced to inefficient or defective brakes, and the operation of stopping a car was not by any means the simple matter it was sometimes assumed to be. A passenger who stopped a car, either in entering or leaving, was responsible for the expenditure of an amount of energy which would suffice to carry him nine miles. The energy absorbed in starting and stopping the cars on a given tramway system was enormous, and it had been ascertained that in several large cities as much as £50 000 was expended annually in stopping cars.

Arrangements have now been completed for the summer meeting of the NEWCOMEN SOCIETY, which is to be held on Thursday and Friday, June 1 and 2. On the first morning a conducted tour will be made through the engineering collections of the Science Museum, South Kensington, followed in the afternoon by a conducted inspection of the roof of Westminster Hall, by kind permission of Sir Frank Baines, Director of Works; a visit to the Clockmakers Company's Horological Collection, and, if time permits, to the Guildhall. At 7 p.m. the party will meet for dinner at the Engineers' Club, Coventry Street, W.1 (morning dress, probable cost 5s. each). On Friday morning a visit will be made by motor coach to the Rotunda Museum, Woolwich, and after lunch at the Ship Hotel, Greenwich, the Naval Museum will be inspected. At 4.30 p.m. the party will leave for Deptford, where a visit will be made to Boulton and Watt Engines, 1812 and 1824, M.W.B. pumping station, Brookmill Road, by kind permission of Mr. T. Melhuish, District Engineer.

Linke-Hoffmann Works.

"The Times" Berlin correspondent states that in the ANNUAL REPORT OF THE LINKE-HOFFMANN WORKS details are given of the arrangement come to with the Allgemeine Elektricitats-Gesellschaft in view of the future electrification of the German railways and the expected demand for electrical locomotives. For this purpose a new group has been formed consisting of the Linke-Hoffmann Works, the A. G. Laushener, and the A.E.G., and by these the "Sgahl and Walzwerk Hennigsdors" has been founded. The Linke-Hoffmann and A.E.G. have acquired an interest in the Rhenische Metallwaaren and Maschinen Fabrik of Düsseldorf, and the former's holdings in J. P. Goossens Lochner and Company and Rudolf Lochner and Company have been increased. The capital of certain subsidiary companies has also been increased. In 1920 the Linke-Hoffmann raised its capital by 56 000 000 marks, and of this increase the A.E.G. has taken over 30 000 000 ordinary shares. An increase of 80 000 000 marks was authorised last December, the greater part of which is being expended in improving the company's holdings in other countries. The Linke-Hoffmann gross profits for the year 1921 were 218 019 928 marks, compared with 82 000 000 in 1920 and 26 000 000 in 1919.

Possible Trade Openings.

The Municipal Council of DEN HAM (province of Overijsel, Holland) has decided to proceed with the electrification of Den Ham and Vroomshoop, for which purpose a loan of Gld.115 000 will be issued.

A correspondent in NOVA SCOTIA asks for the addresses of United Kingdom manufacturers who can supply wireless apparatus and sets suitable for home use. Particulars from the Canadian Government Trade Commissioner's Office, Portland House, 73, Basinghall Street, London, E.C.

An electrical engineer in Weston, ONTARIO, desires to obtain the representation of United Kingdom manufacturers of machine tools, coal handling machinery, boiler house plant, etc., on a commission basis, for the Province of Ontario. Particulars from the Department of Overseas Trade. (Reference No. 522.)

In connection with the invitation by the SIAMESE DEPARTMENT OF POSTS AND TELEGRAPHS for tenders to be submitted by June 28 for telegraph and telephone materials, the Acting Consul General at Bangkok has now forwarded to the Department of Overseas Trade a copy of the form on which quotations are to be made. The form specifies the following material as being open to tender: galvanised iron wire; insulators, white Cordeaux pattern; G.P. insulated submarine telegraph cable; twin opening out wire; rubber cable; galvanised steel suspension wire for aerial cable; magneto ringing wall telephones.

A Committee has recently been formed in Vladivostock for the purpose of rebuilding the town of NIKOLAEVSK-ON-AMUR, which was burnt down in 1920 and which is at present under Japanese administration. The plans of the Committee provide for the establishment of a town electric lighting station, a commercial port with wharves, warehouses, and full equipment both for marine and river transport, the installation of a sewage system, water supply, and telephone service, and also for the erection of 1 500 dwelling houses. The Committee invites the co-operation of British enterprise and capital in the work of reconstruction. Further details can be obtained from the Department of Overseas Trade.

A company who maintain a telephone system in WESTERN CANADA have intimated to Mr. L. B. Beale, H.M. Trade Commissioner for Western Canada, that they are prepared to do business with firms in this country who can quote advantageous prices and delivery dates. The company are accustomed to purchase lead-covered, paper-insulated cable, 22 B. & S. gauge, in standard sizes up to 800 pairs in large quantities of some 480 000 lb., sufficient for a year's work, and are now in the market for such cable. The name and address of the firm to whom communications should be addressed can be obtained on application to the Department of Overseas Trade. The import duty on telephone cable of United Kingdom manufacture is 20 per cent. *ad valorem*, as against 30 per cent. *ad valorem* in the case of United States manufacture, to which must be added in each case a sales tax of 4 per cent. of the duty paid value. In estimating the cost of delivering material in British Columbia, the advantages in the matter of cheap freight rates to be secured by shipment via the Panama Canal should also be considered.

Miscellaneous.

The death occurred last week at Bridgend, at the age of 73, of Mr. JOHN WILLIAMS, one of the pioneers of the Ogmore Valley Electric Light Company.

On the last line but one in the second column of our leading article on International Radio-Communication which appeared on p. 552 of our last issue 150 mV should read 150 μV.

"The Cost Accountant," the official journal of the Institute of Cost and Works Accountants, starts its second volume with the June number, and will contain the first instalment of a new series of articles by Mr. C. W. Charlesworth, F.C.W.A., entitled THE INTERPRETATION AND ANALYSIS OF ELECTRICITY SUPPLY COSTS.

LICENCES OF RIGHT have been granted to the K.W. Ignition Co. for Patent No. 105 328 (3 268/17) for "improvements in impulse starting mechanisms for the ignition magnetos of internal combustion engines," and to P. F. Brittain for Patent No. 135 747 (8 560/19) for "improvements in or connected with motors for dynamo-electric machines."

The forty-third annual CANADIAN NATIONAL EXHIBITION will be held at Toronto from August 26 to September 9. United Kingdom firms desiring to secure space should apply to the Secretary, Canadian National Exhibition, Lumsden Building, West Adelaide Street, Toronto. A Bureau of Information will again be maintained by H.M. Trade Commissioner Service in Canada, at which trade literature, small attractive posters, samples, etc., may be displayed, free of charge. Catalogues, etc., of electrical machinery and appliances; mining machinery and supplies, electrical railway equipment; scientific instruments, etc., are specially mentioned as being useful, and should be sent direct to H.M. Trade Commissioner, 24, West Adelaide Street, Toronto, not later than June 30. Leaflets issued by the Exhibition authorities, copy of correct form of invoice, etc., can be examined at the Department of Overseas Trade (Canadian Section). (Ref. D.O.T. 4985/FB/PN.)

Companies' Meetings, Reports, etc.

The English Electric Company, Limited.

Presiding at the annual general meeting of the above company on Tuesday, May 16, Sir Charles E. Ellis, G.B.E., K.C.B. (chairman of the company), said that the balance sheet showed for the first time the full liability for the note issue, but there was a considerable reduction in sundry creditors and credit balances. On the assets side there was an increase of nearly £700 000 in land, buildings, plant, machinery, etc., while interest in subsidiary and other companies was reduced by £825 000. These differences indicated further progress in the absorption of the constituent firms. The company's stocks had been much reduced during the year both in quantity and value, as they were able to foresee in 1920 that, although orders continued to flow in, the market was becoming exhausted. In addition to making a reduction in quantity of stocks they had met the heavy fall in the market value of all materials by a special writing down to a figure representing to-day's value or less.

Unprecedented State of Trade.

Turning to the profit and loss account the available balance was slightly in excess of that last year. The net profits brought to credit included dividends received from subsidiary companies and amounts transferred from reserves previously set aside and no longer required. In considering what dividend should be paid they had felt bound to look ahead and there they saw uncertainties on every hand. The state of trade was unprecedented, and the engineering industry had to face peculiar industrial difficulties. In recommending a dividend on the ordinary shares at the rate of 5 per cent. per annum, the directors considered that they had reconciled the natural expectations of the shareholders with the needs of a difficult and obscure period to come.

Need for Private Enterprise.

Important steps had been taken to effect every possible economy throughout the company's organisation, but their selling organisation at home and abroad had been increased and strengthened. The chaos in many of our best markets and the apparent failure of any scheme on the grand scale to breathe new life into the trade of Europe had produced a situation without precedent in British industry. He was strongly of opinion that the way out of most of the present difficulties would be through the efforts of private enterprise. So strongly did they hold this view that they had recently, with five powerful associates of world-wide reputation, formed the Power and Traction Finance Company, Ltd., with the object of dealing with comprehensive engineering contracts on a large scale. The electrical industry had been less seriously affected than many others, and during the past year they had secured many important contracts, including the complete central station for the City of Leicester, important railway electrification contracts in Spain and Japan, and others. There were signs that public works too long delayed must shortly be put in hand, and competition by Germany and other countries with depreciated currencies was not so serious as the abnormal rates of exchange would appear to imply.

The Engineering Lock-out.

The Chairman concluded :—

Perhaps the most disturbing feature in the prospects for the electrical industry is the continuance of the engineering lock-out. If the favourable view with which foreign buyers have regarded the industrial stability of this country in the past is to be threatened by disputes such as this, the trade revival in this country may be indefinitely postponed. In this connection the remarks of my colleague Lord Meston, speaking the other day as chairman of the Calcutta Electric Supply Company, are particularly apposite. He said : " Disputes which mutual forbearance might obviate, unless they are shortly abated, will surely drive concerns like ours, however genuine our patriotism, to place our orders for heavy electrical plant outside England."

This is neither the time nor place to discuss the merits and demerits of the engineering lock-out, but it is in my judgment certain that the vast number of workmen and employers are prepared to take the common-sense view that by real co-operation and not by abuse of power on either side are the security of one class and the aspirations of the other to be achieved. Whilst expressing a determination loyally to support the majority of the great Federation to which our trade is allied, we are bound to say that in all our works the relations between our workpeople and ourselves are excellent in every way. The damage to British trade in the eyes of the world by the present serious labour dispute in this country will be almost irreparable unless it be brought to a rapid conclusion, and I sincerely trust that the joint meeting which is to be held to-day will be the precursor of a settlement satisfactory to both parties. It may be that there are extremists on one side or the other, but whether that is so or not, a most grave responsibility rests upon the negotiators which can only be met by a policy of co-operation and goodwill.

The Castner-Kellner Alkali Company announce a dividend of 8 per cent., actual, for six months.

The dividend for the year of the French Thomson-Houston Company remains unchanged at 45 frs. per share.

The Indian Electric Supply and Traction Company announce a final dividend of 7 per cent., making 10 per cent. for the year.

The directors of Babcock and Wilcox announce a final dividend of 9 per cent. actual, free of tax, making 16 per cent., free of tax, for the year.

The Calcutta Tramways Company last week offered for public subscription £250 000 7 per cent. second (registered) debentures. The issue was heavily over-subscribed within a few hours.

The net profit for the past year of Scarborough Electric Supply Company amounted to £45 after adding £4 000 to depreciation. The sum of £9 817 was brought in. A dividend of 2¼ per cent. is proposed, leaving £7 612 to be carried forward.

The net revenue of Tynemouth and District Electric Traction Company for 1921 amounted to £3 860, plus £8 794 brought in, making £12 654. The directors propose a dividend on the ordinary shares at 10 per cent. for the year, carrying forward £6 488.

The accounts of the Shanghai Electric Construction Co. show that £30 000 has been placed to reserve. A final dividend of 8 per cent. (actual) is recommended, making 20 per cent. for the year. In June last a share bonus of 25 per cent. was distributed out of reserve.

The profit of the Cleveland and Durham Electric Power Company for 1921 was £40 462, making with £5 359 brought in £45 821, of which interest on debentures, etc., absorbed £43 945, leaving £1 876 to be carried forward. The capital expenditure on works during the year amounted to £33 627.

The revenue of the Submarine Cables Trust for the year to April 15, 1922, was £29 958, and expenses £1 983, leaving balance of £27 974, plus £19 brought forward. After providing £7 941 to meet payment of coupons and £546 to be refunded to Inland Revenue, £19 456 has been transferred to redemption fund and £50 carried forward.

The profit for 1921 of Gravesend and Northfleet Electric Tramways Company, after providing £11 576 for repairs, renewals and maintenance and meeting debenture interest, etc., was £400, making available, with £4 944 brought forward, £5 344. £1 000 is placed to reserve (making £10 687), leaving £4 258 to be carried forward.

The net profit of the Havana Electric Railway, Light and Power Company for 1921 amounted to $4 620 064. The sum of $1 923 879 has been placed to reserve, leaving $2 696 185, plus $3 629 099 brought in, making $6 326 084. Dividends paid (6 per cent. on the preferred, and 6 per cent. on the common stock) absorbed $2 155 579, leaving $3 781 041 to be carried forward.

The revenue of Peterborough Electric Traction Company for 1921 from all sources was £29 267, a decrease of £1 466. Expenses, including debenture interest and £3 500 placed to renewals fund (against £3 000), amount to £26 607, a decrease of £328, leaving £2 660, plus £932 brought in, making £3 592. The directors recommend payment of a dividend at 5 per cent. on the ordinary shares, carrying forward £1 272. £571 was expended on capital account. Total capital expenditure amounted to £72 266, compared with shares and debenture stock issued of £63 000.

The accounts of Callender's Cable and Construction Company for 1921 show a credit balance of £217 012. After deducting interest on debenture stock, dividends on preference shares, appropriation for depreciation of buildings, plant and machinery of £30 000 and of office furniture £500, the net profit was £117 012, making with £108 101 brought in £225 113. The directors propose payment of a dividend on the ordinary shares at 15 per cent. per annum, less tax, being 3s. per share, of which 1s. per share has been paid. The sum of £150 113 remains to be carried forward.

An Exchange message states that the report of the Swedish-Danish-Russian Telephone Company, which has a telephone system in Moscow, shows a loss last year, when the company's activities were practically at a standstill, amounting to 1.55 million kroner, of which 1.39 million is directly concerned with the Moscow branch. Since 1917 accumulated losses have reached a total of 5.61 million kroner. The company owns 8 808 of the 9 000 shares of the Cedergren Telephone Company, which last year incurred a loss of 1.41 million kroner, making its total losses since 1916 7.79 million kroner.

The report of the Ever Ready Company (Great Britain) for the year to March 31 last shows, after allowing for various charges, £39 576 available for appropriation. The directors recommend final dividends of 5½ per cent. for the half-year to March 31, 1922, on the preference shares, fully paid, making 9 per cent. for the year, and 9 per cent. on the ordinary shares for the year, carrying forward £5 152. Early in March, 1922, a final settlement was made with the authorities of all taxation up to March 31, 1922 (excepting corporation profits tax, which is reserved for). The sum of £4 922 in suspense in the balance-sheet as at March 31, 1921, was absorbed in the settlement.

The accounts of the Indian Electric Supply and Traction Company for 1921 show surplus on working in Cawnpore of £26 501, against £34 969 in 1920, and including transfer fees and bank interest the credit balance is £30 499. Actual net earnings in India were

Rs4 35.232, as against Rs4 10.222 for 1920, but sterling equivalent is lower owing to the fall in exchange. London expenditure was £2 433, and after providing £2 979 for debenture interest and including £5 075 brought forward there remains £30 162. The board have placed to reserve for depreciation and renewals £7 736, and recommend a final dividend of 7 per cent., making 10 per cent., carrying forward, subject to taxation, £3 197.

The accounts of the Potteries Electric Traction Company for the year ended December 31 last show that the capital expenditure during the year amounted to £12 199, and the revenue to £300 832. The traffic and parcels receipts, which totalled £283 153, exceeded those of last year by £2 521. Expenses increased by £6 562. After deducting all expenses chargeable to revenue, including £11 025 for debenture interest, and a provision of £10 000 for renewals fund, making it £55 891, there remains £27 841 against £28 500 10s. for 1920. Adding £6 082 brought forward there is a balance available for distribution of £33 923, which the directors recommend be applied as follows: To reserve account £5 000 (bringing it up to £114 523), to payment of a dividend on the preference shares at the rate of 5 per cent. per annum £12 250, to payment of a dividend on the ordinary shares at the rate of 4 per cent. per annum £9 800, leaving £6 873 to be carried forward.

Presiding last week at the annual meeting of Pinchin, Johnson, Ltd., Mr. Edward Robson said that, in common with practically every other industry, they had found that the general financial and economic conditions of the world had been so exceptional and, in regard to their foreign trade, so chaotic, that with some of the overseas markets it had been almost impossible to trade. They had, however, maintained their markets in a reasonably satisfactory degree. Their home trade had been extremely satisfactory, and even in some of the most difficult of their export markets they had been able considerably to strengthen and consolidate their position. Their stock in trade at December 31 last showed a very considerable reduction compared with the previous year, and they now appeared to have reached the position that was clearly established in regard to raw material values. It was difficult to predict the future in the present unsettled state of affairs, but their returns to date gave every indication that the extreme slump was more or less at an end, and there were already indications, as far as their particular business was concerned, that a moderate but, he hoped, steady, improvement had set in, and they looked forward to a very satisfactory year of trading in 1922.

Addressing the shareholders at the annual meeting of the Bath Electric Tramways, Ltd., last week, Mr. J. B. Hamilton (the Chairman) first apologised for the late date at which the report and accounts were being presented. The delay, he said, was entirely due to his having had, for health purposes, to take a long rest. This took the form of a journey round the world, and being, if anything at all, a transport man, he had been able to advance his knowledge of what was being done in this respect in other countries. He wished to say that those who had invested their money in tramways in cities of this country need have no fear of such undertakings being superseded by other forms of traction which were very loudly applauded in some of the motor journals. There was not a single example, either in America or throughout the East, of tramways being superseded by any other form of traction in cities. It was quite true that in some places where tramways were unsuitable, owing to great density of traffic, such as prevailed in London, motor buses had been introduced, and that, in districts where the population was too sparse to justify the high initial cost of installing a tramway, other forms of traction had been adopted, such as motor omnibuses or railless electric traction; but in all the cities of the world where the electric tramcar was practically doing the work of transportation it was, in his view, likely to continue to do so for many years to come. An abstract of the accounts appeared in our last issue.

The revenue of the Cork Electric Tramways and Lighting Company for the year 1921 amounted to £114 773. The revenue from the tramways was £1 406 less than for the previous year, due to the strike referred to in the directors' last report. The revenue from lighting and power shows an increase of £6 430 and the profits on supply sales, discounts, etc., a decrease of £1 018; expenses amounted to £98 772. The cost of generating was £1 593 less than for 1920, due to the fall towards the end of the year in the price of coal. There were increases of (*a*) £687 in the cost of maintaining and operating the tramways, (*b*) £1 841 in the lighting and power distribution expenses, (*c*) £2 576 in insurances, management, and other general expenses, and (*d*) £293 in bad debts. The gross profit for the year was £16 001 to which is added £5 702 carried forward from 1920, and after meeting income tax and interest charges and transferring to reserve for depreciation and renewals £12 000 (compared with £6 500) there is a balance to carry forward of £2 800. The capital expenditure during the year amounted to £35 031. This mainly covers the installation of a 2 000 kW Curtis turbine and other plant at the Cork generating station, additional cables and house services to meet the increasing demand for lighting and power, and new plant at the Queenstown generating station which has been installed in order to reduce the cost of generating. The revenue to date shows an increase over the corresponding period of last year and enables the company to pay a half-year's dividend on the 5 per cent. cumulative preference share capital. This payment will clear the arrears to June 30, 1920.

New Companies.

George McCombe and Company.

George McCombe and Company, Ltd. (18 200.) Private company. Reg. in Edinburgh May 4. Capital, £2 500 in 2 300 preference shares and 200 ordinary of £1 each. Motor, steam and electrical engineers, etc. Subscribers: J. K. MacDonald, R. Cunningham.

Superadio, Ltd.

Superadio, Ltd. (181 747).—Private company. Reg. May 12. Capital, £1 000 in £1 shares. Manufacturers, exporters and importers of, and dealers in wireless telegraphic and telephonic appliances, installations, goods and accessories of all kinds, electrical lighting goods, &c. Subscribers: C. Orgel and S. Orgel. Registered office: 111, Great Eastern Street, E.C.

Newcastleton Electric Supply Company.

Newcastleton Electric Supply Company, Ltd. (12 204). Private company. Reg. in Edinburgh, May 9. Capital, £1 000 in £1 shares. To carry on business as indicated by the title. First directors: Miss Agnes Scott, C. Wood, T. Martin, T. J. Ewart, T. Oliver, A. Oliver, R. Wilson, J. Davidson, D. Oliver and J. Carruthers. Registered office, 44A, South Hermitage Street, Newcastleton.

Tylor Engineering Company.

Tylor Engineering Company, Ltd. (181 672). Private company. Reg. May 9. Capital, £120 000 in £1 shares. To acquire the business carried on by J. Tylor and Sons, Ltd., and to trade as mechanical, consulting, hydraulic, electrical engineers, manufacturers of electrical plant and apparatus, etc. Subscribers: A. J. Fletcher, H. E. Herrick. Solicitors: Collisson, Prichard and Barnes, 27, Bedford Row, W.C.1.

Illuminated Identification Number Plate Company, Ltd.

Illuminated Identification Number Plate Company, Ltd. (181 688.) Private company. Reg. May 10. Capital, £500 in £1 shares. Manufacturers and sellers of parts and apparatus of all kinds for lighting, illuminating and heating; contractors, general engineers; manufacturers of and dealers in lamps, lanterns, etc. Subscribers: D. A. Ellam, H. Robinson, N. R. Spencer. Registered office: 10, Raglan-street, Halifax.

Magneto Repair and Winding Company.

Magneto Repair and Winding Company, Ltd. (181 658.) Private company. Reg. May 9. Capital, £500 in £1 shares. To take over the business of magneto repairing and electrical engineering carried on by D. Jones at 5, Salubrious Place, Swansea, as the "Magneto Winding and Repairing Company." Provisional directors: D. Jones, F. H. Thomas. Secretary: D. Jones. Registered office: 5, Salubrious Place, Swansea.

French Mutagraph Company.

French Mutagraph Co., Ltd. (171 646.) Private company. Reg. May 9. Capital, £5 000 in 4 500 preference shares of £1 each and 10 000 deferred shares of 1s. each. To adopt an agreement with L. E. Falcy, and to carry on the business of advertising sign manufacturers, mechanical and electrical engineers, etc. First directors: L. E. Falcy and H. L. Dixon. Qualification: £100. Registered office: 14, Bedford Row, W. C.

Acme Production Company.

Acme Production Company, Ltd. (181 752).—Private company. Reg. May 12. Capital, £3 000 in £1 shares. To acquire the business of manufacturers of and dealers in electrical and mechanical appliances and scientific instruments now carried on by W. J. Allen and W. D. Vick at 73½, Coleshill Street, Birmingham. Permanent directors: W. J. Allen, W. D. Vick, and W. H. Fulford. Registered office: 73½, Coleshill Street, Birmingham.

The Wayne Engineering and Equipment Company.

The Wayne Engineering and Equipment Company has opened the following branch offices: The Efandem Company, Ltd., 28, Queen-street, Albert-square, Manchester; Astbury and Madeley, Empire House, Great Charles-street, Birmingham; W. Anderson Penman, 36, Exchange-street, Norwich; G. F. French, Kent Works, Kendal; Douglas G. Cochrane and Co., Ltd., Princes-buildings, 11, Akenside-hill, Newcastle-on-Tyne; Philip and Bruce, Ltd., 50, Wellington-street, Glasgow.

H. R. Gear.

H. R. Gear Co., Ltd. (181 590). Private company. Reg. May 6. Capital, £5 000 in £1 shares. To acquire from E. C. Hatcher and T. Rooke, the benefit of certain existing inventions relating to reduction gears, and to carry on the business of engineers and contractors, manufacturers of and dealers in railway, tramway, electrical, magnetic, galvanic and other apparatus, etc. First directors: Major E. C. Hatcher, T. Rooke, H. C. B. Underdown, G. E. Marten. Solicitors: Kimbers, Williams and Co., 79, Lombard-street, E.C.

Park Electrical and Engineering.

Park Electrical and Engineering Co., Ltd. (181 622). Private company. Reg. May 8. Capital, £10 000 in £1 shares. To acquire the land and building in Ashburton Road, Trafford Park, Manchester, and now owned by the Park Electrical and

Engineering Co., and to carry on the business of electrical and mechanical engineers, electricians, and manufacturers, etc. Permanent directors: G. L. Brown, A. C. Penny. Secretary: G. L. Brown. Solicitor: J. Prior, 438, Corn Exchange-buildings, Manchester.

Wholesale Electrical Company.

WHOLESALE ELECTRICAL CO. (1922), LTD. (181 757).—Reg. May 12. Capital, £20 500 in 20 000 cumulative 10 per cent participating preference shares of £1 each and 10 000 ordinary shares of 1s. each. To adopt an agreement with A. W. Little, and to carry on the business of electrical and mechanical engineers, manufacturers of electrical equipment, &c. First directors: A. W. Little (chairman), N. E. Rutherdon, and T. W. Greaves. Registered office: 5, Guildhall Chambers, 31-4, Basinghall Street, E.C.2.

Sir Charles Bright and Partners.

SIR CHARLES BRIGHT AND PARTNERS, LTD. Reg. May 10. Private company. Nominal capital, £2 000 in £1 shares. To adopt an agreement with Sir Charles Bright and Partners, and to carry on the business of advising, inspecting, consulting and superintending engineers, electrical (including telegraph, telephone and submarine cable) engineers, etc. Permanent directors: Sir Charles Bright, A. H. Seabrook, A. J. Stubbs, Lieut.-Col. H. W. Wordall. Secretary: A. J. Stubbs. Registered office: 146, Bishopsgate, E.C. File number, 181 695.

Electrical Imports and Exports.

IMPORTS.—The following are official values of electrical machinery, apparatus and material imported into this country (*a*) during April, 1922, and (*b*) the aggregate figures from January 1 to April 30, with increase or decrease compared with corresponding periods of 1921 :—

Electrical machinery, (*a*) £68 967 (increase £16 810), (*b*) £450 512 (increase £151 439); telegraph and telephone cables, submarine, nil; other than submarine, (*a*) £1 241 (decrease £9 364), (*b*) £12 156 (decrease £26 188); telegraph and telephone apparatus, (*a*) £12 323 (decrease £24 705), (*b*) £51 610 (decrease £73 850); other electrical wires and cables, rubber insulated, (*a*) £18 023 (increase £15 170), (*b*) £37 384 (increase £26 762); with other insulations, (*a*) £2 445 (decrease £1 857), (*b*) £18 954 (decrease £24 045); carbons, (*a*) £1 609 (decrease £6 304), (*b*) £11 899 (decrease £29 085); glow lamps, (*a*) £10 435 (decrease £27 614), (*b*) £63 145 (decrease £37 578); arc lamps and electrical searchlights, (*a*) £15 (decrease £829), (*b*) £65 (decrease £5 570); parts of arc lamps and searchlights (other than carbons), (*a*) £1 383 (increase £484), (*b*) £3 552 (decrease £2 500); batteries, (*a*) £6 233 (decrease £3 447), (*b*) £21 918 (decrease £37 600); electrical instruments, commercial, scientific and electricity meters, (*a*) £4 683 (decrease £12 238), (*b*) £19 000 (decrease £66 060); switchboards, (*a*) £140 (increase £34), (*b*) £1 519 (increase £243); other electrical goods and apparatus, (*a*) £42 000 (decrease £39 803), (*b*) £175 990 (decrease £203 627). Total of electrical machinery, apparatus and material (other than uninsulated wire), (*a*) £169 497 (decrease £93 663), (*b*) £867 704 (decrease £327 659).

EXPORTS.—The exports of electrical machinery, apparatus and material (*a*) during April, 1922, and (*b*) from January 1 to April 30, with increase or decrease compared with corresponding periods of 1921, were as follows :—

Electrical machinery, (*a*) £450 489 (increase £27 732), (*b*) £1 886 883 (increase £209 315); including railway and tramway motors, (*a*) £5 098 (decrease £22 323), (*b*) £58 708 (decrease £23 868); other generators and motors, (*a*) £202 263 (decrease £16 797), (*b*) £1 001 453 (increase £74 110); and other electrical machinery, (*a*) £243 128 (increase £66 862), (*b*) £826 722 (increase £159 070); telegraph and telephone cables, submarine, (*a*) £23 020 (decrease £364 929), (*b*) £105 271 (decrease £569 610); other than submarine, (*a*) £61 813 (decrease £65 268), (*b*) £207 549 (decrease £400 305); telegraph and telephone apparatus, (*a*) £166 909 (increase £36 229), (*b*) £707 978 (increase £131 657); other electrical wires and cables, rubber insulated (*a*) £49 931 (decrease £112 983), (*b*) £195 504 (decrease £461 073); with other insulations, (*a*) £83 567 (decrease £146 157), (*b*) £421 026 (decrease £419 284); carbons, (*a*) £2 850 (decrease £328), (*b*) £15 458 (decrease £28 178); glow lamps, (*a*) £39 178 (decrease £14 321), (*b*) £136 120 (decrease £55 522); arc lamps and searchlights, (*a*) £409 (decrease £737), (*b*) £3 254 (decrease £722); parts of arc lamps and searchlights (other than carbons), (*a*) £546 (decrease £460), (*b*) £1 938 (decrease £1 085); batteries, (*a*) £41 990 (decrease £32 446), (*b*) £147 903 (decrease £144 009); electrical instruments, commercial and scientific and electricity meters, (*a*) £28 547 (decrease £14 905), (*b*) £134 488 (decrease £27 177); switchboards, (*a*) £13 185 (decrease £9 322), (*b*) £139 050 (increase £70 483); other electrical goods and apparatus, (*a*) £82 146 (decrease £116 391), (*b*) £418 995 (decrease £483 167). Total of electrical machinery, material and apparatus, other than uninsulated wire, (*a*) £1 044 580 (decrease £814 286), (*b*) £4 521 417 (decrease £2 166 677).

FAVERSHAM Corporation has received a protest from the A.M.E.E. against the reduction of the salary of the electrical engineer (Mr. G. S. Somerville) to £396 per annum; but at last week's meeting the Council decided to adhere to the decision to make the reduction.

Tenders Invited and Accepted.

UNITED KINGDOM.

BELFAST TRAMWAYS COMMITTEE. May 19.—Four junctions and 12 crossovers; also reconstruction of 10 miles, or alternatively $3\frac{5}{8}$ miles of single track. Specifications from General Manager

COUNTY BOROUGH OF WEST BROMWICH. MAY 22.—Supply of the following in connection with the reconstruction of the tramways: (1) Rail, fish plates, &c.; (2) tie bars, bolts, &c.; (3) points, crossings and special work; (4) copper bonds. Particulars from Mr. A. D. Greatorex, Borough Engineer and Surveyor, Town Hall, West Bromwich.

CHESHIRE LINES COMMITTEE. May 30.—Six months' supply of stores, including telegraph materials, iron tubing, oils, paints, &c. Specification from the Stores Superintendent, Cheshire Lines, Warrington.

GREAT NORTH OF SCOTLAND RAILWAY COMPANY. May 30.—Telegraph material, castings, ironmongery, rubber goods, &c. Forms of tender from the Stores Superintendent, 80, Guild-street, Aberdeen.

LAMBETH GUARDIANS. May 30.—Wiring and fitting of Lambeth Hospital. Particulars from the Clerk, Guardians' Offices, Brook Street, Kennington Road, S.E.11.

NOTTINGHAM ELECTRICITY COMMITTEE. June 1.—General stores for the electricity department for six or twelve months. Forms of tender from the Electrical Engineer, Electricity Station, Talbot Street, Nottingham.

ISLINGTON GUARDIANS. June 15.—Installing electric light and power equipment at St. John's Road Institution, Guardians' Offices, and Relief Offices. Particulars from Messrs. Wallis Jones & Dent, Consulting Electrical Engineers, 23, Old Queen Street, Westminster, London, S.W.1.

DUBLIN COUNTY COUNCIL.—Tenders for the removal of the old, and installation of a new system of inter-communicating house telephones. Particulars from Mr. H. J. Clancy, Secretary, Dublin County Council, 11, Parnell Square, Dublin.

BELGIUM.

MUNICIPALITY OF SAINT GILLES (BRUSSELS). MAY 23.*—Supply of (1) About 4 000 metres of armoured cable of 3 by 50 mm.²: for three-phase current at 5 000 V. between phases, 50 cycles; (2) about 2 000 metres of armoured telephone cable of 2 by 1 mm.²; (3) all the necessary accessories for the above.

INDIA.

HIGH COMMISSIONER OF INDIA, June 9.—Supply of copper telegraph wire, Carsack elements for Leclanche cells, V.I.R. cable. Particulars from the Director-General, India Store Department, Belvedere Road, Lambeth, S.E.1.

AUSTRALIA.

COMMONWEALTH OF AUSTRALIA. June 20.—426½ tons bronze wire (Schedule 28), 400 tons galvanised iron wire (Schedule 32), 47 tons galvanised steel wire (Schedule 32), 313 400 jointing sleeves (Schedule 33). Particulars from Supply Officer, Room 101, Australia House, Strand, W.C.

VICTORIAN ELECTRICITY COMMISSION. September 1.—Five surface-feed water heaters, six surface vapour condensers, and twelve feed-water evaporators. Specifications from the Agent-General for Victoria, Melbourne-place, Strand, London, W.C.2.

SOUTH AMERICA.

ARGENTINE BOARD OF SANITARY WORKS. JUNE 28.*—Construction and erection of equipment for a hydro-electric generating station and transforming sub-station for the town of Catamarca, Province of Catamarca.

BUENOS AIRES WATERWORKS.*—Machinery for three pumping stations, one power station, and eight transforming sub-stations.

SOUTH AFRICA.

MUNICIPAL AUTHORITIES OF THE CITY OF GRAHAMSTOWN. September 1.*—Complete Lighting scheme for the city.

CHEADLE Urban Council have accepted the tender of the Macintosh Cable Company for cable at £18 737.

BRIDGEND Corporation have accepted the tender of W. H. Allen, Son & Company for a two-phase turbo-alternator at £3 445.

The tender of G. H. Blackburn has been accepted for electrical equipment for a new cinema in St. George's-road BOLTON.

BRADFORD Tramways Committee have accepted the tender of Hadfields, Ltd., for 12 pairs of manganese steel points at £101 per pair.

BOLTON Tramways Committee have accepted the tender of the General Electric Company for e.h.p. switch gear for Bradshawgate sub-station.

LONDON County Council have accepted the tenders of A. Hawkins & Sons for electric wiring, &c., in Belleville Road (Battersea) schools at £718 10s., and Wormholt Road (Hammersmith) schools at £718 15s.

PORTSMOUTH Town Council has accepted the following tenders :—Pirelli General Cable Works, Ltd., cables at £483 10s.; Johnson and Phillips, Ltd., cable, £52 10s.; G. and J. Weir, Ltd., circulating pump, £970, and three feed pumps, £185 each.

* Particulars from the Department of Overseas Trade.

COMMERCIAL INTELLIGENCE.

Deeds of Arrangement.

WYNESS, Thomas Reginald Watt, and BALE, George Wilfred, trading at 13, Commercial Street, Brighouse, as WYNESS & BALE, electrical engineers. Filed May 10, by order on terms. Trustee, H. S. Dickinson, 30, Huddersfield Road, Brighouse. Secured creditors, £726; liabilities unsecured, £2 704; assets, less secured claims, £1 656. The following are creditors:—W. T. Henley's Telegraph Works, London, £199; English Electric & Siemens, Ltd., London, £157; Berry's Electric Company, Ltd., London, £34; Metallic Eng. Company, Birmingham, £76; Simplex Conduits, Ltd., Birmingham, £63; Donovan & Company, Birmingham, £109; Hirst, J. A., Brighouse, £150; Albion Electric Stores, Leeds, £31; General Electric Company, Leeds, £253; Wholesale Fittings Company, Manchester, £31; Beardsell & Company, Manchester, £47; Edison & Swan, Ltd., Ponders End, £59; British Insulated & Helsby Cables, Ltd., Prescot, £56; St. Helen's Cable & Rubber Company, St. Helen's, £88; Walsall Hardware Company, Walsall, £190; Siemen Bros. & Company, Woolwich, £47.

JONES, Herbert Henry, electrical engineer, trading as the STANDARD ELECTRICAL COMPANY, 4, Dillwyn Street, Swansea, electrical engineers' merchant. Filed May 11. Trustee, C. H. Harvey, 3, Goat Street, Swansea. Secured creditors, £293; liabilities unsecured, £1 773; assets, less secured claims, £1 448.

RECEIVERSHIP.

REMCO CARBON COMPANY, LTD.—R. Crane, of 46 and 47, London-wall, E.C., was appointed Receiver on March 1, under powers contained in debentures dated November 29, 1918.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

AIREDALE ELECTRICAL & MANUFACTURING COMPANY, LTD., Bradford. Registered May 2, £350; general charge, *£525. March 14, 1922.

BODMIN ELECTRIC LIGHT & SUPPLY COMPANY, LTD. Registered May 4, £100 debentures, balance of £2 000; general charge. *Nil. February 21, 1922.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Companies Winding-up Voluntarily.

AQUA ELECTRIC COMPANY, LTD. C. H. McKnight, 36, New Broad Street, E.C.2, appointed liquidator. Meeting of creditors at the Chartered Institute of Secretaries, 59a, London Wall, London, E.C.2, Monday, May 29, at 2.30 p.m. Particulars of claims to the liquidator by July 10.

BETA BATTERIES, LTD. J. A. Cameron, 5, New Court, Lincoln's Inn, London, W.C.2, appointed liquidator. Meeting of creditors at the liquidator's office, Friday, May 26, at 11 a.m. Particulars of claims to the liquidator by June 17.

PARK BROTHERS, LTD.—W. A. J. Osborne, Balfour House, Finsbury-pavement, London, E.C., appointed liquidator. Meeting of creditors at the liquidator's office, May 19, at 12 noon. Particulars of claims to the liquidator by June 23.

Bankruptcy Information.

CARTER, Thomas, 2, South Street, Dorchester, and at High Street, Swanage, Dorset, electrical engineer. Receiving order, May 11. Creditor's petition.

GIBBONS, Albert Ralph, 8, The Parade, New Eltham, Kent, electrical engineer. Receiving order, May 9. Creditor's petition. First meeting, May 22, 12 noon, 29, Russell-square, W.C.1. Public examination, June 20, 11 a.m., Court House, Greenwich.

HILL, George, NOBLE, George, and COWLEY, Edgar, in co-partnership as GEORGE HILL & COMPANY, 22, Chantry-lane, Great Grimsby, electrical engineers. Receiving order, May 6. Debtor's petition. First meeting, May 20, 11 a.m., Official Receiver's office, St. Mary's Chambers, Great Grimsby. Public examination, June 1, 11 a.m., Town Hall, Great Grimsby.

MAGSON, Reginald Silver, 10, Stoney Stanton Road, Coventry, as R. S. MAGSON & COMPANY, electrical engineer. Receiving order, May 11. Debtor's petition.

RIDGWAY, Fred, and TYNAN, Thomas, in co-partnership at 21, Bowling Old-lane, Bradford, under the style of RIDGWAY & TYNAN, electrical engineers. Receiving order, May 8. Debtor's petition. First meeting, May 19, 3.30 p.m., 12, Duke-street, Bradford. Public examination, May 24, 10 a.m., County Court, Manor-row, Bradford.

RIMMER, William Frederick, 21, Ellesmere-street, Patricroft, co. Lancaster, electrical engineer. First meeting, May 23, 2.30 p.m., Official Receiver's office, Byrom-street, Manchester. Public examination, June 15, 10.30 a.m., Court House, Encombe-place, Salford.

Application for Discharge.

HOPKINS, John Howard, formerly trading as THE ELECTRICAL MAINTENANCE COMPANY, 57, Castellaine Mansions, Maida Vale, lately at 140, Wardour Street, London. Hearing, June 16, 11 a.m., Bankruptcy Buildings, Carey Street, London, W.C.2.

Notices of Dividends.

DAVIS, William Aaron, late 3, Coronation-street, now 14, Basinghall-street, Leeds, electrical engineer. Amount per £, 2⅛d. First and final. Payable, May 25, 24, Bond-street, Leeds.

OWEN, Joseph (trading as J. OWEN & SONS), 186, Westcombe-hill, Greenwich, and 3, The Grove, Greenwich, electrical engineer. Amount per £, 2s. 3d. First. Payable, May 30, 29, Russell-square, W.C.1.

WOLLMAN, Harry Michael, late 9, Greasbro'-road, Parkgate, Rotherham, co. York, electrical factor. Amount per £, 4s. 4¼d., first and final. Payable, May 17, 14, Figtree-lane, Sheffield.

Order Made on Application to Approve Scheme.

ROTHWELL, Peter, 13, Hampden-street, Bolton, trading with P. A. Rothwell (a minor) as P. A. Rothwell & Company, 64, Higher Bridge-street, Bolton, electrical engineer. Order made, April 12. Composition of 7s. in the £ to all unsecured creditors. Receiving order discharged.

DUBLIN GAZETTE.

PORTARLINGTON ELECTRIC LIGHT AND POWER COMPANY, LTD. Particulars of claims by June 22, to Michael Crowley, 16, College-green, Dublin, the liquidator.

Catalogues, Price Lists, &c.

Details of the HILGER CHEMICAL SPECTROMETER are given in an illustrated leaflet just issued by the firm.

The advantages of intercommunication telephones are attractively set forth in a leaflet on the subject lately published by the RELIANCE TELEPHONE COMPANY.

A "HANDBOOK ON CONTROLLERS FOR ELECTRIC MOTORS" has lately been published by the Electric Power Club, St. Louis, U.S.A., and contains a simple description of controllers and definitions of the terms used in connection with them.

The Shurvent renewable fuse, recently developed by the WESTINGHOUSE ELECTRIC and Manufacturing Company, of East Pittsburgh, Pa., is described in detail in Folder 4 472, entitled "Shurvent Protection," which has just been published by the company.

The quarterly bulletin (No. 94) of A.C.E.C. (ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI) is to hand, and contains further particulars regarding the effects of the German occupation of the company's works. Interesting articles on electric winding engines, high lift centrifugal pumps and condensers for power factor improvement, etc., are also given.

An excellent photograph of the machine, fitting, and winding shop at the Albert Works of GREEN & SMITH, LTD., is shown on a leaflet just issued by the firm. The shop is fitted with a 3-ton travelling crane, modern machine tools and drying oven for stators, armatures, etc. Another leaflet shows, after repair, a 500 V d.c. coal cutter armature, which was sent to the firm with a broken shaft and loose core.

WATSON & SONS (ELECTRO-MEDICAL), LTD., are circulating several new publications. The "Sunic" ionostat, a new instrument for galvanization, ionization, electrolysis, illumination of surgical lamps, etc., is fully described in Bulletin 43 S., which also contains particulars of various instruments for electrolysis, etc. Bulletin 45 S. deals with the radiological i nometer and other instruments for measuring X-ray dosage; and in Bulletin 46 S. waterproof surface "Sunic" intensifying screens are described.

Arrangements for the Week.

FRIDAY, MAY 19th (to-day).

INSTITUTION OF ELECTRICAL ENGINEERS.
(LONDON STUDENTS' SECTION.)

7 *p.m.* At Savoy-place, London, W.C.2. "The Elimination of Atmospherics in Radio-Telegraphy," by Mr. A. H. Reeves.

SATURDAY, MAY 20th.

ROYAL INSTITUTION OF GREAT BRITAIN.

3 *p.m.* At Albemarle-street, Piccadilly, London, W.1. Lecture on "The Disappearing Gap between the X-ray and Ultra-Violet Spectra (II) Photo-Electric Methods," by Prof. O. W. Richardson, D.Sc., F.R.S.

WEDNESDAY, MAY 24th.

ROYAL SOCIETY OF ARTS.

8 *p.m.* At John-street, Adelphi, London. "The Natural Power Resources of Ireland (Coal, Peat, Water Power)," by Mr. George Fletcher.

THURSDAY, MAY 25th.

INSTITUTION OF ELECTRICAL ENGINEERS.

6 *p.m.* At Savoy-place, London, W.C.2. Annual General Meeting.

ILLUMINATING ENGINEERING SOCIETY.

8 *p.m.* At Royal Society of Arts, John-street, Adelphi, London. Annual Meeting. Presidential Address by Sir J. H. Parsons, C.B.E., F.R.S.

FRIDAY, MAY 26th.

PHYSICAL SOCIETY OF LONDON.

5 *p.m.* At the Imperial College of Science, South Kensington, London. Lecture on "Atomic Weights and Isotopes," by Dr. F. W. Aston, F.R.S.

JUNIOR INSTITUTION OF ENGINEERS.

8 *p.m.* At Caxton Hall, London, S.W. "Engineering Appointments and How to Get Them," by Mr. J. Cameron Rennie.

ROYAL INSTITUTION OF GREAT BRITAIN.

9 *p.m.* At 21, Albemarle-street, London, W.1. "The Internal Combustion Engine: Its Influence and its Problems," by Mr. W. E. Dalby, B.Sc., F.R.S.

Prices of Metals, Chemicals, etc.

TUESDAY, MAY 16.

		Price.	Inc.	Dec.
Copper—				
Best Selected ..	per ton	£63 10 0	—	5s.
Electro Wirebars ..	,,	£68 0 0	£1	—
H.C. Wire, basis ..	per lb.	os. $10\frac{1}{16}$d.	$\frac{1}{8}$d.	—
Sheet	,,	os. $9\frac{7}{16}$d.	—	—
Phosphor Bronze Wire (Telephone)—				
Phosphor Bronze Wire, basis ..	per lb.	1s. $2\frac{1}{16}$d.	$\frac{1}{8}$d.	—
Brass 60/40—				
Rod, basis ..	,,	7d.	—	—
Sheet, basis ..	,,	$8\frac{3}{4}$d.	—	—
Wire, basis ..	,,	$9\frac{3}{4}$d.	—	—
Pig Iron—				
Cleveland Warrants	per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 S.W.G.	,,	£18 0 0	—	—
Lead Pig—				
English	,,	£25 5 0	—	5s.
Foreign or Colonial	,,	£24 0 0	—	7s. 6d.
Tin—				
Ingot	,,	£149 10 0	—	—
Wire, basis ..	per lb.	2s. $0\frac{5}{8}$d.	—	$\frac{1}{8}$d.
Aluminium Ingots ..	per ton	£100 0 0	—	£20
Spelter	,,	£27 0 0	—	2s. 6d.
Mercury	per bottle	£11 0 0	—	—

Sulphur (Flowers)—Ton £10 15s. *Sodium Chlorate*—Per lb. $3\frac{1}{4}$d.
,, (Roll-Brimstone)—per ton £10 15s. *Sulphuric Acid* (Pyrites, 168°) per ton, £9.
Sodium Bichromate.—Per lb. $5\frac{1}{4}$d. *Copper Sulphate*.—Per ton £26 10s.
Boric Acid (Crystals). Per ton £60.
Rubber.—Para fine, $10\frac{1}{2}$d.; plantation 1st latex, $8\frac{1}{8}$d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Company.

The TELEPHONE SERVICE IN FRANCE appears to be so bad that many deputies are urging the Government to hand over the business to a private company for development. The inefficient service is said to be the cause of the limited use made of the telephone in France, where there is only one instrument for each 143 of the inhabitants, compared with 1 in 64 in England, 1 in 59 in Germany and 1 in 8 in the United States. The demand for an improvement of the service and an extension of telephone facilities is growing in volume and intensity, notwithstanding certain allocations for equipping new exchanges and for erecting additional trunk lines.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MEWBURN, ELLIS & CO., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

COMPLETE SPECIFICATIONS.

143 250 MAREK, A. Process and apparatus for coating articles by electro-plating and heat treatment. (10/10/17.)
171 423 SIEMENS BROS. & CO., LTD., PETITHORY, E. A., & COLLYER, J. E. Selecting devices for automatic telephone systems. (18/5/20.)
145 406 GOUSSET, G. B. Collectors for magnetos used with four-cylinder internal combustion engines. (20/6/19.)
171 430 GREENHALGH, E., & ELECTROMOTORS, LTD. Dynamo-electric machines. (5/7/20.)
146 492 ZÖLLER, A., & FISCHER, G. Electric lamps. (7/11/13).
147 441 GES. FUR DRAHTLOSE TELEGRAPHIE. Electronic tubes. (23/1/18.)
147 463 SCHRÖTER, F. Electric discharge tubes for coupling electric circuits. (9/2/15.)
147 466 SOC. FRANCAISE RADIO ELECTRIQUE. Electro-magnetic wave-receiving systems. (7/5/19.)
147 777 APPLE, V. G. Construction of armatures for dynamo-electric machines. (29/1/17.)
147 778 APPLE, V. G. Armature construction for dynamo-electric machines. (19/11/14.)
148 229 ADERT, L. (formerly ADAMCZAK, L.). Driving system for alternating current meters on the Ferraris principle. (14/1/19.)
148 368 KÖHLER CO. Electric generating systems. (20/3/19).
148 985 SIGNAL GES. Acoustical improvements in electro-magnetic sound producers and receivers. (20/1/19.) (Addition to 148 976.)
171 433 SIEMENS BROS. & CO., LTD., & CHRISTIAN, D. A. Automatic and semi-automatic telephone systems. (12/7/20.)
149 192 HUTH GES., DR. E. F., & HELLER, W. Method for generating and amplifying oscillations of any frequency, especially for wireless telegraphy. (17/7/18.)
149 194 HUTH GES., DR. E. F., & ROSENBAUM, B. Arrangement for wireless telegraphy from submarines. (8/12/16.)
149 272 FOREST, L. DE. Radio-signalling systems. (10/5/15).
154 914 LUFTFAHRZEUGBAU SCHUTTE-LANZ. Electro-magnet for locking devices. (9/12/16.)
151 245 ADERT, L. (formerly ADAMCZAK, A.). Driving system for alternating current meters on the Ferraris principle. (31/12/18.)
152 316 ALLGEMEINE ELEKTRICITATS-GES. Safety switch for installation systems and for windings of electrical machines and apparatus. (6/10/13.)
151 972 ALLGEMEINE ELEKTRICITATS-GES. Coin-freed meter for electric current, gas, water, or the like. (19/9/14.)
151 973 ALLGEMEINE ELEKTRICITATS-GES. Coin-freed meter for electric current, gas, water, or the like. (4/7/17).
171 441 DUCOUSSO, T. Driving electro mechanism for operating rail-track apparatus. (15/7/20.)
171 442 BRITISH THOMSON-HOUSTON CO., LTD. (GENERAL ELECTRIC CO.). Apparatus for electric arc welding. (16/7/20.)
171 451 CLARK, W., & CLARK'S NEO-ELECTRIC DEVICES, LTD. Electrical resistances. (9/8/20.)
171 453 TAGGART, J. SCOTT-, & RADIO COMMUNICATION CO., LTD. Modulation systems and the like in radio-communication and the like. (10/9/20.)
171 458 RAILING, A. H., & ANGOLD, A. E. Electric arc lamps. (11/8/20.)
171 463 SMITH, F. P., & WILSON, T. F. Safety-lock electric switches. (12/8/20)
171 470 WESTERN ELECTRIC CO., LTD. (WESTERN ELECTRIC CO., INC.). Method and means for determining the transmission equivalent of an electrical circuit. (13/8/20.)
171 481 SULLIVAN, H. W., & JOSEPH, J. Variable electrical condensers. (16/8/20.)
171 484 BRITISH THOMSON-HOUSTON CO., LTD. (GENERAL ELECTRIC CO.). Electric switches. (17/8/20.)
171 494 MAURI, D. Three-phase electric furnaces. (19/8/20).
171 497 MILLER, C. A., MILLER, F. J., & SANDERS, E. A. Switch and fuse-holder units for use in electric car-lighting systems. (21/8/20.)
171 498 AUTOMATIC TELEPHONE MANUFACTURING CO., LTD., & MERCER, R. Circuit arrangements for controlling automatic selector-switches. (21/8/20.)
171 502 SEWARD, G. O. Electrolytic apparatus. (23/8/20.)
171 517 LEPINEY, L. A. Incandescent electric lamps. (1/9/20.)
171 520 RADIO COMMUNICATION CO., LTD., & LEA, N. Production of and modulation of electrical oscillations by means of thermionic valves. (2/9/20.)
171 523 SIEMENS BROS. & CO., LTD., PETITHORY, E. A., & COLLYER, J. E. Number-dials for automatic and semi-automatic telephone systems. (3/9/20.)
171 544 HAMMONDS, A. C., & WAGG, M. J. Electric cooking appliances. (8/9/20.)
171 547 REMUS, S. Sparking-plugs for internal combustion engines. (9/9/20.)
171 553 RICHARDS, F. H. Electric ignition in internal combustion engines. (10/9/20.)
171 554 TAYLOR, A. M. Electric power transmission. (11/9/20.) (Patent of addition not granted.)
156 076 AUTOMATIC TELEPHONE MANUFACTURING CO., LTD. Electro-magnetic relays. (31/12/19).
171 578 WATKINSON, J. Electric switches. (5/10/20.)
171 579 CRABTREE, J. A. Electric switches. (6/10/20.) (Addition to 140 180.)
171 581 PAINTER, F., & IDGE, G. H. Electric switches. (7/10/20).
154 931 HOFFMAN, O. Electric pocket lamps. (4/11/19.)
160 456 LATOUR, M. Thermionic valves. (18/3/20.)
170 893 REES, H. P. Tuning instruments for use in wireless telegraphy and telephony. (20/1/21.)
170 901 MARSOLLIER, C. J. Electrical connecting devices and lamp-holders. (29/6/20.) (Addition to 145 587.)
170 902 SMITH, E. A. LAYTON-. Magnetos for ignition purposes. (30/6/20.)
170 915 RAILING, A. H., GARRARD, C. C., & WILSON, W. Balanced electrical relays. (27/7/20.)
170 941 ROUND, H. J. Reception of wireless signals. (30/7/20.)
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11 466 Western Electric Co. Selecting systems.
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11 487 R. Barwinkel. Supplying low voltage current from high voltage supply.
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11 601 Western Electric Co. Means for reducing distortion in repeating systems.
11 606 D. C. A. Hulström. Receiving, reproducing or reinforcing sound waves.
11 611 J. Collie (Nikolsky). Electric indicating and recording mechanism for weighing apparatus.
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11 617 V. Paivelecki. Electric safety lamps for mines, &c.
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11 945 E. Barber. Electric burglar alarm contact.
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11 965 A. Reuther. Electric alarm clocks.
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11 976 Automatic Telephone Manufacturing Co. Telephone systems. (28/4/21, U.S.)
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12 088 Western Electric Co. Selecting Switches.

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12 145 W. B. Shaw. Jointing glass covers of electric lamps to fittings or casings.
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12 174 H. Krebs & E. Wolff. Multipolar magneto.
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12 229 Metropolitan-Vickers Electrical Co. & F. B. Holt. Transmission systems for electric drives.
12 236 J. D. K. Restler. Means for preventing use of telephones without pre-payment.

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12 363 B. T.-H. Co. (G. E. Co.). Incandescent lamps.
12 364 B. T.-H. Co. Electron discharge devices. (24/5/21 U.S.)
12 369 Western Electric Co. Driving mechanisms.
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12 383 Soc. des Etablissements Gaumont. Electro-mechanical control systems.
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12 404 A. W. Knight. Inductance coil holders for wireless telegraphy, &c.
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12 503 B. T.-H. Co. (G. E. Co.). Measuring instruments.
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12 508 Industrial Appliances, Ltd., & J. E. Hamilton. Electrically propelled vehicles.
12 538 Ever-Ready Co. (Great Britain) & F. S. Johnson. Electric torches.

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12 562 A. Wheatcroft. Operating and releasing brakes on tramcars, &c.
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12 763 C. E Brown & F. W. Cox. Telephone mouthpiece.
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12 775 S. Jonas. Means for supporting incandescent lamps.

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12 793 J. W. Cox. Electric supply systems.
12 795 L. Newsome. Electric lighting of motor vehicles.
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12 862 Akt. Ges. Brown, Boveri et Cie. Multiple control apparatus for electric railways. (20/12/21 Switzerland.)
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CONTENTS.

Notes of the Week.

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The Faraday Medal.

The illness of the President during the Commemoration meetings of the Institution of Electrical Engineers in February robbed the function of a good deal of its glamour and success in the mind of the ordinary member. But those who were behind the scenes knew that in another respect things had not quite gone according to plan. For it had been decided, as Mr. Highfield disclosed at last week's meeting, tangibly to celebrate the Jubilee of the Institution by striking a "Faraday Medal" for periodical award to those whom electrical engineers may delight to honour. Now that the preliminary obstacles have been overcome we learn with no surprise that the first award of this medal is to be made to Mr. Oliver Heaviside. Mr. Heaviside's qualifications for this honour are too well known to require expatiation here. The aptest thing we can do, therefore, is to follow the example of a recent honours list in which the name of a very well-known gentleman was published with no explanation as to why he had received the distinction. For it was felt that his reputation was so world-wide that the reason for the honour was patent. It is the same with Heaviside and the Faraday medal.

The New Council.

At last week's meeting of the Institution of Electrical Engineers Mr. Highfield announced the result of the ballot for the election of officers and new members of the Council for the session 1922-23. Mr. F. Gill, Dr. W. H. Eccles, Mr. A. A. Campbell Swinton, and Sir James Devonshire will be the president, vice-presidents and honorary treasurer respectively, while the discrimination of the election among an embarrassment of choice has resulted in the lot falling on Messrs. J. W. Beauchamp, R. A. Chattock, F. W. Crawter, D. N. Dunlop, K. Edgcumbe, A. F. Harmer, and W. R. Rawlings. The unsuccessful candidates are therefore Mr. A. C. Cramb, Dr. C. C. Garrard, Mr. W. M. Selvey, and Mr. A. B. Hart in the official nominees list, and Mr. R. H. Fletcher and Mr. A. M. Sillar among those who were nominated from outside the Council. This result rather goes to support the view that the Council are better able to choose candidates who will receive general acceptance than are unofficial groups of members, however influential and enterprising. The strength of this argument is not lessened by the election of Mr. R. A. Chattock, who is too well known in the electrical industry to run the risk of being classed as a provincial. Nevertheless we hope that unofficial nominations will continue to be made, especially under the new bye-laws. To make these nominations is not only the members' right but their duty, in order that the Council may be as representative as possible.

Broadcasting Delays.

Electrical firms concerned may be trusted to meet the demands of the enthusiastic wireless amateur, actual and prospective, for all the equipment he requires. Indeed, there is already a good deal of activity towards this end. But it is not so certain that the "broadcasting" which will make the employment of this apparatus a useful and profitable hobby will be established quite so quickly as once seemed probable. A conference of the firms who were likely to be interested in this matter was called by the Postmaster-General on Thursday last, and a further conference of the firms themselves without the official element was held on Tuesday. From both these meetings the Press were excluded, which is rather a curious preliminary to a development which, whatever else its result, will mean the wider dissemination of news. Nevertheless

it is evident that matters are not going too smoothly, and that there is some difference of opinion, to put it mildly, on more than one point.

The Points at Issue.

THE principal point at issue at both these conferences has been not, of course, a technical, but a commercial, one. That element can unfortunately be kept out of few wireless discussions. The difficulty is to decide whether all the broadcasting stations should be placed in the hands of one firm, subject to safeguards of some description or other, or whether the stations should be formed into groups operated by different interests, so as to allow of competition. If the latter plan is adopted the patent bogey then takes the stage. Broadcasting by wireless telephony is impossible, we understand, without infringing the patents of a certain company, though that is disputed in other quarters. In any event licence to use these patents would be given, again under certain safeguards. A third point is whether small wireless manufacturing firms who do not contribute to the cost of broadcasting should be allowed to sell receiving sets. Here, then, are three controversial and important points which, if past history is anything to go by, will not be settled without a good deal of discussion. And as the POSTMASTER-GENERAL cannot start broadcasting without the assistance of the wireless manufacturers, even the most optimistic will agree that there must be some delay.

Technical Difficulties.

DELAY will also arise from the fact that no definite conclusions were, we understand, reached on the technical points raised at the conference. Unanimity was, in fact, only achieved on the proposed prohibition of both advertisements and news from the operation of the broadcasting stations. We consider ourselves that advertisements should be rigidly excluded (for one reason because their propagation would mean the crowding out of more interesting information), but that news, though not comment on it, should be allowed. The newspapers would lose very little by this, and would stand to gain by the interest that had been aroused. For the accounts given by wireless could be neither so detailed nor so circumstantial as those published in the morning or evening journals; and in any event the newspaper habit has become too ingrained to be eradicated so easily.

A Change and An Opportunity.

IF the present enthusiasm to possess a wireless telephone has no other result it will, we hope, give the amateur a tighter grasp on electrical knowledge and a better appreciation of scientific method. The wireless amateur is at present, we are glad to see, desirous of obtaining the fullest information about the apparatus which he will use, and this has been reflected by the issue by enterprising contemporaries of more than one text book designed to satisfy this craving. Reviews of already published wireless books, both for the expert and the amateur, are appearing in the columns of the daily papers, an event that is nearly, if not quite, unique, while now that wireless is the fashion it will doubtless be adequately boomed in all the accepted ways, with the exception that, as far as we have been able to ascertain, the information which is given is accurate, if a little dull, and not of the kind which we have so often had to criticise when commenting on other attempts to make an interesting story out of scientific or technical matter. This is a great change and a great opportunity for the electrical industry. And now that a start has been made we hope progress will continue along the same lines.

Some Manufacturing Companies' Results.

THE reports of five distinct manufacturing companies which have recently been published supply a further illustration of the comparatively prosperous condition of the industry notwithstanding the industrial situation and the stagnation in many other trades. For instance, the net profit of Callender's Cable and Construction Co. in 1921 was over £173 000, compared with £139 000 in the previous year, and after making the usual provision for depreciation and reserve and paying the preference dividend, the ordinary shareholders have been given 15 per cent., as in 1920, with a carry forward of over £150 000, as against £108 000. Another cable manufacturing company, Siemens Brothers and Co., announce a final dividend of 5 per cent. making 10 per cent. (tax free) for the past year. Though this is the same rate as in 1920, it must be recollected that the amount of ordinary shares is nearly £500 000 more, and there are also £300 000 of 10 per cent. new preference shares to be provided for, so that there must have been a substantial increase in the profits. Both companies are well organised, soundly financed undertakings whose business greatly expanded during the war and since the Armistice, and the reorganisation of the supply industry, apart from Colonial and foreign demands, should mean even increased prosperity in future.

The English Electric Co.'s Progress.

THE third company to which we may refer is the English Electric Co., whose profit amounted to £317 423, compared with £266 936 in the previous year. After meeting debenture and other interest, paying the preference dividend of 6 per cent., and placing £60 000 to reserve, an ordinary dividend of 5 per cent. has been declared, against 8 per cent. in 1920 and 1919. It will be noticed that the company, which, as our readers know, is an amalgamation of five engineering concerns, made £50 000 more profit than in the previous year, but the interest on the £1 250 000 of 8 per cent. notes absorbed over £15 000 more, the reserves are credited with £35 000 more and the amount carried is £9 363 higher than in 1920. In view of the present situation in the engineering industry this is no doubt a prudent course to adopt. The company's organisation has been steadily developed during the year; the various factories are specialising in certain classes of work; and the selling arrangements have been strengthened both at home and abroad. The result has been, as might be anticipated, increased efficiency and economy. Important contracts for generating plant, and for railway electrification in New Zealand, Spain and Japan have been secured, and there is no doubt that the company will secure its share of the important orders for British railway electrification, which will soon be placed. In addition, arrangements have been made, through the recently-formed Power and Traction Finance Co., to obtain a share of big foreign engineering contracts. Notwithstanding the present disastrous engineering dispute the outlook for the company seems to be promising and it should do at least as well in the present year as in 1920.

A B.T.H. Year.

Another company which has done very well, notwithstanding the unpropitious business conditions, is the British Thomson-Houston Co., which made a gross profit of £509 259, compared with £470 470 in 1920 and £412 399 in 1919. After allocating £160 000 for depreciation and reserves, paying interest on debentures and loans and the 7 per cent. preference dividend, the directors have decided to declare a dividend of 6 per cent. (tax free) on the ordinary shares, leaving £230 704 to be carried forward, or £5 000 more than the amount brought in. The company's report is a good record of expansion and development at Rugby, Birmingham and elsewhere, and new glass works is being erected at Chesterfield.

B. & W. Progress.

Babcock & Wilcox are also able to point to a larger gross profit (£807 500) than in any previous year, but owing to taxation and other liabilities the net profit is less by £7 300 than in 1920. The ordinary dividend is, however, maintained at 16 per cent., the usual provision has been made for depreciation and reserve, and the value of stocks in hand have been written. The expenditure on orders not invoiced is higher than in the previous year, so that the outlook in spite of the industrial dispute, seems to be healthy. On the other hand, Johnson & Phillips have had a disappointing year, the net profit being only £42,737, compared with £98,406. The stock in trade and work in hand have had to be written down drastically, and the coal strike and the engineering dispute must have increased the company's difficulties. However, the firm is an old-established one, with a good connection and electrical reputation, and we confidently hope that it will be able to resume the payment of an ordinary dividend again next year.

Accurate Metering.

A reference in the Bulletin of the National Electric Light Association to some courses of lectures for electric meter men at the Yale and Florida Universities, is a reminder of the very important part which meters play in electricity supply undertakings. At the present time, when the price per unit is high, the question of correct metering becomes correspondingly important. But it is just where correct metering becomes quite crucial, namely in small undertakings, that the provision for accuracy is usually most lax. This is a matter of serious concern, since faulty registration in meters is normally against the undertaking—that is, a meter in use tends to under-register. In addition, of course, there are the faults such as failure to start when one or two lamps are switched on, which also means a loss to the undertaking. It can be easily seen, therefore, that inaccuracy or faultiness of meters may affect revenue to a most serious degree. But this seriousness seems to be by no means as widely appreciated as it should be. Extraordinary "economies" are often practiced, such as leaving meters out on duty for an unconscionably long time, neglecting to have them regularly inspected and tested for starting, and so on. Further, the duty of superintending meters and inspecting them on circuit is too often left as an odd job to a man who is very far from a specialist. And this is in face of the incontestable fact that a skilled man to look after the meters would be a most profitable investment, while a more frequent change of meters would repay the extra capital outlay. There seems always to have been in the industry an unfortunate tendency to under-estimate the importance of a proper meter department, although it is a matter which might most beneficially receive careful consideration, as it evidently is doing in America, to judge from the Bulletin we have mentioned.

Private Generating Stations.

By Sec. 11 of the Electricity (Supply) Act no electricity authority can establish a new, or extend an existing generating station or main transmission line without the consent of the Electricity Commissioners. This restriction does not, however, apply to a private generating station, except that the Commissioners may make regulations as to the type of current frequency and pressure which shall be used, provided that they are so framed as not to interfere with the economical and efficient working of the business for which the supply is generated. The Commissioners have now decided not to make regulations as to type of current, frequency and pressure of private generating stations having an installed capacity not exceeding 50 kW., and no notification need, therefore, be made to the Commissioners regarding the establishment of such stations. It is obvious that private plants of the size indicated cannot play an important part in the economy of a national system of electricity supply and no useful service would therefore be gained by attempting to control them so that the Commissioners have relieved themselves of a duty which might have been arduous without being useful.

Limited Liability Companies' Contracts.

Wiring contractors would do well to read and carefully note the judgment in the case of Pittman *v.* May. It shows, among other things, the necessity of having a definite contract before work is undertaken and the desirability of knowing whether the financial position of a newly formed limited liability company is such as to justify credit being given. Unfortunately, contractors are too often content with verbal instructions, and then when they have finished a job they find they cannot obtain payment. In the present case an electrical engineer was instructed to wire a dancing hall owned by a limited liability company which went into liquidation before the whole of the work had been paid for. In the circumstances the contractor sued the person who originally instructed him, together with another, who were alleged to be in partnership for running the hall. Unfortunately for him, it was proved that he had received three cheques from the company in part payment for the work, and the judge reluctantly held that only the company was liable. The contractor could have refused to accept the cheques and he could have insisted upon payment by the person from whom he received the instructions, but as he did not he lost £200, the balance owing for the work. We sympathise with him in his misfortune, but we hope that he and other contractors in a similar position will be wiser in future; that they will see that contracts are clear and unambiguous in their terms, and that they will take care credit is only given where it is justified.

The "Central" Appointment.

A little while ago an important railway company took the retrograde step of placing its electrical engineering department under the chief mechanical engineer. But it has been left for the delegacy of the City and Guilds (Engineering) Institute to appoint a physicist to the chair of electrical engineering at the Central Technical College. For Prof. C. L. Fortescue (our criticism is quite impersonal),

who is to succeed Prof. MATHER, now holds the chair of physics at the Royal Naval College, Greenwich, and his sole connection with electrical engineering is through wireless science. This appointment is therefore a great and unnecessary mistake, for which the delegacy is alone to blame. We are second to none in our recognition of the need for maintaining progress in wireless work, but at the present time the heavy engineering branch is more important both because of its greater technical scope and of its greater commercial possibilities. Embryo electrical engineers require above all a thorough grounding in the fundamentals of engineering practice and to be taught how to consider problems from the engineering view point. It is difficult to see how Prof. FORTESCUE, with the best will in the world, can achieve these aims.

It is difficult also to see what can be done. The appointment can hardly be cancelled, and the best that can be expected is that it will do a minimum of harm. That result will depend on Prof. FORTESCUE. He should realise his limitations, and do his best to carry on the high tradition of his new position which it is vital should be upheld by every means in his power.

Indian Electricity Supply.

THOUGH there are a number of electricity supply and tramway undertakings in India, mainly owned or controlled by British companies, there is, strange to say, no organisation to protect their common rights, no association to enable the engineers and officers to come together and discuss problems and difficulties which must have an equal interest for them all. The immense distances between the various towns and industrial centres, and the expense and difficulty of travelling are mainly responsible for this splendid isolation, but we are glad to see that steps are now being taken to remedy what is an unfortunate state of affairs. From the purely electrical point of view, the Empire of India is one of great promise. Though some progress has been made, there are clear indications that much more will be made in future. There is an increasing demand for power and lighting, and this will have to be satisfied. There are vast sources of water power available, and if means of development were provided there would be ample supplies of electricity for industrial power, for the electrification of the railways, for irrigation and other purposes. In a country so undeveloped cheap power is no less essential than in an overpopulated land like ours, and electricity supply is given a chance of developing under the most modern conditions, a chance which we hope will be seized with both hands.

Useful Survey Work.

MUCH useful survey work has already been carried out under the direction of Mr. J. W. MEARES, the Government electrical adviser; and the chief obstacle to progress seems to be the lack of suitable legislation. We hope, therefore that the British Indian Electric Committee, which is representative of the Supply Companies, when they have their new organisation, will take up this important matter, and we should also like other British engineering associations to study the situation and make suitable representations to the Government of India upon it. Until reasonably fair and attractive concessions for the development of water power are available engineers and financiers will not be induced to risk their skill and capital in the country. In America, a highly-industrialised country, concessions are granted for 50 years, but for India a longer term is necessary; and in addition good facilities should be given for the purchase of land, for the erection of works, for the acquisition of way leaves for transmission lines, etc.

Trade Outlook Better.

THERE is evidence that the wave of trade depression which has affected the country for some time is passing, and that the political agitation, which has, no doubt, been aggravated by bad trade, is dying down. Consequently the outlook is distinctly better, and the future of industry, particularly of the electrical industry, is promising and should provide a good investment for capital. Apart from any new hydro-electric projects or electric railway schemes, most of the existing undertakings are making rapid progress, and extensions of plant and mains have had to be undertaken. For instance, the Calcutta Electric Supply Corporation reports that it is swamped with applications for new connections; its output for 1921 was over four million units more than in the previous year, and its ordinary dividend and bonus are maintained at 11 per cent. In Bombay, where a similar situation prevails, there is a large demand for electric power for the cotton mills and factories. Other supply companies are also able to point to increased connections and to a sustained demand for both light and power.

Co-operation by Conference.

IT is, therefore, satisfactory to learn that in future there is to be greater co-operation between the various undertakings in India. It is hoped to inaugurate an annual conference of the chief engineers and officials similar to the annual gatherings of the I.M.E.A. and the Municipal Tramways Association. Of course, the circumstances in India are widely different from those which prevail in this country, but nevertheless there should be plenty of useful work for such a conference to do. There are many engineering problems, administration questions and other matters which could be discussed. In addition, the legislation affecting electricity supply, import duties, industrial relations and many other things can be dealt with much better by co-operation than by individual action. Therefore, we welcome the new organisation, and we hope it will be as successful as the British associations upon whose constitution it is, we believe, to be modelled.

The casting vote it will be seen, remains with the politicians. In this country they have done the electrical industry no good. We hope that in India, where the political situation is so difficult, a means will at least be found of encouraging, not discouraging, a most important development.

Industrial Essentials.

THE only commentary on life which could do justice to the present position of the engineering industry is one of Æsop's fables. We have not a copy of that leader writer's *vade mecum* at hand, but we feel sure that among its ancient wisdom is to be found some succinct and enlightening description of a state of affairs where all parties are working to their own hindrance. But it is a state of affairs where, if the parties would only recognise the community of interest that exists between them and the excellent results which would follow from honest common effort, they could really obtain for themselves the prosperity which they are attempting to achieve by means which are as little likely to lead to success in actuality as they are suited to the politics of

some utopian kingdom. There is, we recollect, something about grasping the shadow and losing the substance in the authority we have just quoted. That is what the engineering industry appears to be doing now. It would be as well that all concerned should look facts in the face and learn the lesson that they teach before it is too late. At present cynical laughter is the only fit comment on both their practice and performance.

Theories as a Diet.

During the past few years it may be said with some truth that we have been feeding on theories, basing our actions on suppositions and trying to build up a fabric of a better and more efficient industry upon a foundation which time has speedily shown to be quicksand. That is no cause for blame; it is a natural reaction from war-time conditions. Still less is it a cause for blame, or even regret, that much of that fabric is good and well designed, and that, given sounder foundations, it can still take its place in the building which we must still continue to strive to erect. The Whitley Council movement, the realisation of the need of research, the ethical and physical value of welfare work, the introduction of labour-saving and labour-aiding devices so as to make the worker less of a machine and more of a human being are all stones in the temple of the new industry which will be as useful in the future as they are at present. But these parts of sound construction must not be allowed to conceal the fact that we have not yet found the way to build an industry that shall be well established throughout, or rather that we have not yet cleared away the numerous obstacles which are preventing that construction. The design itself is well conceived. It is its realisation that is difficult.

The Difficulties that Exist.

To consider the difficulties that stand in the way of regaining industrial prosperity may make a solution of the problems that have to be faced easier. It is obvious that manufacturing conditions are undergoing a profound change. Selling the product when it is made is perhaps the most difficult of all the difficulties. This is indicated, perhaps not so clearly in engineering as in other branches of industry, by the feverish activities which are made to obtain the smallest order, in the cajolery of, in the prayers to and almost in the intimidation of the buyer, and generally in the amount of energy which is being expended, if not wasted, to secure what can only be in the nature of things a very small return. The right sort of propaganda should receive every encouragement from the modern manufacturer, but to expend time, money and energy in employing the wrong kind is useless.

A Significant Change.

But more significant, because less directly connected with selling, which after all is naturally a conflict of psychological opposites, is the change which has come over the production side of the factory. The time has gone by when the manufacturer bought at the lowest and sold at the highest price he could without any clear idea of what the connection was between the two sets of figures or whether it was possible to improve the efficiency of his factory (in the mechanical sense) by reducing the margin between them. And providing Mr. MICAWBER'S idea of happiness was realised in his balance sheet he did not much care.

Counting the Cost.

Now the cost, and every factor which has an influence on the cost, of every article and part made in the factory is known, and its progress through the shops is watched and controlled so that the cost is kept at its minimum, and so that its effect on other parts which are passing through the shops is such that their cost is also kept at a minimum. Though it may be argued with truth that the multiplication and complication of some costing systems are more apparent than their utility, it is axiomatic that to know the cost of any particular product, however small, of the factory and to be able to check any waste that occurs in its production are results that are well worth striving for and are an advance towards that real simplicity which it is worth while some effort to make.

To know of what every part of the organisation is capable must, therefore, be the aim of the manufacturer of to-day. For only with that knowledge can he be assured of a return for his capital and labour, with a steady upward movement towards that prosperity which shall allow further expansion and a greater scope for his efforts.

The Most Difficult Question.

It is the intention in the special Manufacturers' Issues of THE ELECTRICIAN, the third of which we publish to-day, to deal with those questions of interest to the industry which can be properly said to lie within the four walls of the factory. And of these, especially at the present time, the most important and the most difficult to solve is that of Labour. The manufacturer has had a good deal of success in dealing with the organisation of his shops, in preparing costing systems and in instituting research, but his success in dealing with the human element as represented by his operatives has not been so patent, and, if we are to judge by present circumstances, might be more aptly described as failure.

A Psychological Problem.

This is to a large extent due to the worker himself, who may be labelled as a mass-individual. In other words the worker is employing organisations which have been laboriously built up for other purposes to further the interests of his own class at the expense of all the others. That way madness lies. The Socialist is at bottom the most individual of men, and equally the Trade Union is the most individualistic of societies. It is this narrowness of outlook which is at the bottom of all Labour difficulties, and bids fair, if recent defeats are any guide, to lead to the immolation of the Trade Union movement. This immolation would be disastrous, but if reluctance to take lower basic wages is combined with a refusal to do more work, no other result can follow. And when to this is added a disinclination to submit to the slightest discipline, things look very black indeed—and blackest of all for the Trade Unions. On the employers' side matters are not what they should be. There is a rigidity and conservatism which can only lead, as they have done, to violent clashing. The alternative must lie in a determination to widen the outlook by seeing the other side's point of view and by a real working together on the lines which the Whitley Council movement has shown leads to a considerable share of success.

It is because the organisation of the engineering industry, except in the comparatively small things, is so confused, and because those most concerned in it seem blind to the confusion, that we have labelled it as we have done in our opening paragraph. It is difficult to see how the present conditions can be changed without a return to something like individualism, and certainly without a return to something like discipline among all parties.

Some Problems of Modern Manufacturing.

By P. J. PYBUS, C.B.E., Managing Director English Electric Co.

However much the pendulum has swung over from the optimism which followed the Armistice to a depression which is equally unjustified, there is no doubt whatever that lately the engineering works of Great Britain have had opportunities for gaining experience in the real science of production such as may never recur. Everyone was a superman in those days, and the process of recovering a slight sense of proportion has been in some cases a fatal operation and in every case somewhat painful. In my opinion the prime mistake did not lie with the works manager or those responsible for production at all. Industrialists are not the only ones who can be wise after the event, and it is regrettable that the economists who now fill our papers with statements that the slump which has hung over industry for the last year was a natural result of all wars did not secure the same publicity for this prediction immediately after the Armistice as they now give to their views when the depression is plain to everyone. Industry made the mistake of allowing "the tail to wag the dog" when they were deciding on their post-war programmes. Having got a plant in many cases financed by Government funds, and of a highly repetitive character, they immediately looked round for something to produce on it, with the result that the market is flooded with stocks of articles resembling war products in shape and dimensions for which there never has been nor ever will be a sufficient market. There is a plague of articles which are short in length, round in shape and which can be handled without a crane, and the wise ones turned down every proposition which came into this category as one in which over-production was certain. The happy undertaking to-day is that which has had the courage to close down its war extensions, to readjust its ideas as to possible turnover and to see to it that the foolishness of the Armistice year is forgotten and that every scrap of the knowledge and experience of production which was gained during the war is made use of wisely and in a moderate way.

Some Useful Wartime Lessons.

The knowledge gained during the war must not be lost in a revulsion from the extravagances of the war period. In nearly every modern works machine tools which before the war were unknown to the executive have come to help costs. Grinding and hardening have become, for those who were amateurish before the war, exact sciences. The extended use of gauges, manufacture to perfectly definite limits and the resultant elimination of shoddy operations for making one part fit another have promoted many of our post-war products into a class which cannot be equalled anywhere in the world. The whole of the internal organisation of factories has been revised. Elimination of guess work has not only come about by the use of limit gauges and more accurate methods, but there are few works to-day which have not entirely revised the basis upon which piece-work prices are calculated. The old system of barter, with all its inaccuracies and irritation as between master and man, has been replaced by something more accurate and scientific.

The Importance of Costing Methods.

I think it will be agreed that the post-war system of estimating works costs is an improvment, with the result that many contracts have been secured against world competition which before the war would have been lost. The importance for British industry of a proper system of costing for estimation purposes cannot be exaggerated, and, much as most of us abhorred the activities of the costing departments of the Ministry of Munitions, there are few who did not gain something by demands for actual costing as against mere "rule of thumb" methods. The real menace to the prosperity of an industry is the concern which does not know its true costs and which quotes accordingly. It is often necessary in bad times to quote prices below cost, but there must be a price at which it pays better to leave work than take it, and the man without the accurate costing system does not know what this limit really is. A practice which ruled in few factories before the war was a definite reconciliation of the costs which were used for estimating purposes with the books of the company. Often the results shown by the works accountant were irreconcilable with the distribution of labour and charges which formed the basis for the original quotation. In this direction I think there was a great gain during the war.

The tendency with regard to piece-work prices which had been developed in a few factories before the war, and which made it possible to show to labour a detailed calculation as to feeds and speeds, grew very much from 1914 onwards. It was the vast numbers of the same product which brought home both to the employer and the workman the necessity for scheming in detail the exact method by which a piece of work could best be carried out, and the five years' war experience of repetition on a vast scale brought home to everyone the impossibility of securing real efficiency unless a good deal of thinking as to method was done before work actually started.

Unscientific Price Fixing.

I believe that, suicidal as has been the attitude of certain sections of labour regarding piece-work, unscientific methods of fixing prices contributed largely to the support which the organised objection to payment by results received after the war. In many shops before the war new prices were fixed during the boom with far too large a time allowance; then, when competition became greater, the employer had either openly to reduce his piece-work price, or alter the method by which the job was done in order to get out of an established piece-work price the maintenance of which meant that his products were unsaleable on account of their high cost. The more scientific practice of fixing piece-work times, with the evidence clearly before employer and workman, has the effect of removing once and for all any question of an enormous gamble for either party.

Rate-fixing à la Mode.

Rate-fixing as it is commonly understood has in practice often meant simply this, that the employer or his representative fixed rates, scientifically or unscientifically, but in secret, wrote them down on a card and gave them to the workman "to take it or to leave it." There was no pretence of making the operation a bargain between the parties, no opportunity for either party in any open and straightforward manner to have rates reviewed when once fixed. This system is fair neither to the employer nor to the workman. The old notion that any foreman or his clerk was good enough to fix rates is exploded. The job calls for complete familiarity with the work done in the shop and the machines employed; for special training; and, what is even more important, for a human manner. There are other walks in life than the diplomatic service for which a rough tongue is not a recommendation, and rate-fixing is one of them.

The Whitley Movement.

But not even the most efficient and the most tactful of rate-fixers can avoid making mistakes on occasion or always succeed in convincing the workman that he is being given a square deal. His work must be supplemented by proper machinery for appeal, which is quick in action and not cumbersome in operation, for the rectification both of a price which is too low and of a price which is too high. It is in this direction that most progress has been made, and it is a matter of the very gravest anxiety to the industry as a whole that any feelings caused by the lock-out shall not interfere with the co-operation which has grown up so

splendidly since the Armistice. The movement originated by Mr. Whitley, together with the establishment of Works Committees in many factories which had no consultative body at all before the war has, in the main, been successful. The Works Committee to-day differs in most factories very materially in scope and power from those created immediately after the war. But there are few factories on which this movement, idealistic though it may have appeared at the beginning, has not left a permanent impression. While many of the original functions of the Works Committee had to be omitted from their constitution owing to the fact that they did not give the proper representation to the organisation of the great craft unions, the movement has come to stay.

Improvement in Working Conditions.

In what was known by the general and quite unsuitable expression, "welfare work," the activities of the war have produced a definite change in the factories and workshops. You have only to walk round the average engineering works to see on all sides improvements in hygienic and sanitary conditions of the shops. Most of the larger works have appointed, and still retain, even in these bad times, their male and female supervisors. The work among girls was easier to initiate than that amongst boys, but it is remarkable that in many of the shops the welfare activities amongst the lads have produced more permanent results than any other form of welfare work. In many works large areas of recreation grounds, containing club houses and in some cases halls in which dancing and concerts take place every week, have rendered the works a definite social centre. Some of the more ambitious schemes will possibly fail to continue on their present scale, but those in which the management is vested in the workpeople themselves will undoubtedly continue to flourish. I do not think that there is any room for a large social organisation connected with a factory situated in a large town where the workers live a considerable distance from their work and where recreation is easily obtained near their homes, but in more isolated works the factory has, since the war, become more than a mere workshop—it is a centre of many activities ordinarily outside the scope of an engineering company.

A Real Advance.

We have, in the last few years, grown so accustomed to lighter and better workshops, proper medical and hygienic appliances and all that these improved facilities make possible, that we are apt to overlook the real achievement which has been effected. If we think back to the time of our own apprenticeship the change is almost unbelievable. The workman hurrying along with his tea-can in one hand and a tin box containing food in the other is now seldom to be seen. The modern canteen, generally spotlessly clean and equipped like a modern restaurant, has changed all that. The ambulance room, with the trained nurse in charge, has replaced the "belt-mender" with his sticking plaster and friar's balsam as a remedy for all wounds. Proper changing rooms, with adequate washing accommodation and a host of other amenities, have changed the whole appearance of the workshop of to-day, and while before the war there were many modern and advanced establishments, it is not too much to say that the more general adoption of such improvements is a direct outcome of the war and a step which was too long delayed both in the interests of the workman and his employer. Let no one imagine that these changes, however far they are pursued, can solve the problem of workshop management. It is easier to design an automatic machine than an automatic man. The disciples of Mr. Taylor will continue to fail if they do not appreciate how complex is the combination of the man and the machine, and how impossible a task it is to analyse the human mind into simple terms. Education and social progress have been applied for generations to the deliberate enlargement of the human aspirations of the workers, and to think to-day that men can be controlled like a machine by the setting of cams is to believe that it is possible to unscramble an egg.

Reviews.

Hydro-Electric Engineering. Vol. I. Civil and Mechanical. By Prof. A. H. Gibson, D.Sc., and H. D. Cook, M.Sc. (London: Blackie & Son, Ltd.) Pp. xx. + 232. 25s. net.

Prof. Gibson is editing two volumes on hydro-electric engineering—the present one deals with the civil and mechanical side; the second volume will deal with the electrical equipment and lay-out, the economic side of the question, and with the possibilities of tidal power. Of the volume under notice, Dr. Gibson is responsible for the sections on: Rainfall and run-off; the flow of water and its measurement; the available power, storage, &c.; hydraulics; the development of water-power schemes; turbines; speed regulation; and water-power reports. Mr. H. D. Cook contributes the sections on civil and mechanical engineering works, and on general arrangement of stations.

Reading this book has been a very refreshing task. The Editor has chosen his matter carefully, and by refraining from an extensive use of purely descriptive matter, has retained ample space for the "real stuff" in the form of calculations in hydraulics, turbines and speed regulation. Thus the work is essentially technical in character, and will serve as an admirable text book. It is doubtful if there are many subjects of more immediate interest to civil, mechanical, and electrical engineers than the utilisation of water-power for the generation of electrical energy, and the Editor might have written at even greater length on certain aspects, such as the linking up of stations. The various means that have been adopted of late years for obtaining a continuous supply of energy from water-power form a very instructive study, and might well provide a section in a book like the present. The electrical designer will not find much comfort in the fact that the runaway speed may equal three times the normal speed. On this point at least the electrical engineer can deny responsibility, unless perhaps it is his duty to find the means of preventing this danger!

It is an authoritative book, which can be thoroughly recommended to engineers. Both printing and illustrations are good, though we should like to see "0" placed before the decimal point—0·4 is much better than ·4 in every way.

S. Parker Smith.

Boiler Inspection and Maintenance. By R. Clayton. (London: Sir Isaac Pitman & Sons, Ltd.) Pp. 118. 2s. 6d. net.

This little book is a useful guide for boiler inspectors and others interested in the close examination of steam boilers.

As a practical and experienced boiler surveyor, Mr. Clayton knows exactly "what to look for" when a boiler is down for inspection and overhaul, and gives the result of this experience in a concise and readable form.

In the initial chapters he deals with the principal types of boilers, including Lancashire, water-tube, vertical, loco., and others, analysing their salient features, and calling attention to possible constructional defects, normal and abnormal effects of wear and tear, water corrosion, and other causes.

The later chapters are devoted to accessory steam plant, such as economisers, superheaters, water softeners and mechanical stokers, and contain many practical hints on the care and maintenance of valves, pipe lines, fittings and other details which will be useful to all operating engineers.

In the preface the question of coal economy is lightly touched upon, but the scope of the work does not call for exhaustive treatment of the operating side, and this phase is not, therefore, developed to any extent. At the same time, there is no doubt that closer attention to the question of maintenance will materially reduce the risk of breakdown, and Mr. Clayton's treatise may therefore be recommended as a useful addition to the boiler engineer's library.

Percy E. Rycroft.

Electricity and Safety First in Factories.

By W. H. SEAL, H.M. Deputy Superintending Inspector of Factories.

Mr. Seal's article is written to stimulate interest in the important problem of how safety can best be insured in our factories. This is both a human and an economic question, and in its solution electricity can be of the greatest assistance. Mr. Seal suggests a code of safety rules and calls attention to the legislative difficulties which prevent the full blossoming of "safety first." Certain precautions desirable in using electrical machinery are discussed in detail.

It is only possible in the brief space alotted to me for this article to touch the fringe of such an interesting and important subject; if, however, anything herein stimulates more active interest or encourages further efforts by those to whom it appeals, it will not have been written in vain. Moreover, this is not an official review, but some reflections of my own personal impressions.

Politics and Safety First.

The late Mr. Gladstone once defined the science of politics as "to make it easy to do right and hard to do wrong"; the same words apply equally to the science of the subject under review, particularly from the electrician's point of view, for the art and functions of true statesmanship consist, not so much in trying to deal successfully with national needs and international problems as they arise, but, what is far more important and valuable, in foreseeing and averting dangers which threaten the State. Similarly, and with equal force, this applies when dealing with "Safety First in Factories," which may be summed up in the prosaic words, "prevention is better than cure."

Apart from the problem of creating a more harmonious and better co-operative relationship between employers and employed—a most desirable achievement in the present state of industry—no industrial issue of recent years has become, perhaps, so prominent a theme for discussion, or involves more important prospective results.

This Country the First.

There can be no question but that this country was the pioneer in this desirable movement, mainly, perhaps, owing to its excellent Factory Acts and their administration; but its *commercial* value was quickly recognised by employers of labour and insurance intellectuals in America, which country, with its usual activity and hustle, was not slow to explore and develop this comparatively unknown sphere of utility, so that it has actually outdistanced us in the great strides made and wonderful results achieved.

True, its propaganda may appear sometimes crude in conception and somewhat gruesome in the illustrations used to illuminate its efforts; still, the movement is so widespread, the efforts so forcible, and its promoters so sincere, that, judged by results, "it gets there"; this is proved by facts and figures which are unimpeachable, but which space forbids being chronicled here.

The Pathos of Commerce.

The subject under review assumes additional prominence when we try to realise the constant and continuous toll made upon our industrial life, and the human misery involved by the fact that during 1920 accidents reported under the Factory Acts to H.M. Inspectors totalled 1 404 fatal, 42 012 due to machinery, and 94 286 others. And, quite apart from the necessity of complying with safety requirements enforceable under the Factory Acts, and the moral obligations arising out of the human aspect, there is the industrial side—viewed from the employers' standpoint—and this is the one with which, for the present, we are here mainly concerned; and thus the question naturally arises, does "Safety First" pay? Leaving out other considerations, the issue may be thus expressed: is there, commercially, an adequate return in interest to an employer for the capital outlay involved in carrying out the provisions to ensure its success? One way of recovering part of such cost would probably be in a reduction of insurance premiums when protective measures were adopted to the company's satisfaction. This is done in the laundry trade, where the Lancashire Mutual Insurance Association allows 5 per cent. discount off premiums when the machinery is protected up to the standard required by its inspectors, whose expenses are paid by members of the Association, and occupiers are keen to reap the advantage.

The Cost of the Worker.

Further, the question is partly answered by asking whether we fully realise what it costs the State to feed, clothe, educate, etc., a worker until the age of productiveness, either professionally or industrially, is attained; and even after that period is reached there are still years of probationary labour required before such a worker can give, either directly or indirectly, back to the State his own cost of production. Hence it follows that whatever can be done to secure the safety, physical comfort, and welfare of each producer is a valuable asset, not only to the breadwinner and his household, but to his employer and the State. No employer willingly allows his machinery to become obsolete or to neglect its efficient working and subsequent impoverishment for the sake of necessary repairs, adopting improved and more up-to-date methods, or, it may be, even the use of a little oil. And so it is with the human element in industry: whatever tends to make the producer less efficient, whether by unhealthy or unsafe conditions, is unjust to the workers, an inconvenience and a loss to the employer, and wrong to the State, for all this has to be repaid either in lessened production, compensation, insurance, etc., etc.

The late Charles Dickens must have been gifted with a prophetic vision of the partial solution of this problem when, 70 years ago, he said, "If ever there was a time when any one class could of itself do much for its own good and for the welfare of society—which I greatly doubt—that time is unquestionally past. It is in the fusion of different classes without confusion; in the bringing together employers and employed; in the creating of a better, common understanding among those whose interests are identical, who depend upon each other, and who never can be in unnatural antagonism without deplorable results."

How Electricity can Help.

And there is no field perhaps which affords such scope for progressive safety devices as the electrical; already much has been done, but very much more can, and must, be done. The first essential is the elimination, as far as practicable, of risks arising from overhead driving shafts, pulleys, and belts, the cause of so many and serious accidents, which can be greatly reduced by use of direct local or basement drives, to a minimum. No one visiting factories, great or small, can fail to observe the network of potential risks which everywhere prevail from unsecured loose belts suspended from overhead shafts, putting belts on pulleys, oiling bearings with shaft in motion, and the use of unsuitable ladders in work incidental thereto, etc. Other advantages of the electric drive include:—

(a) *Flexibility.*—The machinery in the mill can be arranged in the manner most suitable for convenient operation, without having first to consider whether it is possible to drive the machine in the position chosen. Alteration and extensions can be easily and efficiently carried out. The buildings can be scattered over a large or irregular area without appreciable disadvantage.

(b) *Lighter Building Construction.*—The absence of heavy mill gearing when electrical drive is adopted will often permit of a lighter type of building construction.

(c) *Sectional Working.*—Although most textile mills usually run at full load throughout working hours, cir-

cumstances sometimes arise which necessitate the operation of only a portion of the machinery. In such circumstances a prime mover does not operate at its maximum efficiency, and at the same time the percentage loss in friction increases, due to shafting and belting running round light. With a well-arranged electric drive, using purchased power, sections of the mill can be shut down, and the remaining sections will still operate at full load efficiency, whereby considerable economies are affected.

(d) *Smoothness of Drive.*—The individual motor drive of certain classes of machines will assist in obtaining a smooth and constant speed drive, especially if belts can be eliminated altogether. Such irregularities in speed as may be obtained from a belt drive are well known to have a very adverse effect on production, and one of the chief advantages of the electrical drive is that it enables the belt drive to be replaced by direct drive where desired.

(e) *Speed Variation.*—Where machines are required to be driven at variable speed the variable speed motor offers an ideal form of drive, as the speed can be perfectly and easily controlled, and it is much simpler than any mechanical variable speed device.

FIG. 1.—LARGE WOODWORKING PLANT WITHOUT OVERHEAD DRIVING SHAFT, PULLEYS AND BELTS—THE PIPES SHOW SYSTEM OF MECHANICAL DUST EXTRACTION.

(f) *Reduction in Breakdowns.*—The breakdown of a prime mover in a steam driven mill is a very serious matter and often involves a prolonged stoppage. On the other hand, a breakdown or failure in an electrically-driven mill, using purchased power, will, generally speaking, only necessitate the shutting down of a portion of the machinery, and that for a short time, as a faulty motor or cable can be quickly repaired or replaced. Where electricity is privately generated, this advantage of course, cannot be claimed. Apart from the breakdown of the prime mover in the case of the mechanically-driven mill, there is always the question to be considered of the breakdown of some detail in the mechanical drive which may shut down the mill for some considerable time. With the sectionalised electrical drive this disadvantage does not exist to the same extent in either the scheme using purchased power, or in that where the power is privately generated.

(g) *Ease of Control and Upkeep.*—Electrical energy can be very easily and accurately measured, and such measurements afford a continuous indication of the state of the machinery and the amount of work beng done.

(h) *Increased Light.*—Due to the reduction in the amount of overhead shafting, belting and other transmitting media in an electrically-driven mill, more effective lighting, both artificial and natural, can be obtained.

(i) *Improved Welfare of Personnel.*—The reduction in the amount of shafting belting, etc., with electrical driving improves the safety, appearance and cleanliness of the mill, thereby adding to the comfort and health of the staff and to the ease of supervision.

Good Conditions Assisted by Electricity.

The accompanying illustrations (Figs. 1 to 3) serve to emphasise the foregoing where direct electrical drive operates, whilst, in addition, it is possible by suitable gearing to arrange for the stoppage of any machine from various points by means of push-buttons, which of course, involves the use of an automatic circuit breaker, contactor, or some electro-magnetic means of holding the switch arm in position.

Further, it is practicable, by means of automatic starting gear to arrange for the starting and stopping of electrical motors from points remote from the motor. For example, a " blower " for a foundry might be installed in an archway where it was difficult to fence it, so as to safely approach it whilst running, but it could be arranged, by means of push-button starters interlocked with the machine house door, and from outside, so that there would be no possible danger to the operator There are many variations of this method of controlling machinery, but in dangerous places it is quite possible to make starting independent of visual or sound signals. Where basement drive prevails, local pulleys and belts immediately above the working floor can be easily railed off or shielded whereby the only risks arise from the moving parts of machinery, which, in turn, should be adequately fenced as far as practicable.

A Code of Safety Rules.

Having adopted all reasonable precautions for adequate protection from dangerous machinery and conditions of employment, the next step is to try and enforce their use, and the following " Safety Rules " are in successful operation at a large and important works in this country :—

1. ALWAYS BE CAREFUL. Make sure you are right before you proceed with your work.

2. If you have ANY DOUBT about how any work given you has to be done, or if you have ANY UNCERTAINTY as to the manipulating of any machine you are set to operate, SAY SO. Your foreman or overlooker will help you. DON'T TAKE A CHANCE.

3. USE EXTRA CARE whenever you see a machine painted RED, or where you see a RED DISC. Remember personal caution is the greatest and best safety guard. Want of care often does more harm than want of knowledge.

4. REPORT any DANGERS you see to your foreman AT ONCE. Cultivate the " Safety habit."

5. If there are any safety guards or devices on your machine, be sure they are in place before starting. Never start a machine until you have made sure everything is in order.

6. Do not wear clothing with unfastened or ragged sleeves. These may be caught in machinery.

7. All GIRLS must wear their HAIR NEATLY COILED to the satisfaction of the forewoman, WHEN AT WORK.

8. Larking or fooling is strictly forbidden. Do not throw anything.

9. Do not leave any boards lying on the floor with nails protruding. You may lame a workmate for life.

10. DO NOT OIL SHAFTING OR MACHINERY IN MOTION without direct orders from your foreman.

11. Do not use a ladder on wooden floors unless it has safety spikes or feet.

12. Do not use tools with burred ends, or hammers with cracked or broken shafts.

13. Do not pile material so that it can fall.

14. PROTECT the premises AGAINST FIRE. A fire in these works may put many people out of work. PREVENTION IS BETTER THAN CURE.

15. Help to keep the factory and plant clean. There is less chance of accidents happening.

16. IF YOU ARE INJURED, no matter how slightly, REPORT AT ONCE to your Charge Hand or Foreman. NEGLECT of proper

attention MAY CAUSE PAIN AND SUFFERING as well as LOSS OF WAGES TO YOU. Skilled treatment is always available.

The Use of Safety Bulletins.

In large works much can be done by a competent safety engineer or inspector with time and authority to supervise and enforce safety conditions, but in smaller works this must necessarily devolve upon the employer, or some responsible manager, or foreman; but in either case their efforts can be very usefully supplemented by warning placards—sometimes known as safety bulletins—exhibited in the works, of which the following are typical :—

FIG. 2.—WOOLLEN MILL—TWISTING FRAMES (SHOWING PART OF DISUSED MILL GEARING AND PULLEYS).

THINK SAFETY AND PRACTICE IT.	BETTER BE SAFE THAN SORRY.	PREVENTION OF DISTRESS IS NOBLER THAN RELIEF.	*DANGER.* DANGER SIGNS ARE FIXED FOR YOUR SAFETY. DO NOT DISREGARD THEM.
FOOLING. Many accidents are caused by fooling, horseplay, and distracting attention of others. Be sensible.	*HABITS.* It is better to lose a minute in avoiding an accident than a month in nursing an injury.	*WOUNDS.* Septic wounds, however slight, require careful treatment. Have them dressed daily in the Surgery.	
It takes less time to prevent an accident than it does to report it.	It is better to be careful than to be crippled.	It takes less time to learn to do a thing right than it does to explain why you did it wrong.	

Legislative Difficulties.

The question is sometimes asked why makers of, or agents for, machinery are allowed to sell machinery inadequately protected to meet the Factory Act requirements, and the answer, briefly, is : There exists no statutory power, at present, to compel them to do so, but what is being done is, wherever new machinery is found in use in factories with dangerous parts inefficiently protected, to interview its agents or makers and urge the desirability of fencing such parts to meet adequate safety requirements, pointing out that wherever during official inspection such machines are found in use, the employer will be instructed that, from the official safety point of view, they disclose defective conditions which must be remedied. This sometimes has the desired effect on the seller, but others demur (*a*) on the ground of the additional expense involved; (*b*) some employers prefer to provide their own guards; (*c*) that as agents for such machines manufactured abroad (principally America) their powers are limited.

Need of Signalling Systems.

Another very important step taken by the Home Office is to call conferences from time to time with the accredited representatives of employers, employed, and expert inspectors of factories in certain important industries where voluntary agreements are arrived at, as to what parts of their machinery should be fenced, the methods of fencing, together with other questions likely to effect the safety and welfare of the worker—*i.e.*, temperature, ventilation, etc. This is being followed up by the publication of concise explanations in illustrated pamphlets. This is a most praiseworthy development; for "he who runs may read," thereby standardising uniformity of safety conditions and their administration. One important factor in the domain of safety deserving of development is a more efficient method of signalling between two or more persons working in conjunction with, but each independent of, the other; as frequent accidents occur owing to misunderstandings, often due to noisy surroundings, restricted view by, and of, machinery, and which could be largely overcome by the intelligent use of signal lights. Here is an example :—

An Example of Protection.

Two operators are working at a double crank "Bliss" two-man press, one at the back, the other at the front, and the latter operates the lever which works the press, the device herein described being a signalling apparatus from the operator at the back that the material is in position, and ready for the action of the press.

The device consists of two flush type spring push-buttons set at a convenient position within the operator's reach, and at such a distance as to compel the operator to use both hands. The action of pressing the switches starts an electric current which operates a signal lamp, but first of all passes through a solenoid, which, by magnetic action, withdraws the safety pin from the press operating lever. The press then returns to the normal position by mechanical means which is integral with the operating mechanism of the press, and as it does so, the solenoid pin is forced back to its original position by a spring strong enough for the purpose, but not too strong to resist unduly the magnetic action of the solenoid.

Two points have been found by close observation to be necessary to prevent mischievous interference with the safe working of this device: one is that the push switches be of the flush spring type to stop one or both from being locked in the "ON" position; and the solenoid must be encased to prevent the pin being trapped back in such a position as to leave the lever open. The above excellent device was the outcome of an accident by which the operator at the back lost a hand, through the operator at the front of the press *imagining* he had seen the signal light and starting the press whilst the injured man's hands were in a dangerous position.

Many accidents occur during loading and unloading vessels owing to inefficient signalling, etc. These dangers can be largely overcome by the mechanical device illustrated in Fig. 3.

Fig. 3.—Driving a Crane in Safety and Security.

A Device for Safe Unloading.

By this method of control it is possible for the operator to leave the crane cabin and control the operation of the crane from any part of the ship or dock by means of a small portable master controller, which he can easily carry from place to place. When working from the hatchway, the driver has a better view of his work throughout the whole range than if he is up in the crane cabin and is consequently not so dependent on the signals of other people. This is especially useful when drawing cargo from spaces in the hold beyond the hatchway opening and also in swinging goods into these positions. This better view makes the operation so much safer for the man in the hold. It has also the additional advantage of saving the wages of a signaller. There is another point which is specially important at night time, and that is the comparative danger to a man ascending a crane, and especially some very large cranes, when used in the dark. This is of special importance where a man may require to work one out of two or more cranes at various periods in the night.

There is also the matter of comfort of the operator involved, as it is found that most crane cabins are very draughty and require to be heated, and many operators would prefer to work in the cold with a coat in the open air than in a heated but draughty cabin.

Hoist Protection.

Notwithstanding improved methods of protecting the hoist-well itself, the number and seriousness of hoist accidents still continue to be so alarming that it has been found desirable—and even necessary—to try and standardise certain precautionary measures of additional safety, and a pamphlet thereon recently issued by the Home Office states "a large number of accidents are caused by crushes between the travelling cage and door lintels or other projections in the hoist well. *Practically the whole of these would be prevented by fitting a collapsible*

gate on the cage itself. In addition each doorway should be provided with a gate or door fitted flush to the inside of the 'well,' so constructed that (1) it cannot be opened until *the cage is at rest* opposite to that floor or landing, and (2) the cage cannot be moved away until *the door or gate is closed and fastened.*"

This recommendation is essentially an unique opportunity for electrical equipment to come into its own, as thereby the use of hoists can be made practically "foolproof," as an auto locking device can be, and is being, applied to electrically driven hoists, whereby the electric circuit between the cage and protecting gates or doors become operative or broken by the arrival at, or departure from, any floor. In addition, by a mechanical interlock between the gate of the cage and the door, the latter can only be opened when the cage is opposite the door and the cage can only be moved when the door is closed. At first difficulties arose in applying the arrangement to belt-driven and hydraulic hoists, but "necessity is the mother of invention," and these obstacles are now mainly overcome. In one such instance not only are the Home Office recommendations referred to above carried out, but when the gates are properly closed, and not till then, a lamp in the cage becomes automatically alight, and continues so whilst the cage is in motion and the doors or gates remain closed.

Cranes and Accidents.

In proportion to the numbers employed on cranes, the percentage of accidents—mostly serious or fatal—is far too high. There are invariably three types: (1) overhead, (2) runway, (3) overhead, but running on ground rails; and risks may be classified generally as (*a*) falls of persons, (*b*) falls of material, (*c*) contact with other workmen on floor, (*d*) electrical.

Falls of persons in the hand operated crane occur mainly owing to insufficient fencing of the hoisting platform or faulty means of access; in the electrically driven type the same causes operate. Where repairs have to be carried out to the overhead structure a safe platform or other means should be provided. Occasionally, through some failure, the crane cannot be brought back to the usual point, hence means must be at hand whereby the operator can descend safely—*i.e.*, by ladders at intervals, or a rope ladder in the cabin.

Falls of Material are mainly due to (*a*) failure of machine (either faulty design, overloading, or wear and tear); (*b*) failure of chains, slings or ropes; (*c*) contact of hoist material with fixtures; (*d*) improper slinging; (*e*) careless working of crane. Therefore, plant must be properly designed with adequate factors of safety; stop blocks fitted at ends; maximum safe load clearly marked on cranes; structure, chains, ropes, etc., be periodically examined by a competent person; faulty wire ropes be repaired or replaced, and chains annealed; material be loaded under proper supervision; the crane be in charge of an experienced and careful person with a proper system of signals with the ground.

Contact with workmen on the ground may occur either owing to improper handling of the crane, whereby workmen are struck by the load, or, in a gantry crane with floor rails, by crushes between the moving framework of the crane and fixed structures in the building; where this is likely to occur, curved shields on the principle of the cow-catcher should be fitted, so that persons are pushed out of danger. All cranes should be fitted with a distinct form of sound signal—preferably of a continuous type. This is especially important where the workplace is noisy.

Electrical Crane Dangers.

Electrically, the danger on cranes is from shock, which may or may not give rise to a fall; it is therefore important that the cabin switch-board be of a safe type, and switches for various operations be plainly marked. Overhead feed wires should be protected near all parts to which access may be required, and wires along walls from which power is supplied be protected at those points which are to be crossed when the operator has to enter or leave the cabin—a shield fitted so as to run with the crane acts effectually as a protection.

Fire Precautions.

Prompt and efficient means for notifying an outbreak or alarm of fire are a valuable asset to employers and property owners—quite apart from the more important consideration of saving life—hence it is very important that premises be fitted with an electrical device whereby danger signals by lights or bells, or both, can be immediately communicated as a distinctive fire alarm. The necessity for some such arrangement was emphasised recently by an outbreak of fire in a factory in a large city resulting in the loss of five lives, and a miraculous escape of 30 other persons. The fire broke out at 6.30 p.m. (October) on the first floor of a four-storey building, and at the time 35 persons were in the top workroom, but before they could be communicated with, the internal staircase was full of smoke, and efforts to make the danger known to them by persons outside were unavailing, so that by the time the alarm could be given the outside iron staircase was enveloped in flames and escape practically cut off. An efficient system of signalling by means of a substantial bell, operated from, say, the time lodge, would have given ample warning to the occupants of the room that danger was about. The following is an excellent arrangement in operation at a company's large premises for calling appointed firemen from the respective parts of the building to the works' chief fire station, wherein are two sets of accumulators of 15 V each, charged from the electrical supply mains. These accumulators control seventeen 6 in. bells, distributed over the main staircases of six large seven-storey buildings. They are fixed in position on the staircases so that firemen employed can hear them at any time they are required, the wires being run from each bell to accumulators and control pushes in Chief Fire Station. A push-button is also fixed in each block of buildings in a small fire box with glass front, marked "Fire," so that warning can be given to Chief Fire Station in case any of these buildings get on fire; the chief fireman can then ring all firemen from other sections of the premises. A wire is taken from each push-button to a bell in the Chief Fire Station, the chief fireman from the station can press a button and call any section of the men from any single building, or, by pulling down the lever,

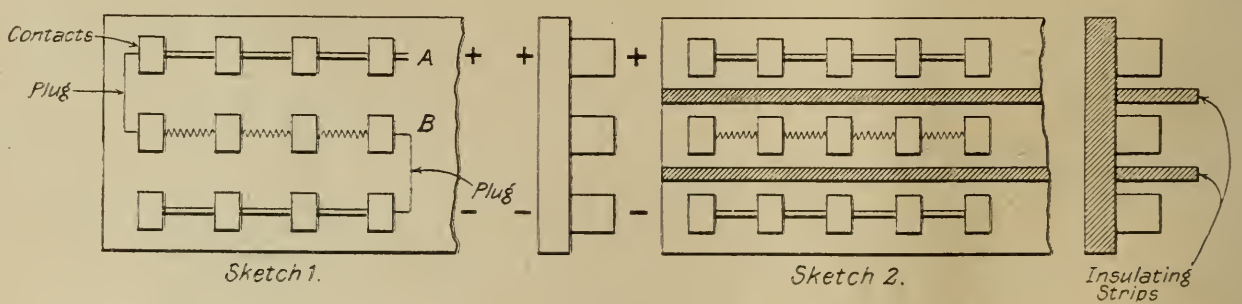

Fig. 4.

which connects all the push-buttons, he can call all men together at the same time from the whole six blocks of premises.

Electrical Accidents in Testing Departments.

Electrical accidents in testing departments may be due to the three following causes :—

A.—Testers' own carelessness—i.e. :

1. Burn or shock due to interfering with connections on switchboard or machine on test without making circuits dead.

2. Burn due to tester shorting mains with one piece of wire owing to not making certain that the voltmeter switch is in correct position for reading a high voltage.

3. Burn or shock which may be caused by paralleling a d.c. machine on the line and tester not carefully testing that there are no volts across switch before closing it.

B.—Bad arrangement of testing sets and materials used—i.e. :

1. Burn on hands or face owing to the fuses on the test switchboard being in too close proximity to the switch.

2. Burn on hand due to plugging up a resistance frame and an arc extending from plug to the opposite pole. Arc may occur across A B, see Fig. 4, Sketch 1.

This can be prevented by placing an insulating strip between the rows of contacts, and thus prevent arcs. See Fig. 4, Sketch 2.

3. Various firms have different methods of dealing with shock prevention on H.T. flashing circuits, and each may have its defect ; but I will deal with the one only with which I am familiar.

In the standard flash test up to 2 000 V the H.T. circuit is supplied by means of a small motor-alternator through a transformer, one pole of which is earthed and the other pole run through H.T. wire down the Test Department, and is tapped off at various points to a guarded hook.

The H.T. lead consists of a special H.T. cab-tyred cable (capable of standing 20 000 V) with specially prepared connectors at each end, and consequently quite safe to use. Care is taken that only one flashing lead is in use at once, and arrangements are made so that the H.T. line is dead when not in use. Thus if a Test Department is arranged conveniently and all testing circuits are entirely separate and controlled by switches and breakers, so as to make it impossible for a tester to obtain shock, etc., from another circuit close at hand, and also all testing leads to be clear of any passage, then the risk of accidents is very much minimised.

First-aid Methods.

Notwithstanding the adoption of efficient provisions to ensure safety, accidents will continue to occur from a variety of unforeseen or unpreventable causes, lack of reasonable care, inadequate supervision, etc., and to deal therewith there should be provided means to enable treatment of injuries sustained during work. And the first essential is a first-aid box (or boxes) suitably placed in the works, equipped, maintained and used in accordance with the requirements needed for each trade dealt with in various Welfare Orders issued from time to time by the Secretary of State.

In certain industries where 500 persons and upwards are employed this provision should be supplemented by an ambulance room suitably placed—in charge of a qualified nurse or other person trained in first-aid, who should be readily available during working hours—and contain at least :—

(i) A glazed sink with hot and cold water always available.
(ii) A table with a smooth top.
(iii) Means of sterilising instruments.
(iv) A supply of suitable dressings, bandages and splints.
(v) A couch.
(vi) A stretcher.

Accidents arising from electric shock require special treatment apart from these provisions, the most important being the immediate application of artificial respiration as a means of resuscitation in cases of apparent death, to be resorted to *at once*, and persevered with for at least two hours, or until the patient revives. Here again it is quite impossible to go into details, and readers are referred to Home Office recommendations thereon. It has also been found desirable by some electrical authorities—to avoid any possibility of misunderstanding verbal instructions—that, before commencing work on any high tension system, the erector, foreman or jointer in charge shall receive from the engineer supervising the work a form as follows :—

To the Foreman-in-charge,
..... Cable.
Time .....
The above cable is dead and earthed, and work can now be started on this line.
Signed .....
Engineer-in-charge, Power Station.

Then when the work is completed the preson in charge shall report :
To the Engineer-in-charge at the Power Station,
or
Senior Operation Engineer,
..... Cable.
Time .....
All men are clear of the above cable.
Signed .....
Mains Department.
Date.....

Conclusion.

Prejudice against new developments, such as "Safety First," dies hard, and difficulties are not so easily overcome. Some day—soon it is hoped—the long contemplated provision and equipment of what has been termed a "Safety Museum" will be established in this country on the lines, it may be, of those in America and on the Continent, whereby can be made known to our manufacturers the adaptation and uses of safety apparatus and the details of organisations in this and other countries that have more or less grappled with the problem of accident prevention. The American museum of safety holds a special charter of incorporation granted by the Assembly and Senate of the State as follows :—"The objects of the Corporation hereby created are to study and promote means and methods of safety and sanitation and the application thereof to any and all public or private occupiers whatsoever, and of advancing knowledge of kindred subjects ; and to that end to establish and maintain a museum, library and laboratories and their branches, wherein all matters, methods, and means for improving the general condition of the people as to their safety and health may be studied, tested and promoted with a view to lessening the number of casualties and avoiding the causes of physical suffering and of premature death ; and to disseminate the results of such study, researches and publication." *

As this article commenced by quoting Mr. Gladstone, with another quotation from him it may fitly conclude : "Apart from his agreement with his employer, each man should have a contract with himself, always and in all things to do the very best he can" ; for only by the loyal co-operation of the worker to make the best use of the means provided by his employer can "Safety First in Factories" be translated from the visionary dreams of idealists into the new awakening of an accomplished reality.

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* In opening the Paris Museum of Safety, the then President of the French Republic (President Loubet) said :—"Never does one appeal in vain in France when it is a question of social usefulness. Thus the Government of the Republic is associated with this museum. How could it be otherwise ? For this work, protecting and lengthening the life and labour of our workmen, is a most valuable asset to our country, and you may be sure that whenever a work of this nature is presented for governmental consideration it will support it with grants of money."

Tariffs for the Sale of Electrical Energy.

By JULIUS FRITH, M.Sc., M.I.E.E., M.Cons.E.

Electrical energy is so essentially unlike anything else which is bought and sold that the principles involved require very special study. In the case of no other commodity do the capital charges involved play so important a *role*. This is mainly due to the fact that storage of electrical energy on any large scale is hardly practicable, and, therefore, that the energy has to be made as and when required.

Roughly, if the total cost of a unit is, say, one penny, one halfpenny of this is for capital costs and only one-half of the remainder, or one farthing, is for coal. This gives to the "load factor" of the demand a preponderating effect which does not obtain in any other commercial transaction.

Object of a Tariff.

Before deciding how to embody these conditions into a "tariff" it is necessary to settle clearly what the tariff is to accomplish, and here a difference which is often lost sight of is brought to light, namely, whether the supply is given by a company or by a municipality.

In the first case the company manager is appointed by the shareholders to earn as good a return on their money as possible, under certain statutory limitations. The prices charged should be as high as possible consistent with not imperilling the securing of additional custom. The division of the contribution levied from the different types of consumers need not necessarily bear any relation to what each consumer costs to supply; it might conceivably be good business to charge a uniform rate to all comers, hoping to make up on the swings what was lost on the roundabouts. The price asked, in other words, is limited only by the will and ability to pay.

Municipal Trading.

The case, however, is very different with the municipal undertaking. Here the ratepayers, for their own ends, have put up a station with money borrowed on the security of the rates. There should be no question here of making a profit, and each consumer should contribute to the joint expense as far as humanly possible, in proportion to what his supply costs the community.

Two Systems of Charging Permissible.

It is seen at once that these two cases may, quite rightly, lead to very different systems of charging for electrical energy. There is one rule, however, to which *all* successful systems should conform. It is that the tariff should be simple and easily understood. The great majority of tariffs at present offered are far too complicated, giving the impression of being manufactured by a mathematician rather than by a business man. It is essential that the prospective consumer shall be able with some certainty to predict what his bill for energy will come to.

After this first principle has been established the tariffs suitable for the two types of supply may be grouped under the following requirements:—

For companies the consumer who pays best should be most encouraged, and the consumers from whom it is next to impossible to derive a profit, should be made to pay as much as an all-wise Government will allow. The aim of the tariff should not be so much to make each individual consumer pay as to make the concern as a whole pay.

For *municipally owned concerns* the aim of the tariff should be, as before said, to make the punishment fit the crime and make each consumer pay what it costs to supply him.

Determining the Cost of Supply.

When these two are compared in this way it is seen that each has an interest in knowing what a certain supply actually costs. Now this is much more difficult to determine than would appear at first sight, for although it is comparatively easy to find out what the cost of the supply is as a whole and how the cost per unit is affected by the load factor of the station as a whole, it is far from easy to see how the connection of any *new* load will affect this cost.

It is desirable that those consumers whose demand lessens the load factor of the station should in some way contribute on a higher scale to the expenses than those whose demand increases the load factor. It is, however, a very difficult thing to devise a tariff which will effect this; for instance, any consumer who takes energy from the station at however low a load factor, but who does not increase the maximum load on the station, increases the station's load factor, but if he does increase the total maximum demand on the station and does not increase the average load by an equal ratio, then his load reduces the load factor of the station as a whole.

It is thus seen that any particular load that may be offered to the station is not good or bad in itself, but only as it differs from or approximates to that of the majority of the other consumers already connected.

Need of Diversity.

It is thus seen that a station stands to gain by the diversity of the individual demands, for its load factor may be increased by a demand at a lower load factor than its own, but cannot be decreased by a load at a higher load factor, even if the maximum of the two coincide in point of time.

Two distinct attempts are being tried at present to meet this; the first is a restricted hour tariff which offers energy at a price free of all capital charges except those of the new service cables, etc., required, to those consumers who do not under any circumstances increase the maximum load on the station. This condition is often enforced by the use of a time switch. The second is a method of charging on the load factor of the new demand, irrespective of its relation to and effect on the load factor of the station as a whole.

In the light of what has gone before, the *justice* of this latter is more than doubtful—*e.g.*, two new consumers may be connected and by reason of the equality of their load factors may be charged equally whilst one may not add anything to the maximum station load, and so be supplied at little more than the cost of coal, whilst the second may involve the concern in capital charges equal to the maximum demand of the new load.

Justice and Experience.

What is not always just may nevertheless sometimes be expedient, and the mixed tariff of so much per annum per kW of maximum demand plus so much per unit taken meets the average case of a demand for industrial purposes fairly well. In some cases the kVA is substituted for the kW of maximum demand, with, however, only a show of justice, as the capital charges are perhaps half way between the voltamperes and the watts.

Supply undertakings are becoming more alive to the cost to themselves of carrying about magnetizing current for their consumers' devices, free of cost, and are one and all considering how the question of low power factor can best be dealt with. As mentioned above, some authorities are making the fixed part of their tariff proportional to the kVA instead of the kW of the maximum demand. This appears to be as unfair to the consumer as the other is to the supply authority. This fixed charge is to cover the capital cost involved in being ready to give a supply if called upon to do so. Now the cost of buildings, steam-raising plant, coal and ash-handling plant, as well as that of the prime mover is unaffected by the power factor and depends on the kW alone.

Other concerns increase the whole quarterly account by a percentage which increases as the power factor decreases. It is, however, very difficult to say what the average power factor of an installation is; this *could* be found by comparing the readings of integrating watt-hour and volt-ampere-hour meters.

It is *most* desirable that some uniformity should be arrived at between all the supply authorities in regard to this matter, as well as in the other parts of the tariff, as there are at present in use about three times as many tariffs as there are supply undertakings in the country.

Modern Industrial Organisation.*

By HUGO HIRST, M.I.E.E.

Industry may be defined as the combined efforts of brain, labour, and capital to create values from raw materials. The brain, because it directs the activities of the body, comes first. Capital is the accumulation of savings produced by the efforts of brain and labour.

Among Government Departments, now being so keenly criticised, the Post Office alone seems to resemble more closely a business concern than any other Government Department, but even here the possession of a monopoly eliminates many of the difficulties inherent in competitive businesses. In industry questions of mutual interest arising between purchaser and seller cannot be settled by regulations imposed by either side. Every point has to be settled diplomatically by persuasion or by compromise. It is necessary, however, to bear in mind the fundamental difference between an industrial and a Government organisation. The Government has to render services to the community, the value of which cannot be expressed in money, and its departments are not in most cases limited by the time factor. Industry has to render services, which must be expressed in terms of £. s. d., the result being obtained within a limited period. The civil service organisation is framed to last for long periods, and absence of flexibility may be an advantage.

Individualism in Industry.

It will be clear, therefore, that in industrial organisations the individual must receive more latitude than in Government Departments. Industry is in a constant state of evolution, and changes due to fashion, competition from other countries, financial conditions, inventions and many other circumstances may produce sudden stoppages or changes. It is essential that an industrial organisation should be pliable, simple, human and personal, rather than rigid and anonymous. The consequence of this is that men engaged in industry must be ambitious and with strong will-power and personality. Such qualities would be a handicap to a civil servant, for this service seems to require men of high integrity and education, but with capacity for self-effacement. They must suppress the spirit of risk and adventure so much appreciated in industrial life. Examinations may conceivably be used for selecting Government servants, and a system of promotion by seniority might be arranged, but no examinations could be used to select men required for industry: character, initiative, energy, enterprise, decision, and all the many factors in personality count as much in an industrial worker as his accomplishments.

The Organisation of the General Electric Co.

Experience has taught us that the only safe basis of organisation is not the system, but the human factor that controls the system in this industrial undertaking. The General Electric Company has some fourteen factories, each belonging to a different industry in different parts of the country, and thirty or forty sales organisations in the United Kingdom, and some thirty others overseas, all managed independently. The relations between management and staff, between management and workpeople, the relation between a company and its customers, and authorities or public bodies, its attitude towards competition in this and every other country, its share in the development of industry, should be conducted everywhere on the same lines. This can only be accomplished by having placed at the head of each factory, each branch, each enterprise, a man of good character, fully conversant with the policy and the mentality of the chiefs of the concern, and being a faithful interpreter of their wishes and ideals. Such men cannot be found from without; they can only be created by a process of education from within. Education of one's staff as regards business policy and business principles is one of the great problems of industrial organisation.

Rising to the Top.

I have, in the course of years, brought on a number of men and placed them at the head of works, at the head of branches at home and overseas, or at the head of companies which we control. Many of them started at 10s. to 20s. per week and have risen in course of time to high and responsible positions, with emoluments ranging from £1 500 to over £5 000 per annum. We leave it to them to work the enterprise for which they are selected, putting at their disposal trained experts both on business and technical sides, assisting them with publicity and propaganda, catalogues and general sales regulations. We give them the fullest power within the limits of the capital put at their disposal—power equal to that commanded by ownership. Except the annual audit, there is no system of control and inspection. They have, vis-à-vis to customers and staff, the same authority as if they were principals. Their limitations are only known to themselves and the Board.

In the 35 years of my experience, I know of no single instance where this confidence has been misplaced, though I do not say every one has been successful.

The yearly balance sheet and certain statistics bring out the weaknesses of each organisation and lead to discussions, alterations and improvements. I therefore can describe our system as management by personal representation or substitutes, and yet there is a very real control and direction from above.

The system that we are applying is particularly suitable for English industrial concerns. In industrial concerns in Germany and America more rigid organisations exist. The system of schools and Universities in those countries is more standardised, and it is more possible to find a number of men of similar qualifications that can replace with each other. In this country you can scarcely find two men with the same qualifications; you must let each work in a manner that he can get the best out of himself.

Some Fundamental Industrial Safeguards.

I now wish to dilate on a number of points which will explain how it is that an organisation so apparently loosely knit together can still act as one unit, carry out one policy, and how irregularities and risks are limited.

There are a few fundamental safeguards, such as :—

(1) Limitation of the capital put at the disposal of the different undertakings.

(2) Separate finance for expenses and trading.

(3) Head office control of all trading finance and capital expenditure.

Apart from these, all interference, all direction emanating from head office, is suggested by watchfulness of balance sheet and monthly statistics of expenses and sales. It is little realised, even by the subordinates of one's own organisation, what an eloquent document a balance sheet is, what it tells the chief of a concern who knows his business. The actual profits made are by no means the determining factor in the eyes of the chief whether a concern is well managed or not.

The branch manager producing a document thinks all the items are peculiar to his branch or district; the man at the head, reviewing scores of these documents year after year, has learnt that economic laws are governing them like everything else. For instance, assuming that a manager sends me his balance sheet, what are some of the critical points to be considered?

Critical Points in the Balance Sheet.

(1) *Sales.*—Is the total turnover which he does a reasonable proportion of the possible sales in the territory, bearing in mind the relative position of my company with competition in the country?

(2) *Stock.*—Is his stock in the right proportion to sales?

(3) *Accounts.*—Are his outstanding accounts in proportion to his turnover?

(4) *Expenses.*—Are the expenses in the right ratio to turnover? What is the ratio of salaries to other expenses, etc.?

It can be elaborated in a very few words how an intelligent study of these figures leads to just appreciation of the merits or failings of the management.

More difficult is the criticism of works accounts, owing to the factor of changing prices of raw materials and the frequent change of patterns, designs and methods of production which influence works balance sheets, which is in some measure mitigated by fixing maximum and minimum stocks. A specific indication in a works balance sheet is the ratio of output to productive and non-productive wages, etc., etc. But generally it is expected of the managing head that he should have ever present in his mind all that is happening so that he can form a correct picture.

* This article is based on an address delivered to the Association of Civil Servants. Had the audience been from a less limited field some of the comments would have been different.

The Captain of Industry.

It is little known what volume of high pressure work and intensity of thought are expected from a modern industrial chief, frequently called "captain of industry." His duties are ever so much more complicated than those of the mere merchant or distributor. He has to deal with all the problems of the merchant so far as the distribution of his goods throughout the world is concerned, but whilst the merchant has the whole world open to him to buy in the cheapest market, the industrialist has to produce under conditions prevailing in his country in a manner to enable him to compete against the cheapest market. It is for him to judge the possible market for his wares and to lay out his works accordingly. We have no reliable census of production in this country, and a mistake made by him in this respect is often the fundamental cause for eventual ruin. It depends on his judgment whether he succeeds in selecting the best scientists, the best technical men, the best works managers and the best commercial people. It is up to him so to co-ordinate them that there is the least amount of friction, and yet in an industrial concern you have not only to reckon with petty jealousies like everywhere else, but there is the fundamental jealousy or fight for supremacy between the commercial and technical elements. He cannot possibly know all the details of his business, but he must be a man of high integrity and education so as to understand the intricate scientific, technical and commercial problems which are put up to him for judgment and decision when experts differ, which is all too frequent. Research, development, production, sales and distribution must be correctly co-ordinated in his programme. He must keep himself informed of all progress in his industry, of all progress in methods of production, of all new inventions affecting his interests, of activities of competition all the world over. He should know something of the raw materials and the purchasing capacity of each country, with which should be combined a knowledge of the political, social and economic conditions in these countries. It is for him constantly to encourage and inspire the men under him. He must endeavour by personal attainments to merit their regard and, by unbending and mixing with them on the right occasion and in the right manner, to merit their friendship and confidence. Above all, it is for him to bring home to his people the national need for production. He must have a good understanding of the principles of law and finance and should take every opportunity to offer his valuable experience to the country and those that rule it.

No Regulations or Agreements.

Under normal conditions, it is my duty to direct an organisation of from 15 000 to 20 000 people. In industry we have no army regulations that enable us to command and that forbid subordinates to ask why. We have no common great danger which spurs us on to united effort: united effort is only possible if those you lead believe in your high ideals, your integrity, fairness and correctness in every detail of your actions. To my knowledge not one of the principal members of our whole organisation has an agreement. Weekly or monthly servants have been with us for a generation and do not worry about their future.

His task, which has ever been difficult, is not lightened in modern times by the fact that the majority of his men have not only him but many others as masters. All his decisions must be quick, otherwise he loses opportunities and, though he may be subject to a board, unless the board give him the fullest confidence—including the right to make mistakes—so that he can act independently and quickly, he cannot make a success of the enterprise in the face of the world's competition.

Price of Greenock Tramway Current.

At last meeting of Greenock Corporation, Bailie N. M. Brown, convener of the Electricity Committee, announced that they had RECEIVED THE FINAL AWARD in the arbitration concerning the charge for electricity for traction purposes. The local Tramways Company appealed to the arbitrator against his first finding, but no alteration had been made. Under the award the Corporation obtained an additional £2 811 and a proportionate increase for the next four years. Under the old scale the first 500 000 units was at 1½d. per unit, the next 150 000 1d., and all beyond 0·85d. per unit. The new scale was 2·4d., 1·85d., and 1·03d. respectively, all subject to a coal clause. Putting it shortly, and taking the average price of coal at 30s. this year, the Corporation would (he said) receive £1 400 more under the award than under the old scale. They also got all expenses in the first part of the arbitration and half of the latter. He thought the Committee was to be congratulated on the result, and thanks were also due to their legal and engineering advisers.

Electric Traction in Chile.

For the last ten years the foreign trade of CHILE has been mainly with the British Empire, the United States and Germany, and though the latter lost her trade to the Americans during the war, she has again entered the Chilian market, and the Commercial Secretary at Santiago (Mr. W. F. V. Scott) thinks that British manufacturers have more to fear from German than from American competition. The coal market prospects continue depressed, and the electrification of the first zone of the State Railways, of the Iquique Nitrate and Chilian Transandine Railways, and the completion of the power plant of the Compania Nacional de Fuerza Electrica will effect considerable economies in the consumption of coal, and further affect the situation.

During the year the Westinghouse Electric International Company secured what is said to be the largest electric traction scheme executed by any American firm abroad. The contract is for the conversion of the first zone of the Chilian State Railways (between Valparaiso and Santiago) at a cost, including locomotives and all material required, of $5 677 947.71 (U.S.) and $2 319 707.56 (Chilian). Power will be supplied by the Compañía Chilena de Electricidad, Ltda., at 4 centavos gold (0·72d.) per kWh. The work has already been commenced, and a special commission of Chilian engineers has left for the United States of America to take delivery of the locomotives and other material purchased.

A Political Hitch.

The Iquique Nitrate Railways concession had been renewed by a Ministerial Decree for 50 years, and the company was empowered to raise its tariffs 35 per cent., in consideration of which the railway agreed to electrify the system and repair certain deficiencies in the service. The decree has been pronounced unconstitutional, having been signed without the consent of Congress, and has consequently been rescinded. The matter will be brought up for reconsideration at a future date, and it is believed that it will be passed.

The Chilian Government has agreed to the fusion of the Chilian Transandine Railway with the Argentine Transandine Railway. It is proposed to make such improvements on this line as will make stoppage during the winter by snow almost impossible, as well as to electrify the major part of the line. During the negotiations with the Chilian Government, estimates were required for the electrification, and help was sought from the representatives of some British firms capable of undertaking the work, but none was found and recourse had to be had to the International Electric Company of America. The railway will require to purchase considerable quantities of rolling stock, machinery, etc., at an early date.

Several small railway lines have been constructed, and some are in course of completion. The most important future work is the construction of a new line between Valparaiso and Santiago, passing through Casablanca and Curacaví, with a short branch to Talagante, which will bring the principal port twenty-six miles nearer the capital, the tortuous line at present used, and now being electrified, is 130·2 miles long. Owing to lack of funds, the railway will have to be constructed under concession. The line is to be worked by steam or electric equipment. The concession is to lapse on the termination of the amortization, but may be terminated earlier by the payment of the outstanding capital plus 10 per cent.

Electricity Supply and Tramways.

The Chilian Electric Tramway and Light Co., Ltd., of Santiago, which was handed over to the Receiver of Enemy Firms during the war, and in which an English firm acquired the controlling interest, has been reformed into the Compañía Chilena de Electricidad Limitada, with an increased capital of £12 000 000, and has also acquired the controlling interest in the recently formed Chilian Compañía Nacional de Fuerza Eléctrica, whose original capital was £800 000, now increased to £3 000 000. A large power plant is being erected to utilise waterfalls within 30 miles of Santiago, which is anticipated to be in operation in July next. Distributing stations will be erected for utilising the power over a large radius round Santiago, and beyond lighting the Capital and running its tram service, the contract has already been secured for running the first zone of the State Railway between Santiago and Valparaiso. Other contracts likely to be secured are the running of the Transandine Railway, shortly to be electrified, Valparaiso Port Works, and a large number of industries in the zone covered.

The Madrid combination of Spanish and German interests took over the Valparaiso tramway undertakings of the Deutsche Ueberseeische Electricitäts Gesellschaft in March, 1921. A small electric tramway service was started during this year at the town of Temuco, and permission was requested in November, 1921, to instal a similar service in Valdivia.

Submarine and Radio Telegraphy.

Interest is being taken in the project for laying a submarine cable connecting Italy with South America. The cable will start from Fiumicino, in Italy, and run to the Argentine, Uruguay and Brazil, and in Europe have branches to the Near East, the Balkan States, Spain and North Africa. It is proposed to connect the Pacific Coast to Buenos Aires by direct telegraph line.

The Chilian Government concluded a contract in October, 1921, with the Siemens-Schuckert Co. for the erection of eleven radio telegraph stations at Santiago, Valparaiso and Punta Arenas (all capable of communicating with Buenos Aires) and at Iquique, Antofagasta, Taltal, Tocopilla, Caldera, Concepción Valdivia and Chiloé, with a maximum radius of 1 550 miles. The contract price is $1 385 000, and the Telefunken system will be installed.

The Future of Industrial Research.

By F. PEAKE SEXTON.

The question of industrial research has been much to the fore since the war demonstrated what could be done within a short period by well organised work. It may be truly said that the valour and courage of the troops would have been wasted but for the continued success of our hastily organised research.

Many of the largest and most progressive firms in the country began to create research departments directly after the termination of the Armistice, doubtless thinking that what had so profited the country could in an equal manner profit commerce. Funds were plentiful, the excess profits tax was still in force and private enterprise stood to gain much for the smallest expenditure, but unfortunately the conditions soon changed with the development of labour troubles and financial uncertainty. Then arose the real test of the progressiveness of our manufacturers, and sad to relate many were induced to abandon their pioneer work.

Not a Simple Question.

The question of research laboratories is not so simple as might be inferred or, naturally, all firms would have adopted or dispensed with them. It is not fair to say, as some scientists do, that because some firms have not adopted research laboratories they are backward, out of date, or unprogressive, for the mere success of a business implies considerable ability from the management, even though, naturally, errors may be made. Hence we should carefully search for the reason in many, in the very many, cases of the absence or understaffing of the technical departments. The commercial management looks with invariable disfavour on any department that is not either directly engaged in production or the sale of the trading commodity. Office systems were at one time regarded as wasteful luxuries only to be indulged in by the most successful, yet now success beyond the "one-man business level" is impossible without the highest organisation. In the same way the question of industrial research is passing through this stage until it will ultimately reach the level of a business necessity.

The Financial Aspect.

Nevertheless, the engineer or scientist, who is pressing for the universal adoption of works laboratories, must remember that he is proposing a heavy expenditure on laboratory, apparatus and personnel that can only with profit be borne by the larger firms. Although the result would help even the smallest manufacturer, in his case, in all probability, the gain would not pay for the expenditure. Commerce being entirely financed for the production of profit does not wish to take risks, thus accounting in the past for the gross neglect of technical research.

The present trend of progress is indicated by the development of trade combinations, acting jointly in the provision of a research laboratory and its endowment with maintenance funds. The results of the work done there are open only to the supporting firms, which also should have the right of having tests made on their behalf either free or at a nominal charge. These tests should cover the testing of raw material, the finished product or of proposed new methods.

The Importance of Trained Personnel.

The personnel of the laboratory is the most important item, for here are not required men of great inventive genius, but rather men of great practical care and thoroughness in the testing of details. The work is hard and exacting and not likely to yield that glory sometimes obtained by research on the purely scientific side. On the other hand, there is the great satisfaction of knowing that the work is being immediately applied either in the saving of raw materials by the perfection of a process, or in the production of new materials.

A Lesson from Germany.

We can even now learn something from Germany, which in pre-war times was heavily involved in industrial research. As an example a glass works may be cited where independent of theoretical considerations the effect of varying proportions of minerals in glass was tabulated and correlated by a staff of observers and experimenters. Here were found a number of small furnaces and testing plants so that each experimenter worked on his special section, the joint results being interpreted by another department

The staff need not have the inventive genius beforementioned, be they assistants or chief, and while in the former case thoroughness and skill are required, in the latter to these must be added great clearness of vision and organising ability. Although technical ability is not mentioned, it can be taken for granted that a good technical training is absolutely necessary for success in work of this nature.

If a laboratory be founded on these lines, and well equipped with personnel and apparatus, success and great profit are assured, provided that there is whole-hearted co-operation between all concerned.

The staff should work together with the directors as one man with the one idea of furthering the industry. Too often valuable progress is retarded by internal friction, sometimes inter-staff, sometimes between the staff and directors. The fault is often on both sides and is due to lack of firmness in the control and a certain natural reluctance to take a firm course. There should be mutual consideration on all points and where possible joint discussion and consideration of grievances, but if friction develops, then it is the duty of the director to clear his staff of it, or if he fails the management should not hesitate to act. Drastic action is distasteful to all but in circumstances it is necessary, as otherwise the whole efficiency is likely to be lost. There are many cases of whole institutions being ruined from lack of control.

America *v.* Europe.

By A. P. M. FLEMING.

It is notorious that the greater the odds against which men have to struggle the greater will be their efforts to overcome them. Much of the fear the Allies have of future German trade competition arises from the strength Germany will gain in fighting to regain her place. A somewhat similar thought was evidently in the mind of Mr. D. T. Farnham, an American efficiency engineer, who visited Europe in 1920 with the object of obtaining a first-hand impression of the strides which industry made during the war under the tremendous stimulus of war-time conditions, the result of which has recently been published for the benefit of his countrymen.*

Raw Materials and Industry.

The importance of surveys of this character can scarcely be exaggerated. In the initial stages of growth the location of industries in any particular country was determined not merely by the genius of its people, but by the presence and appropriate distribution of raw materials. To-day the position is profoundly modified. Due to striking improvements in means of transport and communication, the success of an industry is dependent to a much lesser extent upon the necessary raw materials being found in any particular location. As potential wealth, of course, raw materials are of vast importance, but their distribution is immaterial. On the other hand, it is now recognised that labour is comparatively immobile. Success in industry is therefore becoming increasingly dependent upon the other great factor concerned, the organising and administrative ability of leaders of industry. In an era of world competition the standard of living of people at large, the industrial supremacy—ultimately the political supremacy—of an industrial nation depends upon its economy of manufacture. To a much greater extent than is commonly supposed the future of industrial countries lies in the hands of its industrial leaders. Comparisons between the principal manufacturing countries, Great Britain, U.S.A., Germany, France, Switzerland, Italy, Japan, Belgium, assume therefore a considerable importance, particularly with regard to their methods of organisation and industrial control.

Understanding One Another.

Herein lies the value of Mr. Farnham's attempt, the British precursor of which was Dr. Arthur Shadwell's well-known "Industrial Efficiency." Apart from its direct contribution to management, Mr. Farnham's book should have considerable value in enabling business men on both sides of the Atlantic to understand one another. In Europe only too frequently are American business methods condemned because of the

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* "America *versus* Europe in Industry," by D. T. Farnham, New York, Ronald Press, 1921, xvii+492 pp. $4.

prevailing American tendency towards advertisement. Even when this is allowed for fully there still remains an enormous amount which Europeans can learn from American energy and enterprise. On the other hand, American business men may be surprised to find how advanced are industrial concerns in Europe. Their ignorance very largely arises from lack of advertisement on this side of the Atlantic, because industry is taken as a normal and everyday affair about which we should no more think of talking than about eating, breathing or sleeping.

Need for More Examination.

It is inevitable that a book covering such a wide field should be to some extent discursive, and American publishers have not been compelled by circumstances to discipline authors with regard to space. Nevertheless, there is matter of considerable interest relating to the personal methods of business leaders in various countries, methods of organisation, labour, factory buildings and management. On the whole, the conclusions drawn with regard to the industrial position in Europe are correct, and we may predict that those responsible for industrial enterprises will in future be more and more compelled to examine what is being done in other countries, for each country will ultimately produce only that which it is most economically fitted to undertake.

The Psychological Effects of the Whitley Councils.

By A MEMBER.

The Whitley system has now been operating in the electricity supply industry for somewhat over two years. Its inauguration and the first year of its life coincided with a very disturbed state so far as labour was concerned. The Industrial Councils had therefore plenty of work to do and it is generally acceded that they did their work well. Now, largely—and indeed mainly—to their good offices, the industry is entering smooth waters. The croaker's opportunity has therefore come, we hear overt or more often veiled criticism, sometimes even a suspicion of back-door intrigue. "What is the good of the Councils?" is the question we hear asked by these ingenious critics.

Now, to answer this question, accepting it as a *bona fide* one, is the object of this article.

The Growth of Mental Intimacy.

The tangible results in the way of codification of wages adjustment to cost of living and so on speak for themselves, so does the "industrial peace" of the years under review. But what is not so obvious, but is equally real and indeed potent for good, is the psychological result. By this we mean the subtle but fundamental change in the whole mental attitude of both sides towards each other. There has been engendered a kind of mental intimacy, so to speak, which makes for mutual understanding. This is a fundamental condition without which there is no chance of "living together." And labour and capital have most certainly got to "live together," and to achieve the fine art of doing so, like man and wife. In each case—the industrial no less than the matrimonial—this can never be achieved by any meticulous settlement of rights and duties and so on. Sir William Mackenzie, in his recent decision in the Industrial Court on the engineering dispute, came to this conclusion, and pointed out that no amount of rigid definition could take the place of good sense and good will, or in other words, of a mutual and amicable understanding. But it is just the latter that the Industrial Councils in the electricity supply industry have, to a very great measure, achieved. The scheduling of wages and conditions of working and so forth are excellent so far as they go, but their real value is only to be assessed in conjunction with the potent concomitant of good will and understanding which is being gradually but surely built up. After all, a paper agreement is a bruised reed to rely on if the attitude of each party is one of suspended hostility, or even of mutual suspicion. (Seldom has a more salient example been forthcoming of this than in the present engineering dispute.) Schedules of wages and so forth could have been formulated by *ad hoc* joint committees, but what would they have been worth without the continuous influence of the Councils, which is the sole vital and integrating force which prevents all these schedules being treated, sooner or later, as dishonoured "scraps of paper."

The Critics' Fundamental Error.

But the fundamental error of the critics of the Whitley Councils lies in the assumption that a permanent "settlement" can be arrived at between Capital and Labour, and after that each can go its own way. But this state of industrial affairs is long since past—anyhow, in such a highly organised industry as that of electricity supply. In modern industry, as in modern matrimony, workman's rights like woman's rights have come to stay. We have a new state of affairs, where the problem is to take the new conditions as we find them, and evolve a *modus vivendi*, or in other words, some satisfactory mode of *continuous relationship*. This is a psychological, not a legal problem, and it is the virtue of the Whitley system that it is constituted so as to achieve this—the only industrial machinery, in fact, which has ever been capable of doing anything at all in the way of maintaining a continuous relationship between both sides.

What the Councils Have Done.

How the Whitley councils have accomplished this is obvious. It is a natural result of their procedure. You cannot meet a man face to face every month or so and discuss with him at length intimate problems which affect his life and well-being (and your well-being too) without either becoming determined enemies and breaking off negotiations or else becoming something very like friends. Further, when the watchword is (as in the Whitley councils) "we meet as friends," then each party instinctively curbs any unfriendly proclivities, and it only requires time for the ideal tone to become the real tone. The old spectres vanish from the dispute, or are laughed away. You cannot visualise the opposite side (if you are an employer) in a lump, as Bolshevists or so on, or (if you are an employee) as grinders of the face of the poor. You cannot theatricalise the situation when you are sitting calmly and quietly facing each other time after time across the Ministry of Labour's tables. You have to let go the hereditary and clap-trap feuds between abstract capital and labour.

As Human Beings.

You have got to deal with each other as human beings as reasonable as your individual interests at the moment will allow you to be. And so you come, willy nilly, to more and more of a mutual understanding. Such, indeed, is the inevitable result of the Whitley system when comprehensively applied to an industry as it is in the electricity supply industry, a result none the less valuable since it is wholly psychological. And it is just this important aspect of Whitleyism that we would specially commend to the consideration of the critics when they talk as though the industry would go on just as well if the Whitley Councils were snuffed out.

Electrification of Swiss Railways.

In his report for 1921 on the economical and commercial conditions in Switzerland Mr. J. Picton Bagge, H.M. Commercial Secretary at Berne, states that the electrification of the Gotthard line is making satisfactory progress. Work on the line Lucerne—Zug—Zürich is proceeding, and is expected to be completed by the end of 1922. It is anticipated that electric traction will be started on the Sion—Lausanne section in the course of 1923. The electrification of the Berne—Neuchâtel line as well as of the Emmenthal group of lines has been postponed owing to the fall in the price of coal.

This latter, together with the high capital outlay involved by the present cost of labour and materials on the construction of the great dams and other necessary works, has made the extension of electrification schemes a matter of grave consideration. It is doubtful however, Mr. Bagge states, whether Switzerland, in view of the anxiety and loss suffered during the war through difficulties in the coal supply, can afford to renounce schemes which insure her against any possible recurrence of such troubles.

With regard to the electrification of private railways, the Rhetian Railway has already 200 km. of line run by electric power, and the electrification of the Reichenau—Ilanz—Disentis line is expected to be completed this summer.

Water Power.

The total water power available in Switzerland is estimated at 4 000 000 H.P. New principals and regulations for the exportation of electric power were established by the Federal Council in its sitting of June 3.

The Royal Society Conversazione.

To the electrician the most interesting novelty among the exhibits at the first ROYAL SOCIETY CONVERSAZIONE, on May 17, was the demonstration, by MR. W. M. MORDEY, of some very curious effects of alternating magnetism. Mr. Mordey had arranged 12 poles of finely-laminated electro-magnets, wound for monophase or diphase circuits, in a row, the laminations being parallel to the common longitudinal axis of the poles. On the poles he placed small and large trays, made of glass and cardboard, containing coarsely or finely-powered magnetic materials, pure or mixed with sand, etc. In ordinary experiments laminated alternating-current magnets are supposed to behave like direct-current magnets, and they do not appear to offer any special advantages for the magnetic ore concentration. Mr. Mordey's striking demonstration will alter that view, and the phenomena, which Mr. Mordey associates with hysteresis susceptibility, should be seen fully to be appreciated. When filings of iron, nickel or cobalt, were placed, say, on the left side of the tray, which covered several poles, the particles merely arranged themselves axially with the monophase currents. When the second phase was turned on, the mass became greatly disturbed and the particles were impelled in three directions, upward, longitudinally to the right and crossways. "Planes of force" formed on the left side, the particles standing up in parallel fins more than a centimetre in height; the material was drawn in on the left and expelled to the right, new fins finally forming on the right wall of the tray. The particles travelled rapidly, at the rate of several inches per second, and the upward movement was so lively that glass covers had to be put over the trays. When the tray was moved crossways, the planes of force swayed to and fro with the motion; when the field was weakened or the tray lifted higher, the planes would collapse while the movements continued. One thinks of eddy currents as the cause; but powdered aluminium gave no effects at all, and when a copper disc, capable of spinning about a vertical axis, was approached to one of the poles, the rotation in the half of the disc over the pole was to the left, *i.e.*, opposite to the migration of the iron filings.

Equatorial Grouping in Monophase Fields.

Magnetite and iron sands from New Zealand and powdered stalloy behaved similarly to iron filings, but the effects were less marked. Specular haematite seemed to vary. This iron-grey variety of haematite (iron oxide) is paramagnetic, though very feebly. In a one-phase field of two poles only, the haematite placed itself equatorially, like a diamagnetic material. But when the tray was put over three poles (of the row of electro-magnets), and the central pole was not excited, the particles arranged themselves in two intersecting rings about the poles, while the square outlines of the poles were indicated by tufts of the powdered material; and it was shown that the equatorial grouping was a special case of monophase fields with small pole gaps. When the magnetic materials (comprising earthy red haematite) were mixed with sand, the magnetic materials were driven out of the sand, in the same three directions, especially when the sand was stirred, the ore collecting on one side. A mixture of tungsten and tinstone was sifted and the tungsten concentrated in the same way. Similar movements, modified by buoyancy and surface tension, are further observed in water, and Mr. Mordey has also experimented on the treatment of ore slimes. As regards the theory, the number of laminations has at any rate no direct connection with the number of the vertical planes of force mentioned, and moderate frequencies (85 periods per second were used) seem desirable. At 150 and 350 periods haematite particles stand erect, oriented to the poles, but without motion, and Mr. Mordey assumes the hysteresis has ceased or is diminished at 150 periods.

Hughes' Historical Apparatus.

Historically we ought to have mentioned the original microphones of 1878 and Experimental Apparatus of DAVID E. HUGHES in the first instance. These were exhibited by the Science Museum at South Kensington and comprised the original model of his induction balance and of the apparatus for the transmission and reception of wave signals, which Hughes showed at the Royal Society Conversazione in 1879.

In the astronomical clock and uniform motion governor of Lord Kelvin, now in the entrance hall of the Royal Society building, the Graham dead-beat escapement wheel is reduced to a rotating arm so that the whole train of wheels need not be stopped by the pressure of a tooth moving with the pendulum. The original hand-winding mechanism (with its weight dropping 11 ft.) has been replaced by the CAMBRIDGE AND PAUL INSTRUMENT COMPANY by an electric automatic winding gear of the type adopted by Howard Grubb for equatorials.

Radio-telegraphic Records.

Mr. A. A. CAMPBELL SWINTON'S radio-telegraphic records obtained by various methods comprised string galvanometer records obtained with signals sent from the Poulsen arc station at Tralee, in 1910, and the most recent Creed perforated tape Roman type prints. The telephone transmission measuring apparatus exhibited by the WESTERN ELECTRIC COMPANY, gives direct readings of the transmission loss of telephone apparatus in miles of standard cable as well as visual readings. The high-frequency oscillator consists of a voice-oscillator (200 to 3 000 cycles) and an ultra-audio oscillator (up to 50 000 cycles in steps of 100 cycles) provided with inductance and condensers to filter out higher harmonics.

The precision bridge for platinum thermometry of the National Physical Laboratory was designed by Dr. F. E. SMITH. There are two potential and two current leads; one of these is shunted as in a Kelvin double bridge, one is in the galvanometer circuit, and two are in the variable bridge arms; the resistance of these two arms is about 100 times that of the thermometer, steps on the lowest dial corresponding to 0·001° C.

New X-Ray Apparatus

There were two new X-Ray Bulbs. The one, exhibited by Sir WILLIAM BRAGG and Prof. W. L. BRAGG, together with numerous models, mostly on a scale of 100 000 000 to 1 of crystal structures of inorganic and organic substances, is a wide glass cylinder closed at both ends by brass mountings for connection with air-pump and cold water pipes. Along the axis of the cylinder runs a brass tube enclosing the long leads of the tungsten filament, the rays from the target pass through an aluminium window outside and fall on the specimen, a crystalline powder pasted on paper. The other bulb, shown by the Radiological Branch, Woolwich Research Department, is made of iron and glass, and is self-shielding. The kathode tube fits into the stem of an iron cup; the anode, also iron, is separated from the cup by a sleeve of glass. The cup and anode are water-cooled. The rays fall through an aluminium window on the material which, as in the Bragg tube, is quite close to the window. The apparatus is designed for the testing of explosives, the dielectric constants of which are determined with the aid of another apparatus exhibited by the Explosives Branch of the same department. The specimen is placed in a condenser, and the pitch of the note given by two valves at radio frequency on the heterodyne principle is altered; by means of a variable condenser the original pitch given by a tuning-fork is restored.

New Microscope Lamps.

The many microscopes served chiefly for the display of physiological specimens. New microscope lamps were shown by the NATIONAL INSTITUTE for MEDICAL RESEARCH (quartz-mercury lamp); by Mr. J. J. FOX, a monochromatic illuminator without lenses with rapidly interchangeable parts (made by Messrs. BELLINGHAM & STANLEY); and by Messrs. OGILVY & Co., a new gasfilled lamp (mounted on a tripod base to which a small optical bench is attached), made of a very fine opal glass which obscures the metal filament and does not show any grain of the glass.

Cutting Tool Stresses

We briefly notice a few other exhibits. Prof. E. G. COKER demonstrated, on behalf of the Cutting Tool Research Committee of the Institution of Mechanical Engineers, the action of milling and cutting tools and the stresses set up in the material by means of his beautiful polarisation apparatus. Mr. CECIL C. MASON, of Cambridge, showed an autographic record indicating the loss of rotational velocity of a projectile during flight, obtained for the Ordnance Committee. The CAMBRIDGE AND PAUL INSTRUMENT COMPANY exhibited a new micro-indicator for high-speed engines, the invention of Mr. W. G. Collins, by means of which ten indicator diagrams are scratched on a celluloid disc within half a minute; the disc is placed under a microscope provided with a guticule. Enlarged photographs of these permanent records should prove very useful, especially for taking track tests and studying aeroplane flights. The simple original apparatus, which weighs about 1 lb., comprises an automatic electric switch driven by the engine. This is screwed into the top of the cylinder.

Modern Lamp Manufacturing at Dalston.

Although the general run of the methods employed is well known to readers of The Electrician, it is not realised fully how great a part engineering skill and inventive genius play in lamp manufacturing operations of the present day. That this is so was, however, obvious during the course of a recent inspection of Siemens Electric Lamp Works at Dalston.

The Siemens factory at Dalston is a modern six-floor building, which was originally erected in 1902. Compact but roomy, it is conveniently situated for delivery purposes and in an area in which labour is plentiful. As will appear from the following description, novel and intricate automatic machinery is employed for the various operations to a much greater extent than hitherto. This is maintained by the engineering staff of the firm, and in fact certain machines are of Siemens' exclusive design, among them those which are being used for spiralling and for making the pigtail loops for the filament supports.

Filament Manufacture.

Perhaps the most interesting of the processes employed in the manufacture of the lamps is that of the filament itself.

The starting material is ordinary commercial oxide of tungsten. This is first chemically purified and the purified oxide is then reduced to metal by heating in a current of hydrogen, the result being grey tungsten powder.

This powder is pressed under hydraulic pressure into a stick 7 in. long by $\frac{1}{4}$ in. square, which is baked in order to increase its strength for subsequent handling. The baked slug is then "sintered" by raising it to a blinding white heat by means of an electric current in an atmosphere of hydrogen. (This operation, for convenience, is carried out at Woolwich, and not at Dalston.) The slug at this juncture becomes a solid piece of tungsten metal, the particles having been welded together by the sintering process.

The sintered slug is now passed through the hammering or swaging machine, its diameter being reduced from $\frac{1}{4}$ in. square section down to a diameter of 32 mils. round. The length of the slug is gradually increased on each successive pass through the swaging dies from a length of 7 in. up to over 30 ft.

Drawing the Tungsten Wire.

The wire is next drawn through a succession of diamond dies on machines specially designed for the purpose. The wire is passed through a lubricating bath and heated before entering the dies, after which it is automatically wound on to small drums or bobbins. This process is repeated on a number of wire-drawing machines, each of which has a smaller die, so that the wire is eventually reduced to the diameter desired.

Photo-Micrographic Records.

Owing to the importance placed on the quality of tungsten produced, a plant for taking photo-micrographs of the tungsten, both in slug and wire form, has been installed. By this means the grain and fibrous texture of tungsten produced from various mixtures can be examined and the changes which take place after the tungsten has been under current in an electric lamp compared.

The Spiralising Processes.

The spiralising of the filament, which is the next process with which we may deal, is now done exclusively by machinery. For the heavier gauge wires a number of automatic machines of special design which can be regulated to wind any desired style of filament are being used.

The wire is wound on to a mandril in a similar manner to that employed in making an ordinary spiral spring, with the exception that in these machines the holder containing the drum of tungsten wire is carried on a traversing attachment to ensure even winding. The wire is passed through adjustable tension grips, and the traverse is automatically "tripped" at intervals, so that a number of short straight lengths of wire are left between the sections of spiralled filament. These facilitate mounting on the spider and occur where the filament passes through the supporting loops.

The process is different for the fine wires. In this case a mandril composed of soft brass wire is fed into the machine from a drum, and the filament is spiralised round this as it passes through the machine. Then the wire mandril with the spiralised filament round it, is rewound on to a separate drum. Owing to the small diameters worked on these machines it is practically impossible to remove the spirals from the mandril in the ordinary manner without damaging them, so the former is dissolved in a chemical solution, leaving the spiralised wire intact ready for mounting on the spider.

Foot and Spider Making.

The combined foot and spider is the interior glass structure which provides a sealed entry for the conducting wires, and to which the filament supports are attached. The design varies in accordance with the type of lamp manufactured, but generally it is made up of three component parts—the flanged leading-in tube, the leading-in wires, and the glass stem. After manufacture the three component parts are assembled on the foot-making machines. In this operation the leading-in wires and the stem are first fixed in their correct positions in the flanged tube. The glass components are then heated to a suitable temperature by means of gas flames, and the "pinch" is made which hermetically seals the lower end of the flanged tube, and at the same time welds the stem and the leading-in wires into the "seal."

Details of the Spider.

The spider is built up on the glass stem and provides a method of supporting the filament. The design varies for different types of lamps, but the process is similar for each and consists of two operations. A suitable number of roses or buttons are first formed on the stem by heating to a suitable temperature and pressing. The radial supports are then fixed into these, the number of supports being determined by the type of lamp.

In the past these two operations were carried out separately and by hand, but some special machines in which the two processes are combined have been installed. The assembled foot and stem is placed in a machine and the button or rose is first formed by heating the end of the stem to a suitable temperature and pressing. The machine next brings the stem into the correct position for fixing the spider arms. The wire used for these is fed into the machine from bobbins, and gas jets are concentrated on to the glass button in order to raise it to a suitable temperature to receive and hold the supporting wires. The machine automatically adjusts the lengths of the supports and forms the pigtail loops.

Filament Mounting.

The first operation in filament mounting is placing it on the pigtail hooks. This process is accomplished completely by hand. The filaments for the varying types of lamps are supplied specially spiralised to suit the design of lamp required, and the ends are securely fastened to the leading-in wires.

In the case of high wattage gasfilled lamps where the leading-in wires are required to carry a heavy current, metal tape electrodes are used instead of the round wire conductors employed in the lower wattage types. The ends of the filaments—which are necessarily of fairly heavy gauge—are secured to these metal tapes by a process of spot welding

All spirals are carefully inspected before being mounted on the "foot." This is especially necessary in the case of the very fine filaments used for the 30 and 40 W gasfilled types of lamps, where the filament diameter is approximately 1/1000th of an inch. These small spirals are examined by placing them in an optical apparatus, which projects the highly magnified image of the spiral on to a screen. Subsequently the lamps are flashed and sealed in.

"Pipless" Lamps.

In this connection it may be recalled that the modern trend in electric lamp making is in the direction of so-called pipless lamps. Certain types of gasfilled lamps are now being marketed in which the pip is concealed within the cap of the lamp, thus leaving the base of the bulb perfectly rounded. This is arranged for when the "foot" is made. A small stem tube is passed through the flanged leading-in tube, and welded on to the "foot" just above the "pinch." The filament is then mounted and the completed foot is sealed into the neck of the bulb in the ordinary way. The bulb is afterwards exhausted through the stem tube and the pip is formed at the cap end of the bulb. It is found that this method does not add materially to the cost of manufacture, while the elimination of the "pip" end from the finished lamps, considerably reduces breakages in transit.

Some Aspects of Dalston.

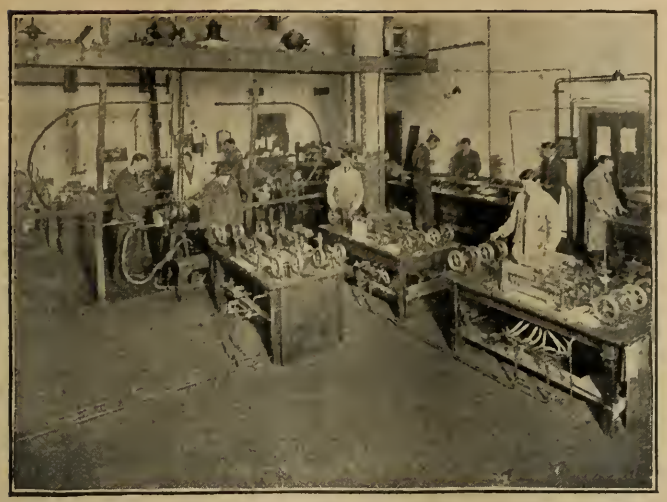


Fig. 1.—Swaging and Wire-Drawing Machines.

[Fig. 2.—A Corner of the Stemming Department.

Fig. 3.—Filament Mounting for Large Lamps.

Fig. 4.—Sealing-in Department for Standard and Gasfilled Lamps.

Fig. 5.—Fine-wire Drawing Machines.

Fig. 6.—Some of the Vacuum Pumps.

The Institution of Electrical Engineers.

There was a very crowded attendance at the INSTITUTION OF ELECTRICAL ENGINEERS on Thursday last, to hear Sir Ernest Rutherford give the Kelvin Lecture on "Electricity and Matter."

Mr. J. S. Highfield (President), before calling on Sir Ernest Rutherford, announced the result of the ballot for the election of President and Council as follows:—*President*, Mr. F. Gill; *Vice-Presidents*, Dr. W. H. Eccles and Mr. A. A. Campbell Swinton; *Hon. Treasurer*, Sir James Devonshire; *Members of Council*, Mr. J. W. Beauchamp, Mr. R. A. Chattock and Major Kenelm Edgcumbe; *Associate Members of Council*, Mr. F. W. Crawter, Mr. H. F. Harmer and Mr. W. R. Rawlings; *Associate*, Mr. D. N. Dunlop.

The Faraday Medal.

Continuing, the PRESIDENT said he had an announcement to make. At its meeting on February 16, 1922, the Council decided to institute a bronze medal, to be designated "The Faraday Medal of the Institution of Electrical Engineers," to commemorate the fiftieth anniversary of the first ordinary meeting of the Society of Telegraph Engineers, now the Institution of Electrical Engineers. The medal might be awarded by the Council not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous services rendered to the advancement of electrical science, without restriction as regards nationality, country of residence or membership of the Institution. With the medal would be presented a parchment certificate of award. A bronze medal was chosen rather than a gold medal, first because a gold medal was a rather difficult piece of property to take care of, and a bronze medal could be an equally beautiful work of art, and it was also desired that there should be no suggestion of any intrinsic value in the medal itself, but rather that it should owe its value first to the fact that it was to commemorate an important event in the history of the Institution; secondly, that it was offered for world-wide services without any restrictions; and, lastly, that it was hoped, as time proceeded, its importance would be advanced by the illustrious names of its holders. A design prepared by Mr. Metcalfe had been adopted for the medal. It was intended to announce the institution of the Faraday Medal during the Commemoration Meetings, but circumstances arose which prevented this being done, and he felt considerable personal pleasure in the delay. He was still more pleased to be able to announce that the Council had made the first award to Oliver Heaviside.

He need say no more about the life work of Oliver Heaviside than was contained in the resolution passed at the Commemoration Meetings, which he read. Heaviside was one of our famous men who in his work displayed the wide and fearless view of the real pioneer. He was sure that all present hoped that in the evening of his life he might feel that those who followed him revered his name.

The Heaviside Layer.

SIR OLIVER LODGE, who was greeted with prolonged applause, said it was an unexpected privilege to be called upon to support the action of the Council. He congratulated the Institution on the use it had made of its first Faraday Medal. A man like Oliver Heaviside, who wrote very abstrusely, and who a good many years ago retired into private life and into the heart of the country, might very well have been forgotten and overlooked. They had sent him an eloquent message, and they had made him the recipient of the first Faraday Medal. Oliver Heaviside might pretend that he did not care much about medals; he was given to express himself in peculiar ways about things of that sort, but he could not but appreciate the feeling which lay behind the award, and the words of the message which had been sent him must, if he were human, give him joy. He understood that the President had been down to see Mr. Heaviside in the country, and that it was his intention to go again and take the medal, which they could not expect Mr. Heaviside to come to London to receive, so that whether Mr. Heaviside liked the medal or not, he would at any rate like the visit of the President.

SIR ERNEST RUTHERFORD then delivered the Kelvin Lecture on "Electricity and Matter," which we shall deal with in a subsequent issue.

Correspondence.

IMPERIAL WATER POWER PROGRESS.

To the Editor of THE ELECTRICIAN.

SIR,—We note in the April 21st issue of THE ELECTRICIAN an article under the heading of "Imperial Water Power Progress," referring to the operations of the Hydro-Electric Power Commission of Ontario, in which you have made certain reference to recently published and widely distributed criticisms of the Commission's activities, by Mr. W. S. Murray, a New York engineer, employed by the National Electric Light Association, an organisation under the absolute control of the private power interests of the United States.

In your comments regarding the Murray Report, we note that you have taken for granted that Mr. Murray's statements are all true and that his conclusions are correct. Located, as you are, a long distance from the Province of Ontario, would it not be well, before condemning the largest and most successful co-operative municipal ownership undertaking in the world, to obtain the actual facts of the case, so that your readers may not be misled in their judgment of this great scheme, in which you, as publishers of a technical journal widely read throughout the British Colonies, should be vitally interested, as we believe it is your aim to publish facts and not fiction in your journal.

Regarding the Murray Report, I might say that this Report was prepared to the specifications of the National Electric Light Association, by Mr. Murray, criticising the Commission's activities, in an attempt to stem the tide of public opinion, which is rapidly crystallising in the United States and other parts of this continent in favour of Municipal Ownership of Public Utilities, similar to the plan that has been in such successful operation in the Province of Ontario for the past eleven years. Mr. Murray's Report is full of mis-statements and comparisons of figures not comparable.

We are, at the present time, preparing a reply to the Murray Report, a copy of which we will forward you for your information, in order that you may be in a position to correctly inform your readers regarding publication.—We are, etc.,

F. A. GABY,
Chief Engineer.
Hydro-Electric Power Commission of Ontario.

Toronto,
May 8th.

DOES THE INSTITUTION NEED A WIDER OUTLOOK?

To the Editor of THE ELECTRICIAN.

SIR,—On several occasions after some years residence abroad I have, on coming home, been struck by the insular parish pump point of view that characterises meetings of the Institution of Electrical Engineers. Naturally having its origin in Great Britain the happenings here must loom large at the meetings and in the proceedings, but the Institution has now widened its activities to all parts of the British Commonwealth and moreover is concerned with a branch of engineering that has a world-wide appeal. I think therefore, that matters that happen outside the British Isles should receive more attention than they do and also that speakers in the discussions might endeavour to see things in a broader way.

Readers may have noticed that the Institution of Civil Engineers is as much interested in engineering abroad as in what happens at home and the proceedings of the I.C.E. contain many papers descriptive of engineering work in all parts of the world. Partly as a result, the membership is very wide-spread.

Engineers as a class travel a great deal, and large manufacturing concerns are as much interested in orders from overseas as they are in local orders so the Institution membership must contain many members who think as I do.

I suggest that a suitable leaven of engineers (now resident in this country), who have lived in some particular country overseas long enough to know intimately actual conditions, should be introduced into the Council in order to ensure that the proceedings of the Institution shall in future have that wider outlook which several observers as well as myself, feel that it needs.—I am, etc.,

E. KILBURN SCOTT.

London, N.
May 16, 1922.

Centrifugal Clutches and Small Motors.

A simple and inexpensive device to enable small power motors from ¼ H.P. to 1 H.P. to start up freely has long been needed. Engineers have made many attempts to overcome this starting torque difficulty by improving the design of the motor or by special switchgear, but neither of these improvements has given real satisfaction. It is, therefore, interesting to note that THOMAS BROADBENT AND SONS, of Huddersfield, have recently been investigating this matter

FIG. 1.—THE PARTS OF THE CLUTCH.

and after considerable experiments have designed a small and compact centrifugal clutch, which appears to have solved this complicated problem. This small clutch embodies all the features of the firm's well-known larger power clutches.

The purpose of a centrifugal clutch is to enable the motor to accelerate up to 75 per cent. of full speed *without load*, the load being then gradually and automatically applied until at full speed the

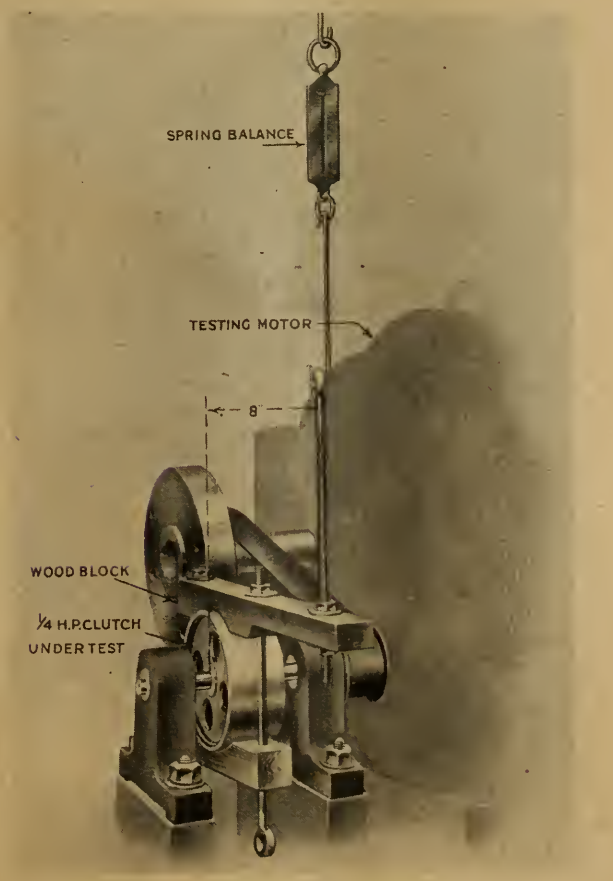


FIG. 2.—THE CLUTCH UNDER TEST.

drive becomes positive. The clutch forms part of the driving pulley or coupling as the case may be and can be adapted to almost any type of drive.

Details of the Clutch.

Briefly described, this small power clutch consists of a centre-piece or spider which is keyed to the motor spindle and carries with it two loose friction shoes with "Ferodo" facings, carried in suitable pockets and clear of the driving pulley rim. These shoes are spring controlled, the tension of the spring being adjusted to retard any movement of the shoe until the motor has attained 75 per cent. full speed.

Immediately this speed is reached the shoes are automatically thrown radially outwards by centrifugal force and engage with the interior face of the belt pulley, thus gradually accelerating the driven machine to full speed. The weights of the shoes are so regulated that when the motor is running at full speed the friction developed exceeds the power of the motor, and, by this means the motor is enabled to start up and accelerate absolutely without load. If desired, the clutch can be arranged to slip at any desired overload, thus acting as a safety overload device.

Test Results.

Broadbents have just supplied a number of these clutches to the General Post Office for use with ¼ H.P. stamping machine motors. The sizes ranged from 4 in. diameter to 5¾ in. diameter at speeds varying from 1 400 revs. per min. to 1 700 revs. per min., and arranged for both flat and round belt drives. Before despatch these clutches were put through the usual tests and some very interesting data was obtained which showed that in every case the motor attained a speed of well over 1 000 revs. per min. before any load came on. The clutch then began gradually to pick up until at full speed the torque transmitted well exceeded the power of the motor.

Fig. 1 illustrates all the interior parts of the clutch, consisting of a hollow driving pulley, a central disc or spider fastened to the motor spindle containing two loose friction shoes and an end cover plate and spring for fastening the plate. It will be seen that the clutch is of such simple design that it cannot possibly get out of order; there are no metallic wearing parts and the action is entirely automatic. The clutch cannot fail to positively pick up the load after the motor has attained pre-determined speed.

Fig. 2 shows the arrangements that were made to carry out the tests. This type of clutch will probably become standard practice for use with small power motors, and engineers will therefore be well advised to give it their serious consideration.

A New Network Box.

CALLENDER'S CABLE AND CONSTRUCTION COMPANY have lately put on the market a new design of network box, the two chief improvements on existing types being (*a*) the mounting of the fittings on metallic frames or grids; (*b*) the provision of renewable and adjustable spring contacts for fuses or links. In addition the new boxes embody an improved design of definite grip fuse or link extractor.

The insulators on which the fittings are mounted are carried on a grid consisting of steel rods which are supported at each side by metallic frames. This grid, with its fittings, drops inside the outer containing cast iron box and rests on feet provided on the frame. The insulators are moulded with grooves at each side so that they are readily slipped into position along the steel rods. This form of construction gives the necessary rigidity and mechanical strength, provides a clear space on the underside of the grid for the cables to be jointed in the box, permits ready assembling and jointing, and also enables the interior gear of the box to be packed for transit separately from the outer containing cast iron box, thus reducing breakages. With the new arrangements of gear no joints other than sweated joints are below the compound level, which is a great advantage and one which will be appreciated by those who have charge of the maintenance of network boxes.

The Callender-Watson Spring Clip.

A special type of spring clip—the Callender-Watson—has been evolved after months of experimenting, which, it is claimed, has none of the disadvantages of the usual type spring clips, which are invariably either too flimsy and result in undue heating, or are so constructed that it is impossible to renew them without considerable trouble and expense. These spring clips form part of a loose contact head which is connected to the cable or busbar stalks by a grip contact which introduces a minimum electrical resistance. The stalk is supported in the insulator by means of an internal nut, so that when the contact head is removed for any purpose there is no possibility of the stalk dropping down and making contact with the bottom of the box.

Manipulation of Fuses.

The question of the manipulation of the fuses or links has received considerable attention. It was considered undesirable to provide each fuse with its own handle, as this increases the cost. On the other hand, the form of loose porcelain handle supplied with the old Callender-Ward pattern boxes had the disadvantage that when used by inexperienced operators the fuse or link was apt to slip out of the handle. In the new fuse extractor supplied with the C.S.W. type of box, however, a definite grip on the fuse holders or dollheads is obtained. This extractor is made in Kalanite, and consists of a two-part handle, one half being made to slide over the other. In cases where customers prefer enclosed fuses, these can be supplied.

Langmuir Condensation Pump.

The Langmuir condensation pump is now being manufactured in Rugby by the British Thomson-Houston Co., who are the owners of the English patent rights.

The Langmuir pump has been designed to produce very high vacua—much higher than can be obtained by other means—and is therefore of value in connection with the manufacture of electric lamps and for many forms of research work. By its aid pressures lower than 10·5 bars have been produced and measured and a speed of 3 000 to 4 000 c.c. per second is obtained under normal working conditions.

The action of this pump is briefly as follows: The mercury in the base of the pump is heated by a gas burner and the mercury vapour which is given off impinges on the baffle-plate at the top of the heating chamber. This baffle-plate deflects the mercury vapour downwards and outwards into the water-cooled condensation chamber, where it mixes with the gas to be removed. This gas is thus carried downwards by the mercury vapour until the vapour condenses, when the condensed mercury flows down the walls of the chamber and returns to the base of the heating chamber while the gas is carried to the atmosphere by means of an auxiliary pump.

Fig. 1.—Langmuir Condensation Pump.

Amount of Mercury Required.

The proper amount of mercury required for each pump is 626 gms., and should consist of mercury which has been thoroughly cleaned and preferably distilled.

The gas burner is fixed in position beneath the heating chamber, the connection to the gas supply being made by means of ordinary rubber tubing. The amount of air supplied to the bunsen burner should be regulated to obtain a non-luminous flame, and the mercury kept boiling steadily, but not too vigorously, so that condensation may be as complete as possible in the water-cooled chamber. It should always be ascertained that the water is flowing through the condenser at the proper rate before heating is started.

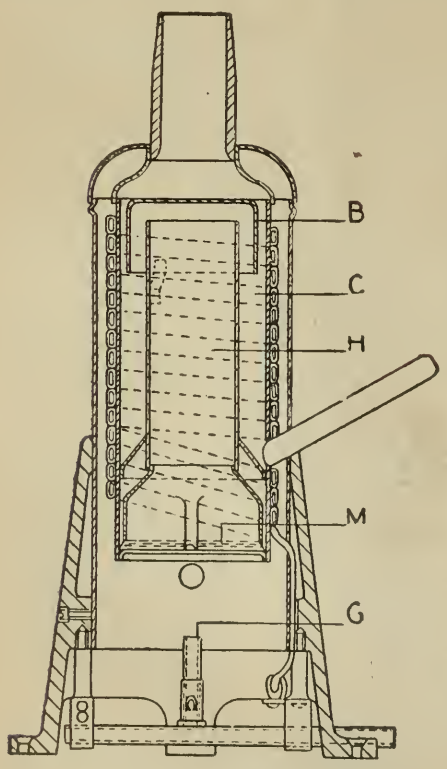


Fig. 2.—Diagram showing Construction of Langmuir Condensation Pump.

Both water connections extend from the bottom of the pump, and can be used for either inlet or outlet. Ordinary rubber tubing is suitable for connecting to the water supply, the tubing being firmly bound to the pump connections and source of supply. The rate of flow of the water should be about 1 000 c.c. per minute.

Methods of Connecting.

The method of connecting the condensation pump to the vessel to be exhausted depends on individual requirements. A ground-glass connection to fit the top vacuum port or a metal connection ground to fit the port may be used—the joint being carefully greased, but care must be taken to prevent any grease from getting to the pump. Another method is to fit, a copper cup over the top vacuum port and by means of sealing wax to make a vacuum-tight seal. A suitably shaped glass connection may thus be fitted over the vacuum port and sealing wax melted in the metal cup until it melts and flows round the end of the glass connection: when the wax cools an efficient joint is made, which can easily be broken if required by reheating the wax in the cup.

In some cases the presence of mercury vapour in the vessel being exhausted may be detrimental, and this may be avoided by putting a trap (cooled by solid carbon di-oxide or liquid air) between the pump and the vessel.

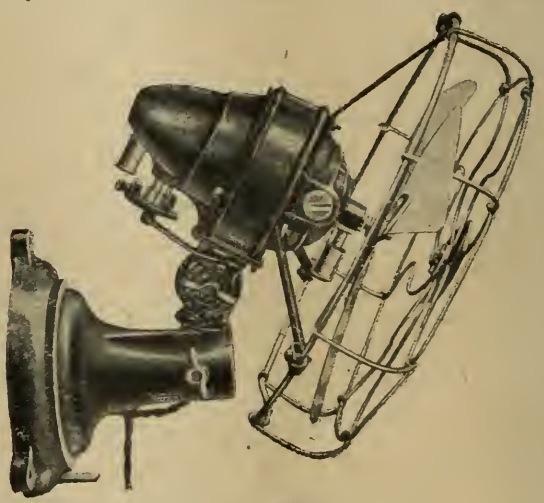
The auxiliary pump is connected to the small vacuum port in the side of the condensation pump by means of stout-walled rubber tubing, and should be capable of producing a vacuum of 0·1 mm. of mercury. If an oil-sealed pump is used as auxiliary, a pinch cock should be fixed between the two pumps to prevent oil entering the condensation pump when shutting down the system.

Method of Cleaning.

The presence of a very little oil or dirt in the inner chamber will make the pump ineffective. To clean, the mercury is first removed by turning the pump upside down, having the large vacuum port closed with the hand, and then returning the pump to an upright position and pouring the mercury out of the smaller port at the side of the pump. This is repeated until all mercury has been removed. Petrol is then poured through the large vacuum port, and the pump shaken vigorously thoroughly to wash the interior. In the same manner the petrol is removed and the washing repeated with benzol. The vapour of petrol or benzol left in the pump is exhausted by means of the auxiliary pump before replacing the correct weight of clean mercury.

G.E.C. "Freezor" Fans.

The General Electric Company announce that they are launching this season a great "Freezor" fan campaign. Full particulars of the campaign, which is designed to assist the trade, will, they state, be announced in due course. Meanwhile we have received an advance copy of a booklet V.2754 which gives full descriptions of the numerous types of "Freezor" fan, together with revised prices which, we notice, represent very substantial reductions. This is just the weather for fans.



The Latest "Freezor" Fan.

New Range of Oscillating Fans.

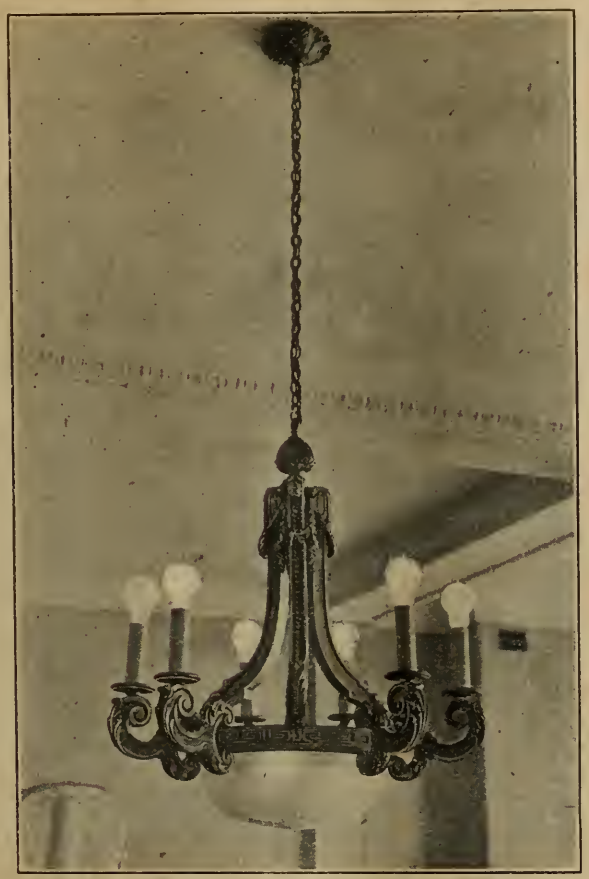
This booklet contains amongst other things details of a complete new range of oscillating fans. These fans represent an entirely new departure in oscillating fan construction, and are claimed to be the only fans of their kind manufactured in England. They are fitted with a very simple and efficient oscillating mechanism. The arc of travel can be adjusted between the limits of 110° and zero and a slipping clutch is provided which allows the blades to continue to revolve even when the oscillating mechanism is prevented from operating by some external obstruction. These fans, one of which is illustrated, are made for d.c. and a.c. circuits in two sizes with blades 12 in. and 16 in. in diameter, and can be easily converted from table pattern to bracket pattern by loosening a thumb screw. The blades are stout sheet brass punchings and are carefully dished to give a definite curvature which has been found by experiment to give a maximum air delivery with a minimum of air friction losses.

The vanes are rivetted to a stout spider which guarantees a rigid structure capable of standing up to air resistance without warping or creaking and the complete rotating portion—armature and blades—is carefully balanced and tested at the works before being finally passed.

H.M. Consul at Colon, Republic of Panama (Mr. C. Graham), reports that a general importer and manufacturers' representative is desirous of forming connections with United Kingdom firms for electric motors and electrical supplies, and steam, water, wind and air motors. Further particulars may be obtained from the Department of Overseas Trade.

The "Ediswan" Fullolite Lamp.

The Royal "Ediswan" Fullolite lamp is already well known to our readers for its many advantages in the elimination of glare and its perfect diffusion of light. A happy adaptation of the lamps is shown in the illustration. The fitting shown is installed at the Oxford Street showrooms of the Rapson Tyre and Jack Co., Ltd.



"Ediswan" Fullolite Lamps.

The fittings, which have been supplied by Maple and Co., are of a massive type and are finished in gilt to harmonise with the general scheme of the showroom decoration, which is in gold and black. The candle flames are 40 W Fullolite lamps, and a practically shadowless distribution of light is given over the entire showroom.

We believe that this is the first instance in which these lamps have been adopted for this combined decorative and illuminating purpose, and the effect gained has certainly justified the experiment.

Advantage of Interlinking.

A good illustration of the advantage of the interconnection of electricity supply systems was recently given at Ontario, where, owing to accidents at two generating stations, the Hydro-Electric Power Commission was suddenly deprived of about 160 000 h.p. Within 15 minutes of the occurrence the Canadian Niagara Falls Power Co. and the Toronto Power Co. were feeding the system of the Commission, and part of the deficiency is also being supplied by the American plant of the Niagara Falls Power Co., so that the whole of the municipal power and lighting service in Ontario has been maintained without interruption.

According to the "Electrical World," the accident occurred at the Niagara Falls station of the Ontario Power Co. at about 3 a.m. on April 30, and is said to have been due to a short circuit on one of the Commission's transmission lines. Two 20 000 h.p. generator sets were destroyed, and as part of one of the generators was hurled through the roof the covering of the new wing fell and smashed the casings of two other turbines. Water then flooded the whole bay and rushed into the main power house, four 16 000 h.p. units being flooded. A few days prior to the accident damage was caused to a 55 000 h.p. generator set at the Chippawa-Queenston station, so that within a week the Commission lost the use of units aggregating 159 000 h.p. Some of the plant has been repaired, and by means of interlinking with neighbouring systems a full service has been maintained and no inconvenience has been caused to consumers.

The prospect of a settlement of the engineering dispute has improved during the week, as the 47 "other" unions involved have now agreed to take a ballot of their members on the proposals submitted by the employers on Saturday last. No definite recommendations will be made, but members will be asked to give the proposals serious consideration. The ballot papers will be returnable by June 2.

New Type of Lightning Arrester.

The Westinghouse Electric and Manufacturing Company has developed a new type of d.c. electrolytic lightning arrester, known as "Type AR," for car or station use on railway, power and lighting circuits.

The new type is for voltages up to 3 800, and contains one to twelve cells. Each cell consists of two aluminium plates immersed in a suitable inorganic electrolyte and supported from a porcelain cover clamped by a zinc ring to a glass jar with a gasket placed between the porcelain cover and the glass jar. Hollow concentric cylinders made from sheet aluminum form the plates, the outer cylinder or plate being punched and upset at frequent intervals in order to allow free circulation of the electrolyte within the cell. Balancing resistors are used with arresters of more than one cell. These resistors cause each cell to take its proper portion of the line voltage and thereby tend to keep the aluminum hydroxide films equally formed.

Position of the Arresters.

The arresters are "floated" between line and ground so that a leakage current of only a few millamperes passes continually. This leakage current serves to keep the film upon the aluminum plate or plates in proper order.

The product is capable of passing a surge current of approximately 1,000 A at double normal voltage when the arrester is functioning, and one arrester should be used for each 500 kW of feeder bus, rotary converter or motor generator capacity to which the arrester is connected. Any voltage in excess of normal line voltage is discharged promptly through the arrester.

Function of the Arrester.

The functioning of the "AR" type of arrester is similar to the functioning of a steam safety valve or a hydraulic release valve. When the impressed pressure, or voltage, exceeds the normal, the valve opens and the excess pressure, or voltage, is relieved; then the valve closes and is again ready for operation. A fuse is placed in series with the arrester cells to prevent destruction of the arrester in the event of a short or heavy discharge for an appreciable length of time occurring. Evaporation of the electrolyte in the cells is prevented by a layer of oil on the surface of the electrolyte.

The arresters are mounted and securely held in asbestos board and wool-fibre lined cypress boxes. The boxes with a flat top are intended for mounting beneath the car and with a slanting top for station, car interior, car roof or outdoor mounting on any vertical flat surface. Although all arresters are inherently outdoor arresters, they can be used satisfactorily indoors.

Electric Bread-baking Ovens.

Interesting particulars of an experiment made by Fisher Bros., of Cleveland (U.S.A.), in the baking of bread in gas and electric ovens are given in the "Electrical World." Two 1 000 loaf conveyor type ovens were used for a year. Formerly natural gas of approximately 1 000 B.Th.U. per cubic foot was used, costing 30 cents per cub. ft. or $66 a day. The electricity bill, at 2·38 cents per unit, came to $36, but, in addition to a greatly improved quality of bread, an unexpected saving was effected. It was found that the amount of flour required to turn out 125 000 1½ lb. loaves of bread a week was much less than had been the case with gas ovens, and ten additional 1½ lb. loaves were produced from each barrel of flour. As the firm use 57 barrels of flour a day, the additional loaves meant an increased income of $62·70 per day, or more than sufficient to pay for the increased cost of the electricity. Apart from the above advantages, with an electric oven so constructed as to retain the steam driven out of the loaves, it is unnecessary to inject live steam into the oven, thus avoiding the use of steam boilers, a matter of considerable importance in small bakeries.

Liverpool Sub-centre of the I.E.E.

The third annual report of the Liverpool Sub-Centre of the North-Western Centre of the I.E.E. states that seven general meetings have been held, with an average attendance of 99, when papers on various subjects have been read and discussed. The annual meeting was held on May 8, when Mr. B. Welbourn was elected chairman and Messrs. E. M. Hollingsworth and H. H. Harrison, vice-chairmen, for the ensuing year. Mr. O. C. Waygood was elected hon. secretary. The meeting was followed by a smoking concert.

The membership (including members, associate members, graduates students, associates) increased from 367 to 447. Members transferred to other districts numbered 38. The area of the Sub-Centre has been extended to include the whole of the County of Flint, Denbigh, Merioneth, Montgomery and Carnarvon, and also the Isle of Anglesey.

The Committee of the Students' Section record a very successful Session. Nine general meetings (average attendance 45) and one open meeting (150 present) were held.

It has been agreed between the Electrical Contractors' Association of Scotland and the Electrical Trades Union, in view of the reductions in wages which have taken place since the beginning of the year, that the present rate of pay should be stabilised until December 31 next, when it will be open to either party to review the situation.

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Junior Institution of Engineers.

A dinner to celebrate the 38th anniversary of the foundation of the JUNIOR INSTITUTION OF ENGINEERS took place on the 18th inst. at the Café Monico, London, Mr. C. H. WORDINGHAM, C.B.E., being in the chair.

The fact that this Institution is regarded as a serious and important factor in upholding the traditions of the engineering profession was demonstrated not only by the professional eminence of the President, but by the attendance of such distinguished engineers as Dr. H. S. Hele-Shaw (President of the Institution of Mechanical Engineers), Dr. W. H. Eccles, Prof. E. G. Coker, Mr. W. B. Worthington (President of the Institution of Civil Engineers) and Mr. T. J. Gueritte (President of the Society of Engineers), while the number of grey heads at the function was sufficient to disabuse one's mind of any preconceived idea that "juniority" would be a prevailing feature.

Dr. HELE-SHAW, proposing the toast of "The Institution," commended the universal feeling of brotherhood which existed amongst the members. There were members present from places as far distant as India, China, and the West Coast of Africa. Many men who had been members had reached the highest positions. As an example of the serious work done by the members he referred to a Paper on "Friction," by Mr. C. H. Plant (with a prefatory note by Mr. E. C. West, Chairman of the Institution), in the May number of the Institutions "Journal" in which the subject was treated in an original way and the subject of electrons was gone into with great gusto.

Mr. E. C. WEST (Chairman of the Institution), in responding to the toast, said the sentiment which actuated the founders of the Institution 37 years ago that the whole of the proceedings should be based on friendship and good fellowship still held the Institution together. They had now nine local sections, amongst the recent additions being one in Assam and one in Australia, and the total number of members was just over 2,000. He mentioned that the Gustave Canet gold medal which was awarded annually to a gentleman of eminence invited to read a learned Paper before the Institution was to be presented shortly to Sir Eric Geddes, who would read a Paper on "The Railway Act, 1921."

Need for a Broad Initial Training.

Mr. C. H. WORDINGHAM, in reply to the toast of "Electrical Engineering" proposed by Dr. W. H. Eccles, said electrical engineering hardly had any separate existence apart from the older branches of engineering. Electrical engineering progress depended primarily on the men engaged in it, and their success depended primarily on character and secondly on training. Training, in the first stages, should be the broadest possible, so that, whatever branch a man finally elected to take up, there would be the solid groundwork of engineering principles to fall back upon. At a meeting of the Electrical Research Association recently, Dr. Eccles had said if there were to be much progress in a particular branch of research it was important to keep an eye on other branches of science and to see whether it might not be possible to apply discoveries in different directions to the particular branch in which one was interested. That speech made a great impression upon him, and it was one they should think over. The great difficulty was that there was such a vast mass of new material constantly welling up, that an engineer should know, that it was hopeless for him to try to deal with it. Attempts had been made to provide condensed selections by means of abstracts, but there were so many different institutions compiling abstracts, so many publications, more or less of a proprietary nature, and such a terrible profusion of periodical literature that it was impossible to read even the best of the matter thoroughly. Again there was much published that need not be—it was purely ephemeral. The great reason for this state of affairs was jealousy and envy. Each institution published its own Proceedings—they did not work together. Another difficulty was the multiplicity of things in which the proceedings were published. There ought to be some tremendous effort made to get a permanent record in which one could find what he wanted to know of progress and discovery during the year. Such a record might be issued weekly and might be the repository of all the Papers of the various Institutions that really mattered.

A European Automatic Sub-Station.

According to "The Times" Engineering Supplement, there is in Europe only one example of a sub-station with a completely developed automatic mechanism. This is used on the tramway between Basel and Lorrach. The equipment consists of a single 250 kW rotary convertor which transforms three-phase current at 6 300 V to direct current at 600 V. The necessary operations for starting and stopping are effected by a combination of relays, contact appliances and electrical remote control devices on the different switches. The electrical mechanisms that control the switches are positively connected with each other, and are divided into a connecting system and a disconnecting system, each of these systems being again divided into several groups. The connections are such that on starting or stopping work the switches always come into connection in the sequence required.

American Trade with Latin-America.

Increasing efforts are being made in the United States to develop trade with Latin-America and Spain, but more particularly the export of ELECTRICAL PLANT AND APPARATUS. As a result the electrical goods sent to these countries in 1921 was not less than in the previous year, notwithstanding the universal trade depression. Compared with 1914, the electrical exports show an increase of 240 per cent., the actual values being $10 194 964 in 1914, $34 456 554 in 1920, and $34 719 906 in 1921. The important items of export were batteries, insulated wire and cable, wiring accessories, incandescent lamps, switches and telephone material, though there appears to be an increasing demand at present for domestic apparatus and meters also.

Bright Prospects.

According to our contemporary, the "Electrical World," the outlook for all electric light and power apparatus in SOUTH AMERICA is bright; stocks are said to be low, political conditions are satisfactory, and an upward trade tendency is already noticeable. With the revival of industry in the United States and Europe there should be an increased demand for South American raw materials, and this should ultimately result in improved exchanges and a greater demand for manufactured goods.

In Spain, the openings are said to be limited, and are mainly for bare copper trolley and transmission lines and wire bars, dry batteries and pocket lamps. The situation in Spain, where a fair amount of hydro-electric development is taking place, is not so promising as in South America, as efforts are being made to establish local factories and there is also increasing competition from Germany.

The Brazilian, Mexican and Cuban markets are said to be likely to improve during the coming year, and regular types of American manufacture are recognised everwhere except in Argentina, Uruguay and Chile, where European types of material are employed and competition has to be faced. The trolley line material in use is also different from the American standard, and European lamps and meters have likewise a wide vogue and enjoy a good reputation. Lamps are being made in Brazil and Argentina, but the output is small. As might be expected, arc lamps are being discarded in favour of gas filled lamps for street lighting. There is an increasing demand for domestic apparatus (except labour-saving appliances), fans, ornamental fittings, etc., though Argentina, Brazil and Spain are endeavouring to meet local requirements by establishing factories for manufacturing cooking and heating apparatus.

Small Generating Sets in Argentina.

There appears to be an increasing demand for small independent plants for public buildings in the country towns in ARGENTINA, and also for farming purposes, especially in the northern part of the republic. The most popular lighting unit appears to be an oil or paraffin set, capable of supplying electricity to 40 to 70 16 c.p. lamps, or a 4 kW set for cinemas. Some German firms have already entered the field, and the Siemens-Schuckertwerke have recently introduced a new set. It must be remembered that small lighting installations must be economical in first cost as well as in operation.

In BRAZIL there is also a good prospect of a better demand for electrical supplies, but the import duties have been modified and increased. Duties are now mainly levied according to the weight and not on the *ad valorem* basis.

In regard to Latin-America generally, it must be remembered that the position of the United States, owing to its position and the financial assistance it has given, is much stronger than in pre-war days. During the past year the loans advanced by United States banks to South American countries amounted to $210 000 000, and it is hoped that, as the greater part of this sum will be spent on railways, harbour and other public works, many orders will be obtained for machinery, locomotives and rolling stock, telegraph and telephone materials, etc. In addition, efforts are being made to attract South American students to technical colleges and institutions in the States, because it is felt that when they return they will be familiar with American machinery and practice, and they will be favourably disposed towards American manufactures.

Possible Trade Openings.

An old-established firm of wholesale merchants at BUDA-PEST desire to obtain the representation of United Kingdom manufacturers of machine tools, electric motors, etc. Particulars from the Department of Overseas Trade. (Reference No. 575).

According to the "Industrial Daily News," important proposals for the ELECTRIFICATION OF THE DUCHY OF LUXEMBOURG have been submitted to the Government of the Duchy by a group of Belgian financiers. A central power station near the town of Luxembourg is to be built, which will develop power from the rivers Semis and Lesse. British engineers in a position to quote for the plant, machinery and equipment required in the scheme will, it is stated, be given every opportunity of submitting estimates. A total expenditure of 150 000 000 frs. is anticipated. The decision of the Luxembourg Government is shortly to be announced.

The foundation stone for the completion of the new wing of the ST. PANCRAS electric power station, in Great College Street, St. Pancras, London, was laid on Tuesday, by the Mayor.

Parliamentary Intelligence.

Ayr Electricity Bill.

The case for the promoters of this Bill continued on the 16th inst., when MR. J. H. RIDER was recalled and gave further evidence. He said that the raising of the dam at Loch Doon from five to ten feet would increase the cost by £11 500, and that would mean £600 or £700 more per annum for operating costs. That extra cost would destroy the economic advantages of the scheme.

For Kilmarnock Town Council, who opposed the Bill, MR. C. P. SPARKS, consulting engineer, stated that in his opinion some of the charges given by Mr. Rider were underestimated. He thought there should be added to the cost an extra sum of £29 000. The main objection to the scheme was the limited output due to the small catchment area. Ayr could not stand alone for 2½ years until the larger scheme was available; during that time provision must be made for an additional supply of electricity. It would be more economical to get the additional supply from Kilmarnock, instead of proceeding with the Loch Doon scheme. The municipal undertaking at Kilmarnock had been an economic success.

In cross-examination witness admitted that the generating station at Kilmarnock was no bigger than was required for their own area. They could supply Ayr, but they would have to increase their plant. He agreed that the smallness of the scheme was no reason why it should be objected to.

MR. W. COLLIER BEXON, electrical engineer to the Burgh of Kilmarnock, said that in 1920 negotiations were opened between Kilmarnock and Ayr as to the former supplying electricity to the latter burgh. Terms of agreement were drawn up in November, 1920, but were never executed. In the expectation that they would be called upon to supply Ayr with electricity they made certain alterations to their plant. He agreed that the Loch Doon scheme was not an economical one; there was not sufficient water to deal effectively with the district and the expenditure proposed was an extravagant figure.

On Wednesday MR. TYLDESLEY JONES, for Ayr Corporation, put in a new clause providing that in the carrying out of the works all reasonable regard should be had to the preservation of the beauty of the district.

MR. MORTON, consulting engineer, said he estimated the capital cost per kW of the Grampian electricity scheme at £108, and of the Lochaber water power project at £56, including the cost of the Parliamentary proceedings. The proposed croys in the stream were ingenious in theory, but he was afraid they would not work out in practice. A flow of 4 000 000 gallons per day would give a depth at one fixed point of only 2½ in., while 6 000 000 gallons would give about 3¼ in. The compensation water was absolutely negligible, but he agreed that the extra yield of water secured by raising the dam on Loch Doon to 10 ft. would not compensate for the extra cost.

Many local witnesses were called in opposition to the Bill, and on the 18th inst. the Committee passed the preamble, subject to the minimum average flow of water in the river being 8 000 000 gallons per day instead of 6 000 000 gallons which the promoters were prepared to concede, and that the clause dealing with the amenities of the district should be approved by the Lord Chairman.

During the sitting for the adjustment of clauses the promoters agreed to a proposal of the Doon Fishery Boards that there should be a minimum flow of 13 500 000 gallons in the tail-race off the mills of the river Doon to ensure a good salmon run, but the claim of the Marquis of Ailsa for the minimum flow of 36 000 000 gallons to maintain full water power for the riverside mills was disallowed, as was a claim for the fencing of the Doon reservoir.

Grampian Electricity Bill.

In reply to a question by Mr. Briggs, the CHANCELLOR OF THE EXCHEQUER (Sir Robert Horne) stated in the House of Commons last week that if a guarantee was given under the Trade Facilities Act the Advisory Committee appointed under that Act would scrutinise the prospectus, and their approval would have to be obtained before the prospectus was issued, so that there was no danger of the public being misled as to the form of the State guarantee.

On the Report stage of this Bill on Tuesday,

MR. BRIGGS moved its rejection. A letter from the Trade Facilities Advisory Committee was put in as evidence before the Committee which considered the Bill, promising a State guarantee of part of the capital to be raised by the promoters. He took exception to that particular guarantee because the assets of the Grampian Electricity Supply Company were not such as warranted it; they were not those of well-established businesses, but were only waterfalls and salmon fishing. He also objected to the guarantee because the scheme was highly speculative.

MR. ORMSBY-GORE, as Chairman of the Select Committee to which the Bill was referred, hoped the motion for rejection would not be pressed, though he agreed that the letter was an improper one. The Bill ought to be considered on the merits of the actual proposal which it contained. It would be advisable in future, before any guarantee was given, that the Trade Facilities Advisory Committee should wait until the Committee stage of the Bill was completed. In his opinion the scheme was as good a one as was likely to be produced for the development of water power in the Highlands.

MR. HILTON YOUNG and others supported the Bill, and the motion for its rejection was defeated by 185 votes to 78. The Bill was then ordered for third reading.

Workmen's Compensation.

We are likely to have a BILL FOR AMENDING THE WORKMEN'S COMPENSATION ACTS this year, for the House of Commons have unanimously passed the following resolution: "That in view of the unsatisfactory state of the law relating to workmen's compensation and of the fact that the War Additions Acts expire at the end of the year this House is of opinion that a Government Bill to amend the Workmen's Compensation Act, 1906, should be introduced and passed during the course of this Session."

In the course of the debate, the HOME SECRETARY (Mr. Shortt) said he did not believe that a single hon. member would allow the War Additions Acts to lapse without anything being put in their place. They must either pass new legislation this Session or include the War Additions Acts in the Expiring Laws Continuance Bill. He did not pledge the Government to any detailed reform which had been advocated. All agreed that the maximum amount of compensation was inadequate, but there was by no means unanimity of opinion as to what the sum should be or as to compulsory insurance and State insurance. There were many points in the report of the Departmental Committee which were highly controversial, and it might be very difficult for the Government when introducing a Bill, as he hoped they would be able to do, to deal with those points. With a view to securing agreement between all concerned, he had approached men representing the employed and the employers, and had put forward certain proposals as a basis of discussion.

Telephone Apparatus.

In reply to CAPTAIN TERRELL (House of Commons, May 22) Mr. Kellaway said that there was now no scarcity of telephone materials, and generally no difficulty was found in dealing promptly with applications for telephone service; but there were still a few localities where from various causes it had not been possible yet to complete the cables which were necessary in order to meet the demands for telephone service. He would be glad to investigate any case that was brought to his notice of an application which had been outstanding for a considerable time.

Safeguarding of Industries Act.

In a written reply (House of Commons, May 16) to DR. MURRAY, who asked the amount of duty collected on various scientific instruments and appliances under the Safeguarding of Industries Act, SIR ROBERT HORNE stated that £946 had been collected on electrical instruments (other than telephonic and telegraphic) and commercial instruments (including ammeters, voltmeters, etc.); £31 on house service meters, £211 on scientific instruments, and £5 555 on electro-medical apparatus, X-ray tubes, wireless valves, vacuum tubes and X-ray apparatus.

The Severn Scheme.

In reply to Mr. MILLS (House of Commons, May 16), MR. ARTHUR NEAL said it was not possible, owing to the financial position and the necessity for drastically curtailing the expenditure of Government Departments, to set up the Technical Commission recommended by the Water Power Resources Committee to consider the possibility of utilising the tides in the River Severn for the generation of electricity.

Bulk Supply Powers of Undertakers.

An interesting conflict of opinion has arisen between HAMMERSMITH (London) Borough Council and the Electricity Commissioners in regard to the Council's proposal to give a bulk supply of electricity to Ealing Corporation, and it is probable that the matter may lead to legal proceedings.

It appears that in November last the Borough Council agreed to give a bulk supply for general purposes to Ealing on terms and conditions which were to be approved by both Councils, and application was made to the Electricity Commissioners for the sanction to the proposal. The matter has since been the subject of correspondence between both Councils and the Commissioners, and conferences have also been held with the Commissioners and representatives of the Councils. The Commissioners now state that, after consideration of the circumstances, they are unable to approve the proposed agreement. On the 3rd inst. a joint meeting of the Ealing and Hammersmith Electricity Committees was held, and directions were given for steps to be taken to test the powers of the Commissioners to refuse their approval of the proposal.

While we are unaware of the reasons given by the Commissioners for their refusal and of the full facts of the case, it is doubtful if the Council can succeed in any proceedings against them, for Sec. 19 of the Electricity (Supply) Act distinctly states that any two or more of the authorised undertakers within the locality (of any Electricity District) *may, with the approval of the Electricity Commissioners* . . . . enter into and carry into effect arrangements for mutual assistance with regard to the giving and taking of a supply of electricity, etc. The Commissioners have hitherto been so business-like and reasonable in their decisions that we venture to think there must be good engineering or economic reasons for their present attitude. At all events, we should deprecate litigation on such a point as that which has arisen.

Legal Intelligence.

An Undue Preference Allegation.

On Tuesday Mr. Justice Swift delivered his reserved judgment in the action brought by the Westminster Electric Supply Corporation against Wykeham Studios, Ltd., for the recovery of £82 18s. 5d. for electricity supplied for their art photography business. Defendants admitted liability for part of the sum claimed but denied they were liable for the rate charged.

In giving judgment his Lordship said:—Defendant company admitted liability for £48 5s. 10d.; judgment for that amount had been signed and liberty was given to defend as to the balance of the claim. It was admitted that the amount claimed was accurate if plaintiffs were entitled to charge the rate they had done. The plaintiffs were supplying electricity under the provisions of the Westminster Electric Lighting Order (1889) in the area mentioned in the first schedule of the Order. For many years plaintiffs had been in the habit of supplying electricity at two different rates of charge, one rate for lighting and a lower rate for purposes other than lighting and supplied through a separate meter and known as power rate.

Defendants have been using electricity for a photographic arc lamp, and it was admitted that the electricity had been used by defendants for purposes other than general illuminating purposes. Plaintiffs sought to charge defendants at a higher rate than the maximum rate stated by them to be payable for electricity used for power, and defendants object that the current having been taken and used by them for power purposes, that is to say for purposes other than lighting and through a separate meter, they were not liable to be charged more than the maximum rate for power. He found as a fact, on the admissions made, that the electric current used by defendants was used for power purposes and not for lighting, and that it should be charged for at the power and not at the lighting rate. That, however, did not dispose of the action, for plaintiffs contended that even if they were under the circumstances compelled to treat defendants as taking electricity for power purposes only, they might still charge them at the rates which they had done, that is to say 7d. per unit for the quarters ending midsummer and Michaelmas, and 4d. for the quarter ending at Christmas 1921. The right of plaintiffs to so charge was dependent upon the construction of section 19 and 20 of the Electric Lighting Act, 1882.

Having quoted both sections, his Lordship referred at length to the judgments in Metropolitan Electric Supply Co. *v.* Ginder, the Attorney General for Victoria *v.* Melbourne Corporation, the Attorney General *v.* Long Eaton Urban Council, and the Attorney General *v.* Hackney Borough Council. He thought the result of those decisions was that where current was supplied on two different systems, the choice of which was left to the consumer, there was no infringement of sections 19 and 20, and that as between customers of each system the undertakers were entitled to differentiate as to price provided that the special circumstances of each customer were regarded. But it was contended in the present case that defendants using the current for power purposes had been charged more than the rate which was fixed and advertised by plaintiffs as being the rate for current supplied for power. He did not see why this should not be done, if regard was had to the special circumstances of those who were charged at the higher rate and if a proper differentiation could be made between them and others who were being supplied with electricity for power in the same area, provided that the undertakers did not charge more than the amount which was fixed by the Act, or which for the time being was agreed upon between them and the consumer. He could not see why they should not be allowed to charge a consumer more if the circumstances under which he was taking power were not similar to those of other persons who were taking it.

In that case, photographers, speaking generally, were not taking current for power under similar circumstances to other consumers. Their lamp was not burning regularly and for fixed hours during the day or night, but was intermittently used as occasion necessitated for the taking of particular photographs, and he thought that the undertakers were entitled to say that, although their ordinary charge to persons using current for power was 2d. per unit, they would charge a higher rate to persons who took current for use in a photographic arc lamp. At any rate he saw nothing in the sections of the 1882 Act referred to or the decisions upon them which was inconsistent with that view. It is clear that plaintiffs were under no agreement to charge defendants other than the rates which they did, and defendants had ample notice of the rates which they would be charged. All photographers in the area had been treated in the same way, and under the circumstances there would be judgment for plaintiffs for the amount claimed with costs.

Improper Use of Electricity.

Last week the Southend magistrates had before them three charges of improperly using electricity, and in two of them alternative charges of fraud were alleged. P. Morgan and Co. were summoned under Sec. 12 of the Electric Lighting Act, 1882, for improperly using electricity within the last six months at their premises; and there was a similar summons against Marshall Rowland Cook, but it was also alleged alternatively that during the past six months he consumed electricity fraudulently, contrary to Sec. 10 of the Larceny Act, 1916. A similar charge of fraudulent consumption of electricity during the past six months was made against Harris Goldstein.

The cases against Morgan and Co. and Goldstein were adjourned for three weeks.

The Asst. Town Clerk (Mr. Beresford) said that Cook, who pleaded guilty, had a supply on the contract rate for light, with a separate supply for power for hairbrushing and for sharpening razors. Requiring more light in the selling portion of the shop, instead of applying for an increased supply, he tapped the power circuit, with the result that he was paying the power rate for that light (3¾d.), instead of the lighting rate of 8d. per unit. He did not inform the Corporation of what he had done, but when spoken to by one of the inspectors, he said: "All right, old man. You need not take the matter any further, I know I have done wrong."

Evidence having been given by a meter inspector and by the meter superintendent, defendant said he knew nothing about electricity. He had the power meter installed some years before the war, and having been away in the Army for seven years, he forgot the terms. He agreed with the statements concerning the lamp, and wished to apologise.

The Bench came to the conclusion that Cook had improperly—not fraudulently—used the light, and fined him £5.

Is a Tramcar a Carriage?

Last week the Bradford Stipendiary Magistrate (Mr. Beaumont Morice) gave his reserved decision on a charge against Mr. S. Goldthorpe, brought under section 28 of the Town Police Clauses Act, for not keeping a motor wagon on the right or off side of the road when passing a certain carriage.

The defence was that the tramcar was not a carriage within the meaning of the Act, but Mr. Morice held that he was bound by a decision of the High Court that a tramcar was a carriage. Having regard to the fact, however, that in the present case two tramcars were on their respective lines, and to the conflicting evidence, he was of opinion that the circumstances were a sufficient reason for the deviation.

The case was therefore dismissed, with costs.

Institution Notes.

The list of successful candidates for the A.M.I.E.E. Examination held last month has now been published. Thirty-six candidates passed the whole examination, sixteen passed Part II only, and two passed Part I only. Results relating to candidates who sat for the examination abroad will be published later.

In the examination for officers of the Corps of the Royal Engineers, fifteen passed the whole examination, one passed Part I only. Of the officers of the Royal Corps of Signals two passed the whole examination.

Members of the Institution of Mining Engineers from Glasgow, Edinburgh, the Lothians, and other centres, paid a visit of inspection last Saturday to the works of the British Electric Plant Co. at Alloa. The visitors were conducted through the works by Mr. F. G. Warburton, of the directorate; Mr. A. S. Murdoch, the works manager; and Mr. R. Wright, the secretary; and great interest was taken in the various departments.

The result of the ballot for the election of officers and new members of Council of the Institution of Electrical Engineers for 1922-23 is as follows:—*President*, Mr. F. Gill; *vice-Presidents*, Dr. W. H. Eccles, Mr. A. A. Campbell Swinton; *Hon. treasurer*, Sir James Devonshire; *ordinary members of Council*, Mr. J. W. Beauchamp, Mr. R. A. Chattock, Mr. F. W. Crawter, Mr. D. N. Dunlop, Major K. Edgcumbe, Mr. A. F. Harmer, Mr. W. R. Rawlings.

The fourth Quadrennial Gustave Canet Lecture entitled "The Railway Act 1921," will be given before the Junior Institution of Engineers by Sir Eric C. Geddes, on Thursday, June 1, in the Lecture Theatre of the Institution of Electrical Engineers, Victoria Embankment, London. The chair will be taken at 7.30 p.m. by Mr. C. H. Wordingham, President of the Institution. Tickets may be obtained from the Secretary, 39, Victoria Street, S.W.1.

South Wales Engineering Exhibition.

The Council of the South Wales Institute of Engineers have decided to hold an Engineering Exhibition at the Drill Hall, Cardiff, during the week commencing November 20 next. Each morning a conference will be held at the Institute, when short papers on various subjects connected with the exhibition will be read and discussed. Offers of such papers will be welcomed.

The exhibition will be divided into six sections, including:—(I) Scientific, Measuring and Recording Instruments; (II) Water-Softening and Cooling Plant, Boilers and Equipment, Oil Burners, Pipes, etc.; (III) Electrical Section: Switchgear, Cables, Controllers, Overhead Lines, Electrical Tools and other appliances, Small Motors, Electric Cranes, Telephone and Wireless Apparatus; (IV) Mechanical Transmission of Power, Bearings, Clutches, Gearing, etc.; (V) Workshop Appliances: Machine Tools, Pneumatic Tools, etc.; (VI) Mining and General Industrial Section.

The British Engineers' Association has been entrusted with the task of organising the Shipbuilding, Marine, Mechanical and General Engineering Section of the British Empire Exhibition to be held in London in 1924. Full particulars, plans, and forms of application for space will be available for issue at an early date. Enquiries should be addressed to D. A. Bremner, Director, The British Engineers' Association, 32, Victoria Street, London, S.W.1.

Electricity Supply.

At a meeting of the HEYWOOD Electricity and Tramways Committee it was reported that the consumption of electricity for lighting and power purposes during March last was 150 328 units, as against 109 755 units for the corresponding period of last year, showing an increase of 40 573 units, or 36·96 per cent. There was a loss on the working of the Electricity Department for the past year of £1 047, due to the coal strike and the slump in trade.

To celebrate the reduction of coal consumption to one ton per 1 000 units, Ald. C. Hardman, chairman of OLDHAM Electricity Committee, entertained members of the Committee and staff to dinner last week. In the course of a speech he recalled the fact that in 1913–44 the coal consumption was 6¾ lb. per unit, whereas it was now about 2½ lb., and he hoped it would be brought down to 2 lb. or less. Although they had expected an adverse balance on the year's working, they had come out with a four-figure profit, and a reduction of prices would be considered shortly.

HAMMERSMITH FINANCE COMMITTEE recommend the Council to apply to the Electricity Commissioners for sanction to borrow additional sums of (*a*) £61 590 in connection with the extension of the electricity generating plant; (*b*) £7 057 relating to the provision of the No. 16 (Stirling) boiler, and (*c*) £3 717 in respect of the erection of the building for the powdered fuel plant. The Electricity Committee recommend that a sum of £1 000 be set aside out of the surplus revenue of the electricity undertaking for the financial year, 1921-22 for the purchase and hiring out of electrical apparatus.

The annual report of BARROW Electricity Undertaking shows a net profit of £374 compared with a deficit in the previous year of £2 500. The income from the sale of electricity was £11 798 below last year, but general lighting and heating receipts advanced by £4 194, and tramway supply by £381. There was a drop of £16 373 in power and industrial supply. Public lighting has increased by £1 172, and rents of motors and apparatus on hire by £1 121. Working expenses are £17 653 less than last year, chiefly due to a decrease in the coal bill of £13 409. The total revenue for the year was £77 122, and the working costs £51 010. The capacity of the plant at the end of the year was 7 025 kW, and the number of units sold 6 886 504, against 9 282 017 units in the previous year

New Schemes and Mains Extensions.

Warrington Corporation is now supplying electricity to STOCKTON HEATH, the formal switching on of current taking place from the sub-station on Monday, May 22.

Accrington Corporation have applied to the Electricity Commissioners for a Special Order to extend the Corporation's area of electricity supply to the Urban District of OSWALDTWISTLE. Any objections must be sent to the Electricity Commissioners by June 19.

The Electricity Commissioners have sanctioned the borrowing of £13 500 by SHREWSBURY Electricity Committee for extensions to the electricity works, and have intimated that they are prepared to consider the sanctioning of the borrowing of any further sum, which may be found necessary when the cost has been approximately ascertained.

HOYLAKE Electricity Committee propose to obtain a loan of £1 000 for mains and services. The Committee have gone back to the pre-war condition of giving 15 ft. free service to consumers, and where extensions of mains are not involved work will be proceeded with without awaiting the Committee's consent. There are now 2 000 consumers, or 150 more than twelve months ago.

The Electricity Commissioners have declined to sanction a loan of £5 000 applied for by GRAYS Urban Council for extensions at the electricity undertaking, and recommend the Council to wait until they can obtain a supply from the proposed new station at Barking of the County of London Electric Supply Company. The urgency of the situation with regard to the continuity of supply during the coming winter is to be explained to the Commissioners by the Council.

PRESTON Town Council has received formal consent of the Electricity Commissioners to the establishment of a generating station at Penwortham, with an initial capacity of 20 000 kW. The Committee are applying for the Commissioners' consent to the establishment of a further generating station, and to the borrowing of £416 450 for the purpose. The Town Clerk has been authorised to take the necessary steps, in conjunction with the Blackburn authority, for the presentation of a scheme for the Mid-Lancashire Electricity District to the Commissioners at the local inquiry.

Alteration of Charges.

The charges for electricity at CREWE are to be reduced by 12½ per cent.

WALLASEY Electricity Committee have decided to exercise their powers under the Electric Lighting Act regarding minimum charges. Under the Act the Corporation is entitled to charge a minimum of £2 13s. 4d. per year to lighting consumers.

PRESTON Electricity Committee have decided to allow 10 per cent. discount to lighting consumers in Preston and Fulwood on meter readings as from the June quarter, and to increase to 15 per cent. the present 5 per cent. discount to power users.

Electric Traction.

ROTHERHAM Corporation has applied to the Minister of Transport for permission to run motor-omnibuses on certain routes.

HEYWOOD municipal tramways were run at a loss of £2 431 last year. In 1914 the working cost per car mile was 3½d.: it is now nearly 1s.

It is stated that the ELECTRIFICATION of the London and North Western Railway between CHALK FARM and EUSTON will be completed by the end of next month.

The experiment made by ABERDARE Urban Council in the use of one-man tramcars and omnibuses has proved satisfactory, and the system is being extended to the trolley omnibus cars.

The annual conference of the managers' section of the BRITISH MUNICIPAL TRAMWAYS ASSOCIATION will be held in Glasgow on June 15 and 16. The topics of discussion will be chiefly questions of car maintenance.

A revision has been made this month of the fares charged on the BRISTOL tramways. Under the new rates children under twelve are carried at reduced prices, and cheaper fares have been introduced on certain routes for all passengers.

By a majority of 7 499, NEWPORT ratepayers, on Saturday, decided upon the introduction of a Sunday service of tramcars. Over 50 per cent. of the electors went to the poll, which was preceded by 19 public meetings. The new service will start next Sunday.

The BIRMINGHAM Corporation Electric Tramways Department made a net profit last year of £192 500, but this sum will be absorbed by the programme of reconstruction work undertaken during the past year by the department. The passengers carried numbered 183½ millions as against 218 millions in the previous year.

Serious corrugation has set in on CARDIFF tram tracks. At a meeting of the Tramways Committee last week, the tramways manager (Mr. R. H. Horsfield) said it was apparent even in the new track which had been laid. The problem was a serious one, and must be dealt with. The attention of the city engineer had been drawn to the matter, and it was decided to await his report.

The new EXPRESS TRAM TRACK IN LEEDS from Harehills to Oakwood was officially inspected last Friday by Major Hall, R.E., of the Ministry of Transport, and on Sunday was opened for traffic. The chief interest in the new system is that for the first time in the city it supplies an example of tramcars run on rails and sleepers, the cost of this particular form of construction being much less than that of laying down concrete beds in the centre of the road. The cost of renewal will also be less.

Alderman Higham, chairman of the ACCRINGTON Tramways and Electricity Committee, informed the Town Council on Monday that, compared with a loss on the tramways last year of £2 008, they now had a balance on the right side of £5 300. After contributions to the appropriation fund they would be able to place £2 234 to the repairs and renewals fund, which now stood at £30 000. The saving had been in general repairs and maintenance of track, which had cost only £10 000, compared with £17 000 last year.

A recommendation has been sent to all the tramways undertakings in the Midlands, including Nottingham and Leicester, by the Midland Area Industrial Council for the Tramway Industry, urging the adoption of the COVERED-IN (OR VESTIBULE) FRONT FOR ALL TRAMCARS, as it is found that the dust caused by the increased motor traffic causes the drivers, when too much exposed to the weather, to suffer from bronchial and eye troubles. The executive of the Municipal Tramways Association have also had the matter under discussion with a view to finding the best type of vestibule to adopt.

Members of LIVERPOOL Tramways and Electricity Committee paid a visit of inspection last Thursday to some of the most important undertakings of which they have charge, including the Lambeth-road works, where a large number of tramway cars are being renovated, and eight new ones of the latest type being built, and the Lister-drive Power Station. The new tramway in course of construction from the city boundary at Knotty Ash to Prescot was partly travelled over, and the Aigburth-road improvements were also inspected. At the luncheon at the Midland Adelphi, Mr. Frank Wilson, chairman of the Committee, who presided, gave a résumé of the year's work. At the Lambeth-road works (he said) a large amount of renewals were being steadily carried out. They had spent £692 738 in this connection during the last three years, and that was one reason why they had had to go in for increased fares. Many of the cars were twenty years old, and a number of them ought to be scrapped. They had now 618 cars in service, of which 450 were twenty years old. He thought the increased fares were justified, for they were now doing very well, and before long he hoped they would have a clean slate. Then they might talk of cheaper fares. They hoped, indeed, to do this later in the year. With regard to the Prescot route, they would be running right through on the new line in three months' time. Their electricity undertaking had increased greatly, and the area of supply now covered the whole of the city from Garston to Aintree. Negotiations were nearing completion to take over the supply in Bootle, Waterloo and Great Crosby, and to supply Hightown and Formby.

Business Items, etc.

Mr. E. F. Turner, for many years works manager for Brind, Gillingham and Co., has started business as an electrical engineer at 20, Banbury Road, Oxford.

Mr. Eric Toft, having retired from the firm of Radford and Toft, electrical engineers, 8, Station Buildings, Altrincham, the business will be continued by Mr. Luke Radford under the style of L. Radford and Co.

Mr. F. Kent, who was formerly with Crompton and Co., has been appointed manager of a branch business at Priory Road, High Wycombe, established by Walters, Dobson and Co., electrical and general engineers, of Sheffield.

Mr. Duncan White, lately with Brooks and White, has now joined the Hotpoint Electric Appliance Co., London, W. Mr. White will deal with applications and problems relating to heating and cooking apparatus and will also deal with maintenance and repair work.

The Manifoldia (Regd.) System, designed by Mr. A. H. Human, for ensuring perfect supervision and record keeping of electrical installations, is on view at the stand of Manifoldia, Ltd., at the Efficiency Exhibition which opened at Bingley Hall, Birmingham, yesterday (Thursday), and will remain open till June 3. We hope to give further details of the system in an early issue.

Plant and Supplies, Ltd., announce that they have purchased the business of Mr. Ashley Pope, Toddington, near Dunstable, and that he has been appointed managing director. Plant and Supplies, Ltd., are the sole agents and distributors for London, the Home Counties and the southern portion of England for the "Sceando" lamp which is manufactured throughout in this country in both the one watt and half watt types.

In order to cope with their increasing business in the south of England Ward and Goldstone have opened extensive premises at 8a and 9, Great Chapel-street, Oxford-street, W.1 (three minutes from Tottenham Court-road Tube Station), where in future all London and district orders will be dealt with. Mr. J. S. Child (ex joint sales manager to the Edison Swan Electric Company) has been appointed to represent the firm in this district.

Telegraph and Telephone Notes.

The reduction in telephone charges, foreshadowed in Mr. Kellaway's speech in the House of Commons on May 4, and given in our last issue, will come into operation on July 1.

The cable ship "Monarch" which has been at Sheerness Dockyard undergoing her first refit since the war, has left Sheerness to resume duties. Arrangements have been made for the "Alert" to refit at Sheerness.

Hull Corporation Telephone undertaking for the year ending March 19 last shows a net profit of £3 938. The undertaking has to pay over £10 000 royalty annually to the Government, and up to date £74 000 has been paid under that head.

The Commercial Cable Company notifies that on and after May 22 deferred messages between Great Britain and Cape Breton, Nova Scotia, New Brunswick, Prince Edward Island and the provinces of Quebec and Ontario will be reduced to 4½d. per word

It is reported that the Indo-European Trust has obtained the concession for the exploitation of the telegraph system of Russia. In addition to this, it is stated that the company will take over the main cable from Odessa to Constantinople and the line from Odessa to Kerlch, Tiflis and the Persian frontier.

In connection with the scheme for the construction and laying of two submarine telegraph cables between Germany and America, orders have been placed with German firms for the manufacture of the cables, which will be operated by the Deutsch Atlantische Telegraphen Gesellschaft. This company has recently been reorganised; its capital has been increased to 40 000 000 marks and agreements have also been made with American cable companies.

The Chinese Telegraph Administration announces that telegraphic communication between the Far East and Europe via Siberia has been re-established. Telegrams intended for transmission by this route should be marked "via Holampo." They will be accepted for the following countries:—All countries in Europe, Russia in Europe, Russia in Asia west of, and including, Habarovsk, Outer Mongolia (Urga). Rates are as follows:— Europe, $1.40; Russia in Europe, $0.75; Russia in Asia, $0.55; Outer Mongolia (Urga), $1.25.

A five years' agreement has been entered into by the London County Council with the London Telephone Service for the hire by the Council of an automatic internal telephone system at the new County Hall. The electric power required in connection with the exchange apparatus is to be supplied by the Council, and the rent to be £1 734 a year for any number of lines up to 400, and £4 a year for each additional line ordered up to a total of 900 lines, together with the usual charges for wiring more than the normal length, to be paid by the Council.

Personal and Appointments.

Sir Charles Addis has joined the board of the Eastern Telegraph Co.

Sir Dugald Clerk has consented to become hon. president of the Cardiff University College Engineering Society.

Mr. Oxenham, of Launceston, has been appointed engineer to Bideford and District Electric Supply Co. He has been in charge of a similar plant at Launceston running on sawdust fuel, which is also to be used at Bideford.

Mr. J. W. Rodger, who for some years has been chief transformer designer and assistant manager with Ferranti, Ltd., has severed his connection with this firm in order to take up a similar position with the Hackbridge Electric Construction Co.

We are asked to state that any business friends of Mr. C. D. Falcke, managing director for the past six years of The B.E. Co. (of London and Birmingham), Ltd., now in voluntary liquidation, and proprietor of the original business in Birmingham for a period of nearly twenty years, who wish to communicate with him, may do so by addressing him at the Engineers' Club, Coventry-street, W.1. For purely personal matters his telephone number is: Paddington 5069.

Mr. C. G. Schluederberg, of the Westinghouse Electric Co., has been elected president of the American Electro-Chemical Society. Mr. Schluederberg belongs to a number of engineering and other societies and has been particularly active in the American Electro-Chemical Society. He has also served on several committees of the American Institute of Electrical Engineers. He has published a number of articles covering original research work and electro-chemical activities and developments.

Wireless Notes.

A meeting of an international committee of shipowners is being held in London this week to consider what changes, if any, should be advocated in the present system of wireless communications respecting ships in distress.

Glasgow and District Radio Club report a considerable addition to their membership and an increased attendance at their meetings. New premises have been obtained at 200, Buchanan Street, and next session meetings will be held weekly.

Mr. J. H. Hammond, junr., an American, claims to have perfected apparatus to prevent a radio station from receiving messages except those intended for it. He further claims that "the same wave can be made to carry several messages at the same time and that both voice and code may be transmitted."

Subject to the approval of the Postmaster-General an agreement has been made, we understand, between the Metropolitan Vickers Electrical Company, and the Radio Communication Company, for the joint establishment and operation of wireless telephone broadcasting stations throughout Great Britain.

A successful experiment in wireless communication between the earth's surface and places in coal mines was recently made by a party of geologists and scientists in the Blue John Mine, Castleton. A receiving set was taken into the cave known as the Lord Mulgrave's Dining Room about 280 ft. from the entrance and a quarter of a mile in any direction from the open. Here a 50 ft. aerial was suspended across the cave and with a small apparatus signals were received clearly from Poldu, in Cornwall, from a station near Berlin, and from other high power transmitting centres.

Representatives of twenty firms attended the conference last Thursday at the General Post Office to discuss the arrangements to be made for broad-casting matter (including music) by wireless sets. It was recognised generally, the official report of the conference states, that, in order to avoid interference, broadcasting stations would have to be very limited in number. Some of the representatives thought that not more than eight could work simultaneously in Great Britain, using the power (1½ kW) and the band of wave lengths (350-425 metres), allowed for the purpose, without such interference as would produce practical chaos. It was also recognised that the provision of a suitable daily programme at the various stations would be expensive, and that it was important in the interests both of the public and the manufacturing industry that the continuity of the service and the maintenance of a high standard in the programme should be ensured. The best means of attaining these objects seemed to lie in co-operation among the firms concerned, and it was suggested that one or possibly two groups should be formed, which should become responsible, both financially and otherwise, for the erection and maintenance of the stations and the provision of suitable programmes. In accordance with these suggestions it was arranged that the representatives of the various firms should collaborate in the immediate preparation of a co-operative scheme, or at the most of two such schemes, for consideration by the Post Office authorities.

The "Daily Mail" announced last Friday that the Ideal Home Exhibition will be held again next March, instead of waiting until 1924, as previously proposed. Our readers will do well to make early application for space.

Imperial Notes.

The Metropolitan-Vickers Electrical Company have obtained a contract for the supply of plant and equipment for the electricity supply scheme for JUBBULPORE (India).

KANDY (Ceylon) Municipality is taking over the electrical generating plant of the Colombo Gas and Water Works Company at Kandy. The purchase price is R. 1 50 000 (£10 000).

Grenville Shire Council contemplate the provision of electricity supply works for LINTON (Victoria), and expert advice is being obtained on the possibility of using water power for generating electrical energy.

It appears that the German experts engaged by the Victorian Government in connection with the MORWELL BRIQUETTE SCHEME are now unwilling to land in Australia. They have, however, been assured that they need fear no hostile demonstrations.

"Indian Engineering" says certain home firms were in communication with the CEYLON Government with a view to entering into partnership with the Government in relation to the proposed hydro-electric scheme. It is now stated that the Government has decided to carry out the work itself, with the assistance of a special staff of engineers engaged from Great Britain.

The Royal Commission appointed by the Ontario Provincial Government to investigate the QUEENSTON-CHIPPAWA HYDRO-ELECTRIC SCHEME of the Hydro-Electric Power Commission of Ontario consists of the following: Mr. Walter D. Gregory (Chairman), Mr. M. J. Haney, Mr. L. Harris, Mr. J. A. Ross and Dr. R. A. Ross. The chairman is a lawyer, and there are two engineers and two manufacturers on the Commission.

In an article on Trolly Omnibuses in "Indian Engineering" it is suggested that RAILLESS TRACTION might be adopted in certain cases of approaches to hill stations, where good roads exist. At GAUHATI-SHILLONG, for instance, there is a first-class road, and hydro-electric power could be provided cheaply in the locality. With cheaper and quicker transport than that now available, the possibilities of Shillong are believed to be unlimited.

Foreign Notes.

The third INTERNATIONAL CONGRESS OF CONSULTING ENGINEERS, organised by the Federation Internationale des Ingenieurs Civils, will take place at Warsaw from the 28th to the 31st inst.

According to the 1920 census, there are 27 077 electrical engineers engaged in the practice of their profession in the UNITED STATES. This compares with 15 278 shown in the 1910 census. In 1920 there were 212 964 electricians, as compared with 120 241 in 1910.

It is reported that arrangements have been made to merge the Dubilier Condenser Company of America, the Federal Mica Company and the Cambridge Manufacturing Company into one corporation, to be known as the DUBILIER CONDENSER AND RADIO COMPANY.

Forty American investment bankers who are at present in France have come over, the "Chicago Tribune" (Paris edition) states, primarily to inquire into some HYDRO-ELECTRIC PROJECTS ALONG THE RHONE and in the Pyrenees. The estimated cost of harnessing the Rhone is over five hundred million francs.

The supply of RADIO RECEIVING SETS is developing into a big business in the UNITED STATES. For instance, the Westinghouse Company is reported to be turning out 500 outfits a day at present, and its production capacity is to be increased to 1 000 a day. As there are several other manufacturers engaged in the same field it will be seen that the radio "craze" is very acute.

In the report of the AMERICAN ENGINEERING STANDARDS COMMITTEE it is stated that work is now proceeding on 79 distinct projects, and 160 National Associations are co-operating. During 1921 the Committee approved 15 standards, including a standard method for sampling coal, The National Electrical Code Specifications for soft or annealed copper, and the Industrial Lighting Safety Code.

An AMBITIOUS ELECTRICAL PROGRAMME has been prepared by the Superior Council of Public Works of FRANCE. It is suggested that hydro-electric generating stations of a total rating of 1 370 000 kW should be erected with a high-tension transmission system of 9 000 to 10 000 miles. The cost is estimated at 15 000 000 francs, to be spread over 15 years. If carried out the scheme will make France less dependent upon imported coal.

The shareholders of the ILLINOIS CENTRAL RAILROAD COMPANY have authorised the issue of $50 000 000 preferred stock in order to finance the company's Chicago terminal. Over $80 000 000 will be spent on the work, and the suburban service must be electrified by 1926. Further time is allowed for other portions of the scheme, but through passenger service must be operated completely by electric service by 1939. Mr. A. S. Baldwin, vice-president, in charge of electrification, and Mr. Hugh Pattison, chief engineer, are visiting Europe in order to study Continental systems.

An important new company, entitled the Societá Italo-Americana per la Elettrotrazione, has been formed in Italy for the purpose of constituting an ASSOCIATION OF ITALIAN POWER COMPANIES AND AMERICAN FIRMS in order to promote the generation and distribution of electricity and the construction and working of electric railways and tramways. The principal object of the company is the adoption in Italy of American systems of continuous current traction at high potential, and some Italian engineers have been sent to the United States in order to study electrification methods.

An ENGINEERING STANDARDS COMMITTEE of 70 members was recently formed in Japan, and much useful work has already been undertaken, including investigations into electric wires and cables and electric motors. The Minister of Agriculture and Commerce is president of the Committee. There are seven secretaries, all engineers in government departments. The "Electrical World" states that there are now national standardising committees or associations in the following countries: Austria, Belgium, Canada, Czechoslovakia, France, Germany, Great Britain, Holland, Italy, Japan, Norway, Sweden, Switzerland and the United States.

Breaking records is one of the pleasant pastimes of our American friends, and judging from the statistics published in the "Electrical World," the supply industry is out to keep itself well "in the limelight," or perhaps we ought to say the electric light. During February the AVERAGE DAILY OUTPUT OF ELECTRICITY IN THE UNITED STATES was 132 720 000 units, or 1 840 000 units more than the previous highest record, in December last. Another feature of the month's record was a drop in the lighting loads, owing to the longer days, and an increase in industrial power requirements. During 1921 the total output was 43 905 000 000 units against 45 678 000 000 in 1920, but notwithstanding this drop the total revenue showed an advance of 7 per cent.

The total consumption of ELECTRICITY IN ITALY in 1919-20 for lighting power and traction was 3 826 562 180 units, or an average consumption of about 9·5 units per head of the population. There is great activity in the development of water power, and even at present most of the plant is hydro-electric. In Lombardy, the most highly developed part of the country, there are plants of 603 000 kW, but less than one-sixth are steam driven; and in Piedmont, out of 405 000 kW steam sets only account for 30 000 kW. Considerable progress has been made since the war, especially in connection with the electrification of railways and hydro-electric schemes, as the high cost and scarcity of fuel compelled attention to the development of a substitute for imported coal.

Mr. Malan, South African Minister of Mines and Industry, introduced into the Union House of Assembly last week an ELECTRICITY BILL providing for the appointment of a Commission for establishing and maintaining stations for the supply of electricity to Government and local authorities, companies, and individuals, also for an investigation regarding additional supplies and the co-ordination of existing undertakings with a view to stimulating the provision of a cheap and abundant supply of electricity. Except in the case of municipalities the Commission would be empowered under the Bill to fix prices and order a return to consumers of 25 per cent. of the surplus profits. After 38 years the Government may give two years' notice of its intention to expropriate all but municipal electrical undertakings, paying nothing for goodwill or prospective profits.

The Engineering Industry in Belgium.

Mr. R. F. H. DUKE, H.M. Commercial Secretary at Brussels, states in his annual report on the economic situation of Belgium that many of the engineering firms have profited by the slackness in trade during 1920 and 1921 to complete the reconstruction of their works damaged by the Germans and to install new equipment. At the same time attention has been given to the importance of making Belgium independent of other countries, and particularly Germany, in regard to electrical material, and during 1919 six new electrical factories were established, manufacturing conduits, switch boards, incandescent lamps, machinery and signal apparatus. The Ateliers de Construction Electrique de Charleroi, which has a capital of 40 000 000 francs, has installed entirely modern machinery and extended its works. Varied types of machinery are manufactured by this firm, from ½ H.P. motors to the most powerful alternator, with all necessary high and low tension appliances. The construction of extraction machines and sets of centrifugal motor pumps for coal mines has also been developed during the year, the production of small motors in series has been organised, and the cable works have been extended.

The Société d'Electricité et de Mécanique Procedés Thompson Houston et Carels have also extended their works; the machine tool and mounting department has been enlarged, the foundry for small parts has been doubled; and a mechanical foundry installed. Large modelling workshops have been built, and also a warehouse for general purposes. Regulators, alternators, transformers and large motors are now manufactured, while as regards the mechanical construction of Diesel motors and steam engines, it is claimed that production has reached the pre-war figure.

German competition in the electrical constructional industry is, however, states Mr. Duke, growing serious in Belgium, and the Allegemeine Electricitaets Gesellschaft have opened offices in Charleroi under the mask of a Luxemburg firm. Any sale of British technical goods in this country is exceedingly difficult owing to the high prices quoted.

The Post Office (Pneumatic Tubes Acquisition) Bill passed its second reading in the House of Commons on Monday, and was referred to a Select Committee.

Miscellaneous.

LICENSES OF RIGHT have been granted to E. L. R. Couch for Patent No. 23 454/13 for "improvements in apparatus for electrolytically cleaning articles."

INCANDESCENT ELECTRIC LAMP BULBS are not apparently included in the Coal Mines (Temporary Provisions as to Safety Lamps) Bill, and only glasses for flame lamps are to be dealt with.

The late MR. JACOB ATHERTON, director of the County of London Electric Supply Company and the South London Electric Supply Corporation has left estate valued at £20 603 (net personalty £2 328).

A CENOTAPH to the employees of the Birmingham Corporation Electric Tramways, who were killed in the war has been erected on the Tramways' Stadium, at Kings Heath, and will be dedicated by the Bishop of Birmingham on Sunday, and unveiled by Lt. Clarke of the Dorset Regiment.

At a meeting of the Council of the South Wales and Monmouthshire University College, Cardiff, the Finance Committee reported that the bequest of the late Sir Archibald D. Dawnay to the South Wales Institute of Engineers had enabled the college to offer an "ARCHIBALD DAWNAY" SCHOLARSHIP of the value of £50 a year, tenable for three years, for competition at the entrance scholarship examination held in April last.

A committee of eleven members, including Mme. Curie, Professor of Physics, University of Paris, Herr Einstein, Professor of Physics, University of Berlin, and Señor de Torres, Director of the Electrotechnical Laboratory, Madrid, have been appointed by the Council of the League of Nations to study the question of INTERNATIONAL INTELLECTUAL CO-OPERATION in conformity with the resolution passed by the second General Assembly of the League.

We regret that owing to an oversight, it was stated in our issue of April 28 that the NEW GRIMSBY EXCHANGE was the first automatic telephone installation in the country. This is, of course, not the case. Automatic exchanges at Epsom, Accrington, Chepstow, Portsmouth, Paisley, Blackburn and Leeds were all in existence before that at Grimsby, and in every case the work was carried out by the Automatic Telephone Manufacturing Company.

A METER FOR STAMPING LETTERS was tested and approved by the Post Office last week when letters at the rate of 250 a minute were post-marked, stamped, sealed, counted and stacked. These meters, it is understood, will be obtainable under license from the Post Office, and attached to specially electrically operated machines in the offices where they are to be used. Each meter has a maximum capacity of 100 000 imprints, which are paid for in advance. A new supply is obtained by taking the meter to the Post Office to be reset. After each setting the register door is locked and officially sealed.

On Thursday, May 11th, Swan, Hunter, and Wigham Richardson, Ltd., launched from their Neptune Shipyard, Walker, a TELEGRAPH CABLE REPAIRING STEAMER, constructed for the Commercial Cable Co. of New York. This vessel, called the "Marie Louise Mackay," is smaller than the "John W. Mackay," launched by the company last November. She is 246 ft. in length by 34 ft. in breadth by 24 ft. 4 in. in depth, and will be propelled by twin screw machinery. The cable will be carried in three cable tanks, placed forward of the propelling machinery, and having a total coiling capacity of about 18000 cub. ft. The machinery required for working the cable includes picking up and paying out gears, Lucas dynamometers, and a Lucas patent sounding machine, and is being supplied by the Telegraph Construction and Maintenance Company.

Fatal Accidents.

AN OPEN VERDICT was returned at the inquest held on Saturday by Sheriff Shennan and a jury into the deaths of Andrew Martin and John Chalmers, miners, who were killed by an explosion in No. 1 Pit in Viewpark Colliery, Uddingston, on April 11. The evidence showed that the explosion occurred at an electrical coal cutter in the splint coal seam of the pit. It was stated that complaints with regard to the coal cutter had been made, and that the machine had been repaired by the colliery electrician, who stated that it was in good order prior to the explosion. After the explosion the machine was found to be without certain studs and bolts.

In order to obtain a good view of a local cricket match at Hull on Saturday, THOMAS BUTLIN, aged 12, climbed an electric standard and was KILLED through touching the live wires. At the inquest on Monday it was stated that there was barbed wire round the pole about half-way up, but Butlin got past it. The boy did not know he was trespassing, as there was no notice board on the gate. The Deputy Coroner (Dr. T. C. Jackson) said that the Corporation, acting upon instructions of the Board of Trade, had every fifth pole marked "Danger." A boy, Taylor, who was with Butlin at the time of the accident, and who had tried to prevent him from climbing the pole, said he noticed the next post to where the accident happened had "Danger" on it, and he pointed this out to his companion, who said: "This one will be all right." A verdict of "Accidental death" was recorded. Mr. Hopkins (for the Hull Corporation) said he would report the circumstances to the Electricity Committee, who would see whether anything could be done to prevent a similar accident in the future.

Obituary.

We regret to report the death on Sunday of MR. R. E. GRAVES, Chief Inspector of Factories.

The death occurred on May 10, at the age of 61, of MR. FREDERICK EDWARDS, electrical engineer, of 2, Brooke Street, Dumfries.

The death took place at Llangammarch on Wednesday, May 17th, of MR. JOHN TEMPLE, C.B., in his eighty-fourth year. Mr. Temple entered the telegraph service in 1852, and after serving in Leeds, Manchester, and London, working on the staff of Sir Charles Bright, engineer-in-chief, obtained a post on the "Agamemnon" during the laying of the first cable across the Atlantic. After acting for three or four years as engineer for the Malta and Alexandria Cable and other cable companies he returned to England, and in 1865–6 assisted in laying the second Atlantic cable.

The death is announced of the distinguished American metallurgist, PROF. HENRY MARION HOWE, University of Harvard; and Professor Emeritus of the Columbia College, New York. Among his many contributions to the science of metallurgy was his great work on "The Metallurgy of Steel," published in 1891. He was also the author of innumerable papers on metallurgical subjects. In 1895 he received the Bessemer gold medal of the Iron and Steel Institute, and the Elliot Cresson gold medal of the Franklin Institute of Philadelphia; also a special prize and gold medal from the Société d'Encouragement pour l'Industrie Nationale, and, finally, in 1917, the John Fritz gold medal, an honour he shared with Lord Kelvin, who received it in 1905, Sir William White in 1911, and Sir Robert Hadfield last year.

Catalogues, Price Lists, &c.

The "GENII P.S." (push system) WATER HEATERS are illustrated and described in Leaflet Y 204 just issued by the manufacturers, George Nobbs, Ltd.

BRITISH INSULATED AND HELSBY CABLES, LTD., have sent us a copy of Pamphlet P.174, which they have just published, giving a list of cables supplied by them for working pressures of 11 000 V and over. This shows that 1 370¼ miles have been supplied at a voltage between 11 000 and 12 000 V, 114 at 13 000 V, 495 at 20 000 and 22 000 V, 17½ at 25 000 V, 39¼ at 33 000 V, 12 at 100 000 V.

Eight new leaflets have just come to hand from the EDISON SWAN ELECTRIC COMPANY, and deal respectively with moving coil switchboard type instruments (IN 252/5 and IN 252/6), portable combined testing set (IN 252/40), moving iron switchboard type instruments (IN 252/106), moving iron instruments for direct or alternating currents (IN 252/105), galvanometers (IN 252/79), moving coil type cell testers (IN 252/77), and insulation testing set (IN 252/73).

We have received from the ENFIELD EDISWAN CABLE WORKS a most useful wall calendar, which will carry us through to the end of next March. Beneath a photograph, showing the "Quest" (fitted with Enfield cables) in the Thames before starting for the Antarctic, are monthly tear-off slips of the same dimensions. The figures are printed in large black type, and below the calendar for the current month that for the preceding and following month is also given.

Arrangements for the Week.

FRIDAY, MAY 26th (to-day).

PHYSICAL SOCIETY OF LONDON.

5 *p.m.* At the Imperial College of Science, South Kensington, London. Lecture on "Atomic Weights and Isotropes," by Dr. F. W. Aston, F.R.S.

WOMEN'S ENGINEERING SOCIETY.

7 *p.m.* At 26, George Street, Hanover Square, London. Paper on "Wireless Telegraphy," by Mr. H. R. Rivers-More, B.Sc.

JUNIOR INSTITUTION OF ENGINEERS.

8 *p.m.* At Caxton Hall, London, S.W. "Engineering Appointments and How to Get Them," by Mr. J. Cameron Rennie.

ROYAL INSTITUTION OF GREAT BRITAIN.

9 *p.m.* At 21, Albemarle Street, London, W.1. "The Internal Combustion Engine: Its Influence and Its Problems," by Mr. W. E. Dalby, B.Sc., F.R.S.

TUESDAY, MAY 30th.

INSTITUTION OF ELECTRICAL ENGINEERS (SUMMER MEETING).

10 *a.m.* At the Royal Technical College, Montrose Street, Glasgow. Paper on "The Dalmarnock Generating Station," by Mr. R. B. Mitchell.

WEDNESDAY, MAY 31st.

INSTITUTION OF ELECTRICAL ENGINEERS (SUMMER MEETING), 10.15 *a.m.* At the University, Glasgow. Paper on "The Hydro-Electric Resources of the Scottish Highlands." by Prof. Magnus MacLean.

THURSDAY, JUNE 1st.

THE JUNIOR INSTITUTION OF ENGINEERS.

7.30 *p.m.* At the Institution of Electrical Engineers, Victoria Embankment, London, W.C.2. Gustave Canet Lecture on "The Railway Act, 1921," by the Rt. Hon. Sir Eric Geddes, G.C.B., G.B.E.

Companies' Meetings, Reports, etc.

Indian Electric Supply and Traction.

In the course of his speech at the annual meeting of the Indian Electric Supply and Traction Co., on Monday, Mr. John G. B. Stone, who presided, said that the company's earnings in Cawnpore showed steady expansion, but in remitting to this country the directors had had to contend with the fall in the exchange value of the rupee from 1s. 11¾d. to 1s. 4d. Owing, however, to their conservative policy in the distribution of profits in the past the directors were still in a position to recommend the same dividend as last year—namely, 10 per cent.—and to add a reasonable figure to the reserves. In the past year the output had been increased from 4 334 724 units in 1920 to 5 204 324 in 1921. The earnings of the company in India were £26 416, as compared with £35 189 in 1920. The fall in exchange accounted for nearly £10 000. They had erected a new alternating current h.t. power station on the banks of the Ganges, which was at present equipped with 6 000 kW of plant. Unfortunately, owing to unforeseen delays in delivery and erection of plant, the company had not yet had the benefit of its output, but the station was expected to be in working in August, if not earlier. As soon as the new station was open they would secure a large addition to their earnings, and so rapidly had the demand, actual and prospective, increased that in order to meet it they had found it essential to make arrangements for a further large extension to the new power station, for which purpose debentures had been issued to the extent of some £250 000, including the conversion and repayment of the existing outstanding £49 600 debentures. In order to get a closer and more accurate view of the company's business in Cawnpore, he went there in the early part of this year. It was a very active centre of trade, and in order to provide for the growth of its industries, etc., it had been found necessary to lay out a large new area as an extension to the city. The work was being actively pressed forward, and he did not think it would be more than a year or two before there would be an active demand from this new area.

Hurst, Nelson & Co. announce an interim dividend of 1s. per share, free of tax, on the ordinary shares.

Brisbane Electric Tramways Investment Company announce a dividend of 4s. per share, tax free, on the ordinary shares for the half year, making 8 per cent. for the year, carrying forward £46 163 subject to corporation profits tax.

The directors of the British Electric Traction Company recommend, subject to audit, the payment of a dividend of 4½ per cent. on the ordinary stock for the year ended March 31 last, compared with 4 per cent. for the previous year.

The profit of La Plata Electric Tramways for 1921, after providing for debenture and other interest, was £2 720, making with £14 531 brought in £17 251. The sum of £10 000 has been placed to reserve, leaving £7 251 to be carried forward subject to corporation tax, if any.

Allotment letters in respect to the recent issue of £250 000 Calcutta Tramways 7 per cent. second mortgage debentures, which was largely over-subscribed, show that applicants for less than £400 have been passed over. Applicants for over £400 and up to £1,000 have only received £100, and larger applicants in like proportion.

The annual meeting of the Rhondda Tramways Company was held last Thursday, Mr. Harold T. Barnett (chairman) presiding. Out of the disposable balance, £5 000 has been transferred to the reserve and renewals account, £4 000 in payment of a 4 per cent. dividend on the preference shares, leaving £1 825 to be carried forward. The election of Mr. E. Morley to the board to fill the vacancy caused by the death of Mr. Schlesinger, chairman of the company, was confirmed.

The accounts of the Ramsgate & District Electric Supply Company for the year to December 31 last show gross profit of £8 033 compared with £5 356 for 1920. After providing for preference share dividend, interest on loans and income tax, and adding the amount brought forward from last year, £477, there remains a balance of £6 011. The directors recommend the payment of a dividend of 10 per cent., that £2 200 be placed to the reserve account, and £1 500 to reserve for depreciation, leaving a balance of £311 to be carried forward.

The report of Johnson and Phillips, Ltd., for 1921 shows profit (including claim for repayment of excess profits duty), after making provision for bad and doubtful debts, and after charging to revenue upwards of £16 000 for maintenance of buildings, plant, etc., of £42 737, plus £38 727 brought in. After deducting directors' remuneration, debenture interest, etc., £18 428 for income and corporation taxes, and £12 255 for depreciation on machinery, etc., £15 138 remains to be carried forward. In view of the present state of trade caused by the engineers' lock-out and the consequent falling off of business, the directors do not recommend payment of a dividend on this occasion.

The South Eastern and Chatham Railway Companies Managing Committee, the S.E.R. Co., and the L.C. & D.R. Co. give notice of intention to apply to the Minister of Transport for an Order under Sec. 1 (1) (*b*) and (*c*) of the Railways Electrical Power Act, 1903, to authorise the construction of a generating station at Angerstein Wharf, Charlton, and works and transmission lines necessary for conveying electric power to certain of their railways in North and Mid Kent, and to work such railways by electric power, etc. A meeting of the proprietors of the S.E. Railway Company is to be held on June 2 to consider this application, and to authorise an agreement with a construction company for the electrification of the suburban lines of the South-Eastern and Chatham Railway Companies.

The net revenue of the Birmingham District Power and Traction Company for the year ended December 31 last, from the tramways and from dividends and interest upon investments, was £99 830. After deducting payments to local authorities, income tax, etc., there is a surplus of £62 840, while £4 508 was brought forward, making a total of £67 348, from which had to be deducted interest on debenture stock, provision for renewals, dividend on the cumulative participating preference shares, and £9 430 placed to the debenture sinking fund, leaving a balance of £25 657. The directors recommend a dividend of 6 per cent. on the ordinary shares, carrying forward £2 981. The Shropshire, Worcestershire, and Staffordshire Electric Power Company was also affected by the trade depression, but there were signs of improvement in the industrial position.

The net profit of Babcock and Wilcox, Ltd., for the year to December 31, 1921, amounted to £490 181, to which was added the balance brought forward from the last account of £99 828, making £590 008 10s. From this sum had to be deducted interim dividends paid in November of 3 per cent. on the preference shares, 2½ per cent. on the second preference shares, and of 7 per cent. on the ordinary shares, amounting to £157 894, leaving a balance of £432 114, from which the directors recommend that the following dividends be paid for the half-year ending December 31 last: 3 per cent. on the preference shares (less income tax), £3 000; 2½ per cent. on the second preference shares (less tax), £4 476; 9 per cent. on the ordinary shares (tax free), £193 394 10s., making a total of £200 871. The sum of £150 000 is to be placed to reserve and £10 000 to the staff pension fund, leaving a balance to be carried forward of £71 243.

The report of Siemens Brothers and Co. for 1921 states that the company has not escaped from sharing in the general trade depression, though it had obtained its full share of orders in the market. Fortunately, contracts in hand from 1920 enabled the company's output to be maintained almost on the previous year's level, except in the case of submarine telegraph cable shops, where work became scanty in the latter months of the year. Prospects in this department are now better. Reduction in output of lamps from Dalston factory was necessary owing to the general depression also affecting the lamp trade and to dumping of Dutch lamps on the English market and colonies. Dumping has now been effectually stopped, so far as gas-filled lamps are concerned, by a recent judgment in the House of Lords upholding an important patent in which the company is interested controlling manufacture of such lamps in this country. No definite assessments have yet been made for liability to excess profits duty for 1918, 1919 and 1920, but £100 000 was paid during the year in respect of same. Profits for 1921 are not liable. The profit was £200 093, plus £437 218 brought in, making £638 212, less corporation tax for 1920 and 1921 £29 100. The directors recommend a final dividend of 1s. per share on the ordinary shares, making 10 per cent. for the year, free of tax, to write off book value of s.s. "Faraday" £10 000, carrying forward (subject to balance of excess profits duty for 1918, 1919 and 1920) £334 112.

The report of the British Thomson-Houston Company for 1921 states that no new works were begun during 1921, and the amounts expended during the year were principally in connection with the completion of the extensions at Rugby, and with the glass works being erected at Chesterfield. It is expected that the latter will be completed during the current year. The profits for the year, after deducting all expenses and charges other than interest on debentures and loans, were £509 259, plus £225 892 brought in, making £735 150, less interest on debentures and loans, £119 446, leaving £615 704. Of this amount the directors recommend that £160 000 be placed to depreciations, reserves, etc., and the payment of dividends at 7 per cent. free of income tax on the preference shares, and 6 per cent., tax free, on the ordinary shares, leaving £230 704 to be carried forward. Arrangements on reasonable terms are practically completed with the holders of the preference shares, whereby from January 1, 1922, the dividends thereon will be at the rate of 7 per cent. per annum, subject to income tax. During the year, the directors arranged for the issue of £1 500 000 par value 7 per cent. mortgage debenture stock, being part of an authorised issue of £3 000 000. The issue was largely over-subscribed. From the proceeds the company's indebtedness was substantially reduced, and since December 31 the entire amount due to the International General Electric Company has been paid off. Debenture stock outstanding amounts to £146 995. The amount outstanding at December 31, 1921, was £152,295. Since the beginning of the year, £7 500 par value of the new 7 per cent. debenture stock has also been retired.

New Companies.

Hamilton and Co.

HAMILTON AND CO., LTD. (18 222). Private company. Reg. in Edinburgh, May 18. Capital, £2 000 in £1 shares. Electrical, consulting and general engineers, etc. Subscribers: A. G. Hamilton and A. R. Fyfe. Registered office: 135, Buchanan-street, Glasgow.

Calphos Electrical Company.

CALPHOS ELECTRICAL COMPANY, LTD. (181 726).—Private company. Reg. May 12. Capital, £100 in £1 shares. Dealers in electric and other lamps and fittings, &c. First directors: J. Pedersen and F. E. Kewley. Reg. office: 66, Victoria-street, London, S.W.

W. K. Simpson and Company.

W. K. SIMPSON AND CO., LTD. (181 674.) Private company. Reg. May 9. Capital, £2 000 in £1 shares. Manufacturers of and dealers in scientific instruments of all kinds, electrical apparatus, etc. First directors: W. K. Simpson, F. J. Milestone. Registered office: 38, Goddard Avenue, Hull.

Sadgrove & Company (Birmingham).

SADGROVE & COMPANY (BIRMINGHAM), LTD. (181 770).—Private company. Reg. May 13. Capital, £5 000 in £1 shares. Autogenous welders, mechanical, constructional, electrical engineers, &c. Subscribers: H. F. V. Sadgrove and H. J. Ardley. Secretary: H. G. Sadgrove. Reg. office: 140, Conybere-street, Birmingham.

Good Bros.

GOOD BROS., LTD. (181 852). Private company. Reg. May 18. Capital, £3 000 in £1 shares (2 900 cumulative preference and 100 ordinary). Manufacturers of and dealers in electrical, magnetic, telegraphic, telephonic and other appliances, etc. Permanent directors: S. Coxon, W. Inglis and F. M. Soulsby. Registered office: 35, South John-street, Liverpool.

Triumph Electric Manufacturing Company.

TRIUMPH ELECTRIC MANUFACTURING COMPANY, LTD. (181 843).—Private company. Reg. May 17. Capital, £6 000 in £1 shares. To acquire the business carried on by A. T. Costigan and C. E. Jenks, trading as "The Triumph Electric Company," at 16, Loveday-street, Birmingham. Permanent directors: A. T. Costigan, C. E. Jenks and W. L. Topple. Registered office: 16, Loveday-street, Birmingham.

Woodcliff.

WOODCLIFF, LTD. (181 910).—Private company. Reg. May 19. Capital, £2 000 in £1 shares. Manufacturers and sellers of all electrical and mechanical processes or appliances for treating silver or other metals, etc., and to adopt an agreement with R. F. Woodburn. First directors: R. F. Woodburn (managing director), W. Ratcliff and H. R. Wilson. Secretary: H. R. Wilson. Registered office: 33, Southwick-street, Paddington, W.2.

T. C. Murphy & Company.

T. C. MURPHY & COMPANY, LTD. (181 771).—Private company. Reg. May 13. Capital, £3 000 in £1 shares (500 preference and 2 500 ordinary). To adopt an agreement with Ada A. Murphy, and to carry on the business of manufacturers of and dealers in ebonite, vulcanites, rubber goods, and other insulating materials. First directors: G. H. Almenrader and Mrs. A. A. Murphy. Registered office: 10, Manchester-avenue, Aldersgate-street, E.C.1.

John Fowler and Co. (India).

JOHN FOWLER AND CO. (INDIA), LTD. (181 834). Private company. Reg. May 17. Capital, £1 000 in £1 shares. To acquire the branch business carried on by John Fowler and Co. (Leeds), Ltd., in India, and to carry on the business of civil, hydraulic, telegraph, mechanical and general engineers, manufacturers of and dealers in wire and other cables, etc. First directors: A. Fowler, C. H. Fowler, E. G. Pelly and T. Davis. Reg. office: 113, Cannon-street, E.C.

H. Cecil Taylor.

H. CECIL TAYLOR, LTD. (181 779). Private company. Reg. May 15. Capital, £2 000 in £1 shares. To acquire the business of an advertising agent and consultant carried on by H. Cecil Taylor at 15-16, Steelhouse-lane, Birmingham, and to carry on the same and the business of electricians, manufacturers of and dealers in mechanical devices and illuminated and other signs for advertising, etc. First directors: H. C. Taylor, I. Mindelsohn and J. W. Pickavant. Registered office: 6, Grosvenor-buildings, Steelhouse-lane, Birmingham.

Gas and Electricity Development Company.

GAS AND ELECTRICITY DEVELOPMENT COMPANY, LTD. Registered May 9. Private company. Nominal capital, £2 000 in £1 shares. To adopt an agreement with Sir Charles Bright and Partners, Ltd., The Premier Gas Engine Co., Ltd., Crompton and Co., Ltd., and F. J. Palmar, and to carry on the business of gas, electricity and water supply, etc., engineers, electricity and gas makers and distributors, consultants, technical and financial advisers, and heat, light and power specialists, etc. Signatories to the Memorandum of Association: E. W. Goodale and R. W. Fiddes. Registered office: 146, Bishopsgate, E.C.2. The file number is 181 648.

Tenders Invited and Accepted.

UNITED KINGDOM.

SHEFFIELD ELECTRICITY DEPARTMENT. May 30.—Supply of materials and works required in connection with the erection and completion of a transformer sub-station in Standon Road, Wincobank; also of a small pump house at Blackburn Meadows power station, Sheffield. Particulars from Mr. S. E. Fedden, General Manager and Engineer, Commercial Street, Sheffield.

ISLINGTON (LONDON) BOROUGH COUNCIL, June 1.—Renting of electric light standards for affixing electric advertisement signs. Forms of tender, etc., from the Electrical Engineer, 50, Eden-grove, Holloway, N.7.

BARNES ELECTRICITY DEPARTMENT, June 5.—Supply, laying and jointing of about 3,500 yds. of triple concentric l.t cable. Particulars from Mr. C. S. Davidson, Electricity Works, High Street, Mortlake, S.W.

RHONDDA URBAN COUNCIL, June 6.—Two sets of switchgear for sub-stations. Specification, etc., from the Engineer, Electricity Works, Porth, Glam.

Y.M.C.A., OLD COLWYN, June 7.—Lighting scheme. Particulars from Mr. J. Evans, Architect, Mohrcroft, Old Colwyn.

MANCHESTER ELECTRICITY COMMITTEE, June 13.—Specification No. B.32, electrical distance indicating and recording thermometers; 5 electrically driven fans (B.33); 6 electrically driven auxiliary circulating water pumps (B.34); electric capstans and bollards (B. 35). Particulars from Mr. S. L. Pearce, chief engineer and manager, Dickinson Street, Manchester.

SALFORD ELECTRICITY DEPARTMENT, June 15.—Supply and erection of turbo-generators (specification A.P.S.1); boilers, stokers, etc. (specification A.P.S.2). Particulars from the Borough Electrical Engineer, Electricity Station, Frederick Road, Salford.

AUSTRALIA.

THE VICTORIAN STATE ELECTRICITY COMMISSIONERS, September 1.*—Supply and delivery of (1) feed water heaters and vapour condensers (specification No. 226); (2) feed water evaporators (specification No. 227).

VICTORIAN ELECTRICITY COMMISSION, June 17.—Aluminium steel-cored cable and accessories. Specification (No. 243) from the Agent General for Victoria, Melbourne-place, Strand, London, W.C.2.

WELLINGTON CITY CORPORATION, June 10.—Supply and delivery, c.i.f., of one 25-ton overhead travelling crane (Sec. "C"); three 1 500 kW rotary converters with transformers, and one 500 kW rotary converter with transformer (Sec. "D"). Particulars from Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W.1.

BULGARIA.

BULGARIAN POST AND TELEGRAPH AUTHORITIES. June 15.* Supply of: (1) 1 A fuses, (2) cartridge fuses for protection from lightning, (3) 3 A fuses, (4) line annunciators, (5) carbon lightning arresters.

ITALY.

ITALIAN STATE RAILWAYS. July 31.—The limit of the period for the reception of tenders for the electrification of the Bologna-Venice-Monfalcone line, fixed previously for April 30 last, has been postponed until July 31, 1922. Offers received before April 30 will be returned in order that they may be re-presented before July 31.

The EDISON SWAN ELECTRIC CO. have secured from the War Office a contract for the supply of dry batteries.

BIDEFORD AND DISTRICT ELECTRIC SUPPLY CO. has accepted the tender of Crompton and Co. for the erection and equipment of an electricity generating station, &c.

CHIPPENHAM Town Council has accepted the tender of the Electric Supply Co. for electricity for public lighting for six months at 6½d. per unit and £1 7s. per quarter for maintenance.

A Reuter's message states that the GOVERNMENT OF NEW ZEALAND has accepted further tenders aggregating £32 000 in connection with hydro-electrical installations on the Waikato River, Auckland Province. The acceptances comprise tenders for head gates, turbines, generators, and exciters. All the tenders accepted were British, including one Canadian, although in some cases foreign tenders were the lowest.

LONDON County Council have accepted the following tenders for works at the new County Hall: Express Lift Company, eight electric service lifts (extension of existing sub-contract), £3 470; Stella Conduit Company, steel conduits and accessories, £2 889 2s., further quantities, not exceeding £4 000, and c.i. boxes, £263 14s. 6d., further quantities not exceeding £600; Dorman & Smith, main switchboard for auxiliary lighting supply, £800; Crompton & Company, motor-booster for auxiliary lighting supply, £850; P. W. Rands, electric fittings (about 600), £950; Davis, Cash & Company, ditto (about 960), £1 170; Best & Lloyd, ditto (about 750), £600; Dorman & Smith, cut-outs for permanent installation, £230; Hooper's Telegraph & Indiarubber Works, Ltd., twin flexible conductors, £150; Sterling Telephone & Electric Company, about 70 division bells, £450; Lamson Pneumatic Tube Company, pneumatic despatch tube in connection with electric annunciators, £100.

SYDNEY (N.S.W.) Corporation have accepted the tender of the Electricity Meter Manufacturing Co., for 5A meters, £3 187.

MOUNTAIN ASH Urban Council have accepted the tender of W. T Henley's Telegraph Works Co. for e.h.t. overhead and underground transmission mains. Five tenders were received.

MELBOURNE (Victoria) Electricity Supply Committee have accepted the tender of British Insulated and Helsby Cables, Ltd., for copper bars, £153, and 25 tons bare h.d. copper cable, £3 267.

GLASGOW Corporation have accepted the following tenders: Metropolitan-Vickers Electrical Co., h.p. switchgear for Whitevale sub-station; Electro-Mechanical Brake Co., spare resistance for electric welding plant; J. Spencer, Ltd., steam piping for 10 000 kW turbo-alternator; Stewarts and Lloyds, Ltd., tramway poles.

HAMMERSMITH Borough Council have accepted the tender of the Hackbridge Cable Company for 1 000 yards 0·05 l.t. cable at £163 10s., 500 yards 0·2 l.t. cable at £183 5s., and 500 yards $\frac{7}{16}$ twin cable at £43 10s.; also the tender of Ferranti, Ltd., for the supply of ordinary and pre-payment meters for 12 months commencing April 1, 1922.

HESTON AND ISLEWORTH Urban Council have been recommended to accept the following tenders: Pirelli General Cable Works (lowest tender), 3 500 yards 0·75 sq. in. single core, paper insulated, lead covered cable, for 600 volts, £1 720, and with 15 lead sleeves and connectors for same, £5 6s. 3d. (Seven tenders received, highest £1 925 and £20 for cable and sleeves respectively); G. Warne (lowest tender), 1 500 yards rectangular troughs and covers, 5 in. by $2\frac{3}{4}$ in., 1s. $4\frac{1}{2}$d. per yard (six tenders received, highest 4s. $1\frac{1}{2}$d.); British Insulated and Helsby Cables, Ltd. (lowest tender), two 4-way link disconnecting boxes (five tenders received, highest £82 5s.), with frame and cover, £45 11s.; General Electric Co., £187 (one other tender received, £200), 1 000 ampere feeder panel, with circuit breakers, instruments and switches.

COMMERCIAL INTELLIGENCE.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

GREENHALGH, E., 99, Hawkshead Street, Southport, electrical engineer. £15 2s. 8d. March 29.

HARDACRE, Wilfred Herbert, 174, Corporation Street, Birmingham, electrical and mechanical engineer. £11 4s. 8d. March 22.

KIRK, John William, 19, Kings College Road, N.W., electrical engineer. £12 11s. February 14.

MAXWELL (ARTHUR), LTD., 2, Fairhazel Gardens, South Hampstead, electrical contractors, £14 0s. 7d. March 28.

OBORN, Thomas, junr., 4, Crawford Place, Edgware Road, electrical engineer, £10 9s. 5d. March 28.

ROBERTS, Edward Henry, 34, New Dorset Street, Brighton, electric lamp factor. £54 11s. 7d. March 17.

ROTHERAY, Leonard, 23, Hall Ings, Bradford, electrical engineer, £35 17s. 4d. March 24.

SHAW, F., 51, High Street, Boston, electrical engineer. £20 3s. 3d. March 24.

TRANMERE ENGINEERING CO., LTD., 599, Borough Road, Birkenhead, electrical engineers. £17 0s. 9d. March 20.

WARREN, A., 66, Elm Street, Cardiff, electrical engineer, £36 10s. March 28.

WARNE & SONS, 19B, North End Road, W., electrical enigneers, £20 13s. 4d. March 20.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Winding-up Petition.

CORONA LAMP WORKS, LTD. A petition for winding-up has been presented by the British Thomson-Houston Co., Ltd., and is to be heard before the Royal Courts of Justice, Strand, June 13, 1922.

Bankruptcy Information.

COUPE, George Francis, 2, Spring-gardens, Stockport, electrical engineer. Receiving order, May 13. Debtor's petition. First meeting, May 31, at 3.30 p.m., Official Receiver's Offices, Byrom-street, Manchester. Public examination, June 13, at 10.30 a.m., Court House, Vernon-street, Stockport.

FRANCIS, William, 4, Prospect Place, Cheam, Surrey, electrical engineer. Receiving order, May 16. Creditor's petition. First meeting, May 30, 12.30 p.m., 29, Russell Square, W.C.1. Public examination, June 21, 11 a.m., County Court, Scarbrook Road, Croydon.

MAGSON, Reginald Silver, 10, Stoney Stanton-road, Coventry, as R. S. MAGSON AND CO., electrical engineer. First meeting, May 31, at 3 p.m. Official Receiver's Office, The Barracks, Smithford-street, Coventry. Public examination, June 12, 2.45 p.m., County Hall, Coventry.

MORGAN, Edward William, Eccles Mill, Monton-lane, Eccles, Lancashire, electrical engineer, etc. Receiving order, May 17. Creditor's petition.

Notice of Dividend.

MATHERS, Ernest Edward, 10c, High Street, Doncaster, electrical engineer. Amount per £, 11$\frac{3}{4}$d. First and final. Payable, May 24, 14, Figtree Lane, Sheffield.

Order made on Application for Discharge.

KERSHAW, Arthur, and WOOD, Charles Herbert, in partnership as electrical engineers and merchants, 9, Bradford Road, Dewsbury, under the style of KERSHAW & WOOD. Order made April 5. Discharged subject to consenting to judgment for £200 and costs of judgment.

Partnership Dissolved.

GREEN, Frederick Samuel, CAIG, John David, and CAIG, Archibald, electrical engineers, 61, Renshaw-street, Liverpool, under the style of CAIG BROS. AND JONES, by mutual consent as from April 27, 1922. Debts received and paid by J. D., and A. Caig, who will continue the business.

WALKER, Harold Stephen, PARTRIDGE, John Alfred, and MAYER, Frank Antony, carrying on business for the manufacture, sale and exchange of electrical and wireless instruments and material, 22, Park Road, Colliers Wood, Merton, S.W. 19 under the style of THE WIRELESS EQUIPMENT COMPANY, by mutual consent as from May 8, 1922. Debts received and paid by H. S. Walker and J. A. Partridge.

Edinburgh Gazette.

BROWN (J. L.) AND CO., electrical engineers, 920, Pollokshaws Road, Glasgow. In this sequestration A. P. Gilmour, 174, West George Street, Glasgow, has been elected trustee. Examination of the Bankrupt at 70, Hutcheson Street, Glasgow, Wednesday, May 24, at 10 a.m. Meeting of creditors within the chambers of Nelson, Gilmour and Co., 174, West George Street, Glasgow, Tuesday, June 27, 1922, at 3 p.m. Particulars of claims to the trustee by June 5.

LIVINGSTONE AND MALCOLM, electricians, 7, Canal-street, Coatbridge. In this sequestration William Gilchrist, chartered accountant, Glasgow, has been elected trustee. Examination of the bankrupts in the Sheriff Court House at Airdrie, on Tuesday, May 30, at 10.15 a.m. Creditors' meeting at the trustee's chambers, 30, George-square, Glasgow, on Thursday, June 8, at 11 a.m.

Bankruptcy Proceedings.

GIBBONS, Albert Ralph, 8, The Parade, New Eltham, Kent-electrical engineer. The statement of affairs shows liabilities of £587 and no assets. Debtor attributes his failure to depression in trade, depreciation of stock, losses on contracts and unremunerative wages paid. For eight years prior to 1914 he carried on business as a electrician and automobile engineer at Tunbridge Wells. In March, 1919, he started business at his present address as an electrical and antomobile engineer with £90 capital. The business was successful until about March, 1921, when there was a depression in trade, and he was under the necessity of retaining a number of skilled workmen for whom he had not full remunerative employment. Since September, 1921, the creditors had pressed for payment, and in December, 1921, a creditor obtained judgment for £145. The only books of account kept were a creditors' ledger and cash book. At the first meeting of creditors the matter was left in the hands of the Official Receiver, as trustee of the estate.

MAGSON, Reginald Silver, trading as R. S. MAGSON AND CO., 10, Stoney Stanton-road, Coventry, electrical engineer. The receiving order in this matter was made in May 11 on debtor's own petition. The statement of affairs shows liabilities of £496, while the assets are estimated to realise £283, or a deficiency of £213. Debtor attributes his failure to illness of self and family. He commenced business in March, 1912, at his present address as an electrical engineer, his capital consisting of £20 cash saved. Shortly afterwards he borrowed £40 as additional capital, which had since been repaid. He became aware of his position about four months ago.

RIDGWAY, Fred, and TYNAN, Thomas, trading as RIDGWAY AND TYNAN, 21, Bowling Old-lane, Bradford, electrical engineers. Statement of affairs shows gross liabilities of £439, of which £432 is expected to rank for dividend, against net assets of £79, or a deficiency of £353. At the first meeting of creditors the matter was left in the hands of the Official Receiver as trustee.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Complete Specifications.

171 717 Radio Communication Co., Ltd., and Taggart, J. Scott-. Apparatus for detecting or translating electrical impulses. (20/5/20).
171 716 Ledwinka, J. Jigs for use in electrically welding the parts of automobile bodies. (20/5/20).
145 469 Siemens-Schuckertwerke Ges. Electric driving of ship propellers. (1/8/16).
147 785 Apple, V. G. Dynamo-electric machines. (23/4/17).
149 217 Huth Ges., Dr. E. F., and Loewe, Dr. S. Process and connection for obtaining a strengthening of wireless messages. (11/6/17).
149 664 Ebner, A. Automatic stopping device for talking-machines of all kinds worked by electric motor. (12/7/20). (Convention date not granted).
171 412 Siemens-Schuckertwerke Ges. Synchronous motors for mechanical loads. (21/7/19).
171 743 Vesme, E. Apparatus for the production by electrolysis of gas under pressure. (26/7/20).
171 752 British Thomson-Houston Company, Ltd., Clinker, R. C., and Carter, F. W. Frequency filters. (16/8/20).
171 756 Prentice. H. B. Electric switches. (17/8/20).
150 323. Akt.-Ges. Brown, Boverie et Cie. Regulating resistances composed of contact-pressure elements with spring-pressing mechanism. (26/8/19).
171 782 Young, A. Machine for the generation of electric currents also applicable as a motor. (23/8/20). (Addition to 171 782).
171 795 Metropolitan-Vickers Electrical Company, Ltd. (Westinghouse Electric and Manufacturing Company). Electrical systems of automatic substations. (26/8/20).
171 796 Metropolitan-Vickers Electrical Company, Ltd. (Westinghouse Electric and Manufacturing Company). Automatic electrical sub-station systems. (26/8/20).
163 021 Wilson Welder and Metals Company Inc. Electric rheostats. (7/5/20).
171 808 Igranic Electric Company, Ltd. (Cutler Hammer Manufacturing Company). Electric motor controllers. (3/9/20).
171 809 Metropolitan-Vickers Electrical Company, Ltd. (Westinghouse Electric and Manufacturing Company). Polarized relay for use in controlling rotary converters. (3/9/20).
171 823 Coulson, W. T., and Optalyte, Ltd. Charging-boards for electrical batteries. (14/9/20).
171 829 Sphinx Manufacturing Company, Ltd., and Clark, W. A. Terminal protectors for sparking-plugs. (17/9/20).
171 836 British Thomson-Houston Company, Ltd. (General Electric Company). Electric transformers and the like. (20/9/20).
171 846 Waygood Otis, Ltd. (Otis Elevator Company). Motor control systems for electric lifts and the like. (23/9/20).
171 850 Lofts, G. H. Electric irons that are fitted with a power's-on indicator. (28/9/20).
171 857 British Thomson-Houston Company, Ltd. (General Electric Company). Operating-mechanism for searchlights, guns, and the like. (5/10/20).
171 859 Thompson, H. H., and Davies, A. E. Magnetic separators. (8/10/20).
152 361 Akt.-Ges. Brown, Boveri, et Cie. Process and apparatus for regulating the direct-current voltage in metal vapour rectifier installations. (14/10/19).
171 870 British Electric Plant Company, Ltd., and Whitesmith, I. N. Brush-holder for dynamo-electric machinery. (16/10/20).
171 878 Oldham, O., Oldham, G., and Oldham, J. Electric switches (21/10/20). (Cognate application, 19 097/21).
167 445 Pedersen, P. O. Arc generators for producing oscillating current of high frequency. (5/8/20).
165 433 Bergman, S. R. Electric reactors. (24/6/20).
171 900 Tessmann, H. F., and Horn, R. C. Insulation of electric overhead lines. (23/11/20).
171 904 British Thomson-Houston Company, Ltd. (General Electric Company). Electric motor control systems. (29/11/20).
171 906 Woodburn, R. F. Electric resistance welding. (1/12/20).
155 579 Metropolitan-Vickers Electrical Company, Ltd. Electrolytes for use in electrolytic cells. (9/12/19).
171 911 British Thomson-Houston Company, Ltd. (General Electric Company). Regulating-systems for electric circuits. (8/12/20).
155 833 Automatic Telephone Manufacturing Company, Ltd. Telephone systems. (27/12/19). (Patent of Addition not granted).
157 104 Behn (nee Eplinius), H. Electric resistances. (3/1/16).
171 921 Cattley, L de M. Accumulator plates. (10/1/21).
159 887 Liebreich, E. Process of electrolytically separating chromium. (8/3/20).
158 222 Automatic Telephone Manufacturing Company, Ltd. Automatic telephone systems. (28/1/20).

APPLICATIONS FOR PATENTS.

May 8, 1922.

12 885 A. E. W. Maseyk. Electrically controlled gear-box.
12 886 K. A. Homer. Electric welding of cast iron.
12 890 F. Wilde. Generators, motors, &c.
12 910 J. H. Wild. Electric motors.
12 914 M. Guthrie. Electric lamp reflectors.
12 927 M. W. W. Mackie. Plug and socket connections for electric circuits.
12 939 M. W. W. Mackie. Dynamos and motors.
12 945 Evershed & Vignoles & J. C. Needham. Telegraph apparatus.
12 949 B. T.-H. Co. (G.E. Co.). Sound reproducing machines.
12 959 C. A. W. Hultman. Setting arrangements for selectors in automatic telephone systems, &c. (28/5/21 Sweden.)
12 970 Felten & Guilleaume Carlswerk Akt. Ges. Pupinizing high frequency telephone lines. (7/5/21 Germany.)
12 971 Akt. Ges. Brown, Boveri et Cie. Multiple control apparatus for electric railways. (1/4/22 Switzerland.)
12 974 J. Houston. Locking device for electric lamps.
12 975 Deutsche Glimmlampen-Ges. & J. M. Schmierer. Glow lamps. (9/5/21 Germany).
12 977 M. A. Persson. Electric contact plug.
12 983 English Elec. Co. & W. O. Manning. Trollies for transport of seaplanes, &c.
12 985 A. Wehnelt. Oxide cathodes for discharge tubes. (6/5/21 Germany).

May 9, 1922.

13 007 T. F. Wall. Electric condensers, &c.
13 047 N. F. S. Hecht. Wireless systems.
13 048 N. F. S. Hecht. Thermionic valve circuits.
13 049 R. T. Smith. Regulating wind-driven electric generators on aircraft.
13 059 G. H. Armstrong. Electric switches.
13 067 D. W. Dant. Electric fittings.
13 079 Metropolitan-Vickers Electrical Co., R. Brooks & B. A. G. Churcher. Controllers for electrical apparatus.
13 080 Metropolitan-Vickers Electrical Co., R. Brooks & R G. Cunliffe Controllers for electric traction, &c.
13 081 Metropolitan-Vickers Electrical Co. & A. Priestly. Controllers for electrical apparatus.
13 082 Metropolitan-Vickers Electrical Co., R. Brooks & W. T. Gray. Controllers for electric traction, &c.
13 084 Naamlooze Vennootschap Philips Gloeilampenfabr. & D. Lely. Leading in conductors for vitreous material.
13 085 Naamlooze Vennootschap Philips Gloeilampenfabr. & J. C. Lokker & E. Oosterhuis. Leading in conductors for vitreous material.
13 095 J. H. Compton. Electrically operated organs.

May 10, 1922.

13 117 R. Greaves. Magnetic separators.
13 127 A. D. Clark & P. O. Knowles. Electric switch boxes, &c.
13 168 H. S. Potter, & M.L. Magneto Synd. Electric lamps for mines, &c.
13 169 Callender's Cable Co. & S. E. R. Beecroft. Electric cables.
13 187 H. Booth. Wireless telegraphy and telephony.
13 215 B. T.-H. Co. Electric relays. (5/7/21 U.S.)
13 218 Western Electric Co. Loaded signalling conductors.
13 229 P. Fogarty. Magneto control devices.

May 11, 1922.

13 254 A. Mayere. Arc lamps. (12/5/21) France.)
13 267 O. T. Baker. Exterior adjustable brush rocker for dynamos, &c.
13 278 A. E. Jones & S. Robison. Telephone, &c., call register.
13 298 F. Contelf. Current converting machinery.
13 307 P. H. Taylor. Magnetos.
13 310 A. H. Railing, A. E. Angold, H. C. Turner & P. H. Coales. Tripping gear for automatic circuit breakers.
13 316 F. Cicogna & E. Mariani. Press button switches for electric circuits.
13 322 British Electric Transformer Co. & J. Roothaan. Transformers.
13 330 F. Ainsley & W. Platt. Overhead electric tramway systems.
13 341 F. Crawford. Electric vehicles.
13 342 Western Electric Co. Loaded signalling conductors.
13 343 Naamlooze Vennootschap Philips' Gloeilampenfabr. Electric discharge tubes. (14/6/21 Holland).

May 12, 1922.

12 910 H. F. Basset. Electric motors.
13 382 E. Y. Robinson. Generation of alternating currents by thermionic devices.
13 384 R. W. Strawson. Electrode holder for electric welding.
13 394 J. Dugdill. Movable supports for electric lamps, &c.
13 412 C. R. Jarman. Exploding air bombs by electricity.
13 422 A. P. Strohmenger. Welding electrodes.
13 442 B. T.-H. Co. (G. E. Co.). Circuit controllers.
13 445 A. Rothschild. Wireless induction coil holders.
13 447 A. P. Ford. Portable accumulator cells.
13 450 P. Arnouil. Convertible and multiple electric junction plugs. (12/5/21 France).
13 454 Western Electric Co. Electron discharge devices.
13 460 O. & S. Oilless Bearing Co. & R. B. Wiggins. Checking apparatus for telephone calls.
13 465 Siemens-Schuckertwerke. Pressure applying means. (20/9/21 Germany.)
13 471 Etab. de Dion-Bouton, Soc. Anon. Regulation devices for electric installations. (27/6/21 France).

May 13, 1922.

13 506 Automatic Telephone Manufacturing Co. & C. Gillings. Telephone systems.
13 509 Vereinigte Metall. & Stanzwerke. Vapour lamps.
13 525 J. Dugdill. Movable supports for electric lamps, &c.
13 547 L. G. A. D. C. Gaunt. Electrical control of hydraulic machinery, &c.
13 551 W. P. Granville & W. S. Smith. Cables for submarine telegraphs and telephones.
13 552 Ges. fur Drahtlose Telegraphie. Wired wireless telephone systems. (14/5/21 Germany.)

Prices of Metals, Chemicals, etc.

Tuesday, May 23.

		Price.	Inc.	Dec.
Copper—				
Best Selected	per ton	£65 15 0	£2 5s.	—
Electro Wirebars	,,	£70 0 0	£2	—
H.C. Wire, basis	per lb.	0s. $10\frac{5}{16}$d.	$\frac{1}{4}$d.	—
Sheet	,,	0s. $9\frac{11}{16}$d.	$\frac{1}{4}$d.	—
Phosphor Bronze Wire (Telephone)—				
Phosphor Bronze Wire, basis	per lb.	1s. $2\frac{5}{16}$d.	$\frac{1}{4}$d.	—
Brass 60/40—				
Rod, basis	,,	7d.	—	—
Sheet, basis	,,	$8\frac{3}{4}$d.	—	—
Wire, basis	,,	$9\frac{3}{4}$d.	—	—
Pig Iron—				
Cleveland Warrants	per ton	£4 15 0	—	—
Galvanised steel wire, basis S S.W.G.	,,	£18 0 0	—	—
Lead Pig—				
English	,,	£26 0 0	15s. 0d.	—
Foreign or Colonial	,,	£24 17 6	17s. 6d.	—
Tin—				
Ingot	,,	£150 12 6	£1 2s. 6d.	—
Wire, basis	per lb.	2s. $0\frac{3}{4}$d.	$\frac{1}{8}$d.	—
Aluminium Ingots	per ton	£100 0 0	—	—
Spelter	,,	£27 5 0	5s.	—
Mercury	per bottle	£12 10 0	£1 10s.	—

Sulphur (Flowers)—Ton £10 15s. *Sodium Chlorate*—Per lb. $3\frac{1}{4}$d.
,, (Roll-Brimstone)—per ton £10 15s. *Sulphuric Acid* (Pyrites, 108°) per ton, £9.
Sodium Bichromate.—Per lb. $5\frac{1}{4}$d. *Copper Sulphate*.—Per ton £26 10s.
Boric Acid (Crystals). Per ton £60.
Rubber.—Para fine, $10\frac{1}{2}$d.; plantation 1st latex, $7\frac{1}{2}$d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

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THE ELECTRICIAN

ESTABLISHED 1861.

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CONTENTS.

Notes of the Week.

Wireless and the Wreck of the "Egypt."

At a time when "broadcasting" is shortly to be started in this country, and when pressure is being brought to bear on the authorities to allow further facilities for transmission, both by amateurs and others, the letter from Mr. Thomas Hesketh, managing engineer of the Folkestone Electricity Supply Co., which was published in last Friday's "Times," should be carefully studied. Mr. Hesketh is himself a wireless amateur. On the night when the unfortunate wreck of the "Egypt" occurred he heard two or three separate S.O.S. calls west of the Isle of Wight. Then the jambing of normal traffic prevented further distress calls being heard, until the Niton station in the Isle of Wight and a French station, probably Ushant, began to call on the other stations to keep silence, as they were listening for S.O.S. calls.

An Appeal Disregarded.

According to Mr. Hesketh this appeal was disregarded, at any rate for a time, and "one home station and several foreign stations continued commercial working, rendering the selective reception of this otherwise clearly receivable message almost impossible." Even after the North Foreland station had subsequently called for silence commercial working still continued, and Mr. Hesketh estimates that from 35 to 45 minutes were lost at a time when every second was of importance. In commenting on Mr. Hesketh's letter Mr. Godfrey Isaacs points out that the "Egypt's" signals and the calls from Ushant were picked up without difficulty by a number of vessels, and that as all commercial wireless operations between ship and coast stations in the Channel are worked on a wave length of 600 m. every S.O.S. signal would be heard in the Channel and answered promptly not only by Government stations, but also by ships within range.

Some Change in the Present System Necessary.

Taken together these two communications form a powerful argument for some change in the present system. Wireless telegraphy, as has been shown again and again, is one of the most efficient methods of saving life at sea, and anything that detracts from that efficiency should be drastically forbidden. Mr. Hesketh suggests that the land lines should be used for giving publicity to the fact that an S.O.S. call has been heard, but Mr. Isaacs points out, quite rightly, that in this particular case that would have been of no avail. A better method seems to us to be to allocate a special wave length for S.O.S. working and for all powerful land stations to be equipped with special apparatus for picking up this call. The Marconi Company already have in use an automatic alarm, and its employment might well be extended. Ships' stations might be required to listen in on that wave length from time to time, and transmission on it, except in cases of real emergency, should be forbidden. The fact that such signals are now sent out on the ordinary commercial wave length is a condemnation of the present system, while the whole episode is an argument against further extending facilities for transmission.

An Industrial Entente.

At the present time engineers will be the first to agree that any proposal for bringing about industrial harmony is worthy of the most careful examination. What is wanted is not only a mere settlement of the present dispute but some tool which shall strike down to the very basis of the relations between employers and employed and discover a bedrock upon which a firm superstructure can be built. Only in this way can our trade develop and our commercial property be ensured. How can this bedrock

be found? We think that a letter published in last Friday's "Times" and signed on behalf of the Industrial League and Council shows one of the most certain ways. The only hope of industrial peace, the signatories say, is an effective entente between employers and employed founded on a mutual recognition of the essentials of each other's position. That recognition, unfortunately, has been too often lacking in the past. They propose to make it more clear that a group of employers and a group of trade unionists should meet in more or less continuous session to formulate a policy of agreement in its general bearings, and especially to secure "team working and the requisite level of technical and productive efficiency."

The Matter in Figures.

PASSING from the general to the concrete, we note that in the same issue of "The Times" Sir CHARLES MACARA recommends that work should be resumed until the differences in the engineering dispute can be settled. This may be a hard saying for some on both sides, but it is axiomatic, as he adds, that "the position of our trade is such that we cannot tolerate these prolonged stoppages." Mr. G. S. FRANCIS, honorary secretary of the National Confederation of Foremen, Managers and Supervisory Associations, puts the matter into the figures, which engineers are supposed to understand better than anyone else. In 1919 we lost 34 000 000 working days through strikes and trade disputes, in 1920 over 27 000 000, in 1921 nearly 90 000 000, and already, in the first five months of 1922, we have lost 30 000 000. What need, then, we may ask, have we of any further witnesses? The Industrial League and Council suggestion should be adopted with the least possible delay. And at any conference that is called, and running through any suggestion that is adopted for the alleviation of this trouble must go the recognition that it is human difficulties that have to be solved and human failings and weaknesses that have to be dealt with.

The Rutenberg Concession.

CONSIDERABLE stir has been caused, especially in Parliamentary circles, by the granting of a concession to supply electricity in Palestine to a Russian, one Pinhas Rutenberg. This concession amounts to an almost complete monopoly, the sort of thing every capitalist dreams of and seldom achieves. If the details given by Sir W. JOYNSON HICKS in a letter published in Monday's "Times" are to be believed, M. RUTENBERG is to be allowed two years to raise £200 000 and, if he succeeds, he will then be given a monopoly to use the waters of the Jordan for a term of seventy years, subject only to the proviso that existing users may continue to use such water, but no more, as they do at present. Expropriation of land and buildings is allowed, and no one else may supply electricity or do any work to that end. Finally, as a sort of make-weight, valid pre-existing concessions may be annulled in favour of the Rutenberg Company.

Why were British Firms Excluded?

THIS, it will be agreed, is a little strong. The whole of a most important development in a country which the British taxpayer has to maintain is to be handed over to a foreigner. Now we are not bigoted in this matter of giving of contracts to foreign firms. Indeed, we have often pointed out that British firms have themselves to blame when work goes abroad after tenders have been fairly invited. But in this case we believe no public tenders were invited. The concession was simply granted without any British firms being permitted to compete, and this at a time when our industry is starving for want of foreign trade. It is a matter which deserves, and, we hope, will receive, the fullest investigation.

Tramway Passengers Rights.

AN important decision on the rights and duties of tramway undertakings and on the liability of employers for the acts of their servants was given by the House of Lords on Friday, and should be carefully studied by those who are engaged in the operation of transport services. The circumstances out of which the action arose were trivial, but an important principle has been vindicated. A passenger on a Glasgow Corporation tramcar tendered an indented penny in payment of his fare, but the conductor refused to accept it and demanded another coin. As the passenger refused to comply with this request an inspector was called and then a policeman was summoned, the result being that the passenger, in spite of having given his name and address, was taken to the police station and there charged with not paying his fare and with tendering a defaced coin. After ten minutes' detention he was allowed to go, on giving an undertaking to appear in court next day. At the police office on the following day the passenger was informed that the charge against him was foolish.

The Issue to be Tried.

Thereupon he commenced an action for false imprisonment against the Corporation, whose by-laws allow their servants to detain and give into custody a person evading payment of his fare, if his name and address are unknown. The Lord Ordinary allowed the case to go to trial, but on appeal the First Division of the Court of Session reversed this on the ground that the Corporation had not given authority for the arrest under the circumstances. On appeal the House of Lords have now unanimously reversed this decision and restored the judgment of the Lord Ordinary, holding that the tramway employees were acting within the scope of their agency and that the passenger was entitled to have the issues of facts tried. As the action has yet to be tried we refrain from comment, except to say that it is equitable to presume that uniformed officials are *prima facie* acting in the course of their employment and in pursuance of authority conferred on them.

The S.E. Lancashire Electricity District.

THE scheme for the South-East Lancashire Electricity District, recently approved by the Electricity Commissioners, has now been embodied in a draft Order and will form the subject of a further inquiry at Manchester on the 20th inst. The Order purports to constitute the electricity district and to establish the South-East Lancashire Electricity Advisory Board as set out in the schedule to the Order, which will come into force as soon as it has been approved by a resolution passed by each House of Parliament. Particulars of the area of the District and of the technical scheme have already appeared in THE ELECTRICIAN, and as these have undergone but slight modification, the only points of interest are the constitution, powers and duties of the Advisory Board.

Powers and Duties of Advisory Board.

This Board is to consist of 50 members, of whom 42 are to be appointed by the authorised undertakers in the District (35 by local authorities and 7 by companies); four will be jointly elected by those local authorities who are not

undertakers but in respect of whose area there is a Provisional Order or Special Act, two by the remaining local authorities, and two by railway companies in the District. A Board of 50 would appear to be too big and unwieldy to be very effective in action, but its limited powers and duties will probably be performed by the Engineering Advisory Committee, which is to be appointed by the Board soon after the final approval of the scheme. The Board are to take all steps "within their power" to secure the carrying into effect of the technical scheme; they are bound to submit to the Commissioners within two years proposals for the extension of electricity supply in districts outside the areas of authorised distributors where there is a reasonable prospect of such supply being remunerative; and the Board may make investigations and recommendations to its "constituent authorities" and to the Commissioners upon any matter connected with the improvement and development of supply in any part of the District. Each "constituent authority" is required to submit plans and estimates of extensions of plant and main transmission lines to the Board, who will then investigate the matter and make a recommendation thereon.

Delegation of Powers.

THE Board also have the right to enter and inspect generating stations and main transmission lines, to make recommendations as to running hours and charges for supplies and to require statistics of supply from constituent members. As the Board may delegate any of their duties to a committee it will be found in practice that all real authority will be exercised by the Engineering Advisory Committee. We believe this would be a good thing, for it would ensure efficiency and progress, which cannot be expected from a Board of 50 without technical or scientific training. Each undertaking which sells more than five per cent. of the total units sold by all the authorised undertakers in the District can nominate one member of the Engineers' Committee; those selling more than three and less than five per cent., two members jointly; those selling more than one and a half and less than three per cent. will have one, and those selling less than one and a half per cent. will also have one member. There is power to co-opt an electrical engineer of one of the railway companies, and in the not unlikely event of railway electrification in the District he would prove useful.

National Electric Traction.

IN an article which we publish on another page of this issue Mr. ROGER T. SMITH gives his impressions of the discussions at the electric traction meetings during the recent International Railway Congress in Rome. We are glad to find that he agrees with the opinion that we expressed a week or two ago, that the greatest good of these gatherings comes not from the formal meetings and discussions, but from the informal interchange of ideas and experiences by "men engaged in the sale of transport in other countries where conditions are quite different from our own." We especially commend the phrase "sale of transport" to the attention of our readers. For to sell transport economically and profitably must be the aim of every railway company in this country, and the discovery of ways and means by which electric traction can do this is the real problem at the present time. It is a problem, therefore, which includes many other things beyond the mere choice of system, and upon some of these, as a result of his visit to Rome, Mr. ROGER SMITH, throws a useful light.

Methods of Generation and System.

A particularly interesting point is the influence of the methods of generation on the choice of system adopted. Mr. SMITH puts forward the suggestion that the single phase system has been adopted in countries where water power is abundant because the employment of that form of power makes it possible to use different plant for the generation of low frequency traction energy and the generation of high frequency energy for industrial and domestic purposes. That choice of frequency is indeed one of the most vital problems with which the railway electrical engineer has to deal, and it is interesting to note in passing that in Switzerland the frequency is being raised from 15 to $16\frac{2}{3}$ and that a definite distinction between the generation of the two forms of energy is being made.

The Limitations of Steam Generation.

Unfortunately such a separation of supplies is impossible in this country. For, as Mr. ROGER SMITH points out, as it is more economical for us to use large steam turbo-alternators and to generate at a high frequency, it almost follows as a corollary that we must use direct current traction in order that the same plant shall be employable for all electrical purposes. In other words, definite sets cannot be allocated to the traction and the industrial loads respectively, as is possible where water power is available. Though we do not suppose for a moment that this argument is incontrovertible by single-phase enthusiasts, it is one of the soundest reasons for the findings of the recent Advisory Committee on Electric Traction that we have yet seen advanced.

Direct Current on the Continent.

It is for this reason, and for the reason that transmission limitations, make it advisable that all generating stations should be "combined" stations, that has led Holland and Belgium to adopt direct current; and the same may be said for France, though this has not been the only factor in their choice. Unfortunately, the policy of most British railway companies that are considering the adoption of electric traction at the present time is in favour of a separate traction station. Arguments to support this policy may be found in dense traffic areas such as the London suburbs, but nothing can be said in favour of separate traction stations elsewhere. To obtain true economy there must be combined stations, and we hope therefore that for the general good individualism on this matter will give way to co-operation.

Some Important Technical Questions.

A word or two must also be said about the technical questions raised at the conference. As regards locomotive types, Mr. GIBBS objected to motors geared direct to the axles except for slow speeds, and thought that even though the quill drive was better it was not altogether satisfactory for heavy service. He preferred gearless motors, with the rod drive, especially on the counts of flexibility and weight distribution. This point does not seem to have been very much considered, though we believe that in this country and on the Continent opinion is rather against Mr. GIBBS.

The Overhead Equipment.

More information was available on the design and construction of the overhead equipment. We were glad to see

Mr. SAYERS insisting on the need for flexibility and the elimination of hard spots by increasing the number of points of suspension. Signor DONATI (an Italian engineer), who also insisted on the need for flexibility, was able to put forward an excellent argument in favour of simplicity by saying that only 80 minutes per month as compared with the 2 080 minutes due to other reasons were caused by the failure of the overhead equipment on the Italian State Railway. But even this might be reduced. The elimination of hard spots, as pointed out by Sir PHILIP DAWSON and the American and Swedish delegates, also has an important influence on the ease of current collection and trolley wire wear. No similar information on the effect on the wear of the contact rail of the method of mounting and fixing seems to have been given. Faulty insulators are not the least important of the troubles that arise in both cases.

Inductive Interference.

A good deal of information on the subject of inductive interference and its prevention was put forward. In Switzerland considerable alterations in the telegraph and telephone lines have been necessary, and in many cases they have been put underground. On the other hand, in France it was stated that it had been found quite possible to suppress all inductive interference without moving the lines, though the cost of the necessary apparatus was considerable. In Italy the heroic course has been taken of removing the telephone lines altogether. There was some difference of opinion as to the effect of direct current traction on telephone and telegraph lines, and this is generally a subject to which railway engineers in this country will have to give close attention. The final conclusion reached at Rome was that while it is technically possible to neutralise inductive effects it is not always financially sound to do so.

It is hardly to be expected that agreement would be reached on all the points discussed. Indeed, in the present state of our knowledge, it is not desirable that there should be agreement. But one thing appears perfectly clear. In its broadest aspect electric traction is rather a national than an international problem, and it is essential therefore that in every way our policy, design and equipment should be as thoroughly British as are the difficulties that have to be solved.

The Electricity (Supply) Bill.

THE threatened challenge to the Second Reading of the Electricity (Supply) Bill made by Mr. GEORGE BALFOUR was met by a promise of further concessions in Committee; a division was thus obviated, but the progress of the measure was delayed by nine days, and this may have an important effect on its ultimate fate. On the whole the debate was of very poor quality. Most of the speeches dealt with the history of the 1919 Act or with points which were more appropriate to the Committee stage. The efforts of Mr. BALFOUR and Mr. MARRIOTT were frankly directed to the advocacy of private enterprise and to the creation of a bogey to frighten the House about an extension of municipal trading. We must, however, recognise facts, and so must they. It is impossible to ignore the strongly entrenched position of municipal electricity supply, and therefore the provisions of the Bill are essential if any progress is to be made, as it must be made.

Fantastic Figures.

SOME fantastic figures of the expenditure of joint electricity authorities were given by Mr. MARRIOTT, who, on the authority of an anonymous financial critic, put the total amount to be borrowed at £110 000 000. His methods of calculation are so ingenious, not to say ingenuous, that they deserve to be put on record. The Electricity Commissioners having provisionally determined sixteen electricity districts, he assumes there will be more to follow, and so he takes 25 as the probable ultimate number. Then, as the authorised capital expenditure of all the electricity undertakings in the country at the end of 1918 was over £48 000 000, he assumes this figure to have risen to £60 000 000 by now. He puts this forward as the sum which will have to be borrowed by the Joint Electricity Authorities at the outset, and as each authority is allowed £2 000 000 for a new capital station and transmission lines, he makes the total £110 000 000! We believe that history has hitherto been Mr. MARRIOTT's *forte*, but, as he has evidently a vivid imagination, he should do much better in fiction.

Calculated to Scare.

No doubt the sum mentioned by Mr. MARRIOTT has been well calculated to scare timid ratepayers, who have been blistered by high rates and are alarmed at Poplar methods of finance. On analysis it will be seen, however, that there is no foundation for the figures. In the first place, he has no right to assume that Joint Authorities will be established in all electricity districts; probably we should not be far out if we put the total number at 10 or 12. In the next place, he has taken the *gross* capital authorised to be borrowed by the whole of the municipal authorities of the United Kingdom, whether in electricity districts or not. Now, a considerable proportion of the borrowed money has already been repaid by sinking funds or other means, and a further large sum must have been expended on the distributing networks of the undertakers and on plant and apparatus which will not be acquired by the Joint Authorities. When all proper adjustments of accounts are made we should be surprised if the total came to 50 per cent. of Mr. MARRIOTT's figure, and of that the London District will account for a large proportion. Further, whatever sums will have to be paid by Joint Authorities for the acquired generating plant and transmission lines will be paid to local authorities, who will then repay their existing loans, and so the total municipal debt of the country will not be increased by the transaction.

The Control of Joint Authorities.

THERE was also a great deal of unnecessary talk about the financial control of Joint Authorities and of the need of further safeguards. It must be remembered that the Electricity Commissioners only grant borrowing powers for sound schemes and that the periods allowed for the repayment of loans are well within the economic life of the plant, mains and other apparatus for which the money is borrowed. Further, the Joint Authorities must furnish annual accounts to the Commissioners, who have also the right to appoint auditors. We think, however, that the power to suspend the sinking fund for five or six years and to pay interest out of capital on unremunerative undertakings is one which should be sparingly used, and should only be authorised in exceptional circumstances and for strictly limited periods. We hope that this unedifying spectacle will soon be closed as the result of the passing of the Bill.

But as the session is already well advanced no time should be lost in bringing this about.

Conflicting Wisdoms.

DURING the recent debate on the Second Reading of the Electricity Supply Bill in the House of Commons, Sir PHILIP DAWSON, following Mr. GEORGE BALFOUR'S lead, wished to substitute the "wisdom" of the House for the "wisdom" of the Electricity Commissioners. In doing so Sir PHILIP DAWSON, referring to the Commissioners, naively asked, "Are they absolutely certain never to make a mistake?" fearing apparently that there was some little danger that they might "look at the picture a little too much from the rosy side." Now anyone who has followed the cogitations of the House on electricity supply legislation will not have anything like absolute confidence in the wisdom of the House. We can hardly imagine, for instance, anyone seriously claiming that the "wisdom" displayed by the House is greater than the "wisdom" displayed by the Commissioners, and when individual lay-members of the House dissertate on electrical questions wisdom of any sort is generally conspicuous by its absence. We notice, for instance, that a recent issue of the "Financial Times" contained an article by Mr. F. A. MACQUISTEN, M.P., on the Electrification of Railways in which he claims that "concurrently with electrification of the railway systems each railway company should be empowered to sell current for heating, light and power to the whole district wherein it operates," and cheerfully concludes by saying, "Let us therefore defeat the Electricity Bill, which will exclude the railways from what is their own by nature and circumstance." Now Mr. MACQUISTEN is a solicitor, and, we presume, fully acquainted with the whole system of electric lighting legislation, but here, at a single blow, he proposes to demolish the legislation of 40 years. Personally we should prefer the "wisdom" of the least of the Commissioners or of the least of the Commissioners' assistants to this sort of stuff.

Institution Business.

THE annual general meeting of the Institution of Electrical Engineers, which was held on Thursday of last week, did not attract members' attention more than is usually the case. There was but a small attendance and the interest in the whole proceedings was decidedly languid. Of course Mr. F. W. PURSE had something to say about the annual accounts and to make his plea (it is becoming his annual plea) for the reduction of the subscriptions, but apart from that everyone seemed satisfied and the proceedings were soon over. They would have been over sooner but for the fact that the commemoration number of the "Journal" had delayed the printing of the Report. This, therefore, had to be read in abstract, but may well be studied at leisure.

The Annual Report.

The most interesting paragraph in the Annual Report, with which we deal elsewhere in this issue, is that relating to the organisation of a National Electrical Convention. That such a Convention should be held regularly is a suggestion that has often been put forward in these columns. It has also received much unofficial support from the leaders of the profession and was officially commended by Major H. RICHARDSON in his Presidential Address to the Incorporated Municipal Electrical Association last year. It will also be generally agreed that the Institution, with its 10 000 members, is the proper body to make the first move in the organisation of such a gathering, which can only be productive of good. If the Institution leads others will follow. But we hope our proposal that the actual work of organising this function should be placed in the hands of a representative *ad hoc* committee will be adopted. The appeal of this conference should be of the widest; it should be popular and it should be well advertised. This is a special task which will require special treatment.

The British Empire Exhibition.

Fortunately, to work on these lines will be made easier by the decision to synchronise the holding of the conference with the postponement of the date of the British Empire Exhibition to 1924. This will give time for consideration and will have the added advantage that an international flavour can be given to the proceedings. Mr. DUNLOP has done a good deal of spade work in organising the electrical section of the exhibition and full advantage should be taken of his work and efforts to make this larger idea a success.

Otherwise there is not much of note in the report. This is not due to any relaxation on the part of the Council but is rather due to the way in which decisions and policies are announced as they fructify. The report tends more and more to become a record and less and less an out-of-date newspaper.

The Informal Meetings.

We are glad to see that a word of commendation is given to those responsible for the informal meetings. These can be, and are, of the widest use to all classes of members and their usefulness is likely to increase. The depressed state of the industry is indicated by the increase in the number of members on the unemployed register from 51 to 120. We hope that all those who can will take the most decided steps to reduce these numbers. That highly trained men should at the present time be out of employment proves clearly that something is wrong with the machine.

The Electrical Proving House.

Another development that is, we suppose, delayed until better times shall dawn is the establishment of the electrical proving house. We hope that something will be done about this before long. It is as essential as standardisation, whose claims are now recognised, for the well-being of the electrical industry.

Electrical Engineering Training.

It is interesting to find that the claims of the Institution to have a voice in the organisation of engineering training has been recognised by the Board of Education. A well thought out scheme of suggestions on this matter has been made and is under consideration. And, as the report rightly says, the matter is one of the very greatest importance, we hope some early decision will be arrived at. There is perhaps no part of our educational machine which requires more overhauling than that which concerns the preliminaries of scientific and technical education.

Finance.

As regards finance, the balance on the cash accounts is rather less than last year, doubtless owing to the expenses caused by the return to the new building; but generally the finances are in a sound enough state. The same may be said of the Institution. The affairs are well directed, and it is now thoroughly representative of all phases of electrical interest.

The International Railway Congress at Rome.

Some Impressions of the Discussions on Electric Traction.

By ROGER T. SMITH.

The ninth Congress of the International Railway Association was held at Rome from April 18 to May 3. Owing to the war no Congress had been held since 1910, when the meeting was at Berne. In the interval the "reporters" of the various sections and others have contributed articles on the various "questions" for discussion at the Congress; and under Section II, Locomotives and Rolling Stock, "Question" VIII, dealing with electric traction, have published some very important papers from time to time in the monthly Bulletin of the International Railway Association. Among those contributions may be mentioned the following as being of special importance and value to all interested in railway electric traction.

(1) Report on Electric Traction in America, by George Gibbs, published in Vol. III, No. 12, December, 1921, of the Bulletin.
(2) Report on Electric Traction in Italy, by Alfredo Donati, published in the same December, 1921, number as the American report.
(3) Report on Electric Traction in Switzerland, by E. Huber, published in Vol. III, No. 10, October, 1921, of the Bulletin.
(4) Report on Electric Traction in Holland and in Great Britain in the same October, 1921, number as the Swiss report.
(5) Report on Electric Traction in Sweden and Norway, by M. I. Ofverholm, in Vol. III, No. 11, November, 1921.
(6) Report on Electric Traction in France and Spain, by M. Sabouret, published at the Congress, appearing as the report for all countries except Holland, Great Britain, Denmark, Norway, Sweden, Italy, Switzerland and America.

Valuable Documents.

The three first reports are most valuable documents for the railway electrical engineer and traffic officer, full of statistical information, but also containing the views of the several authors on the general question of railway electrification and the application of those views to the past, present and future equipment of main line railways for electric traction in their respective countries.

It is the duty of the President of each section, who, together with the section secretary and the assistant secretaries, is nominated by the Permanent Commission, although elected by the section, to submit a summary of the various reports prepared by a special reporter appointed for that purpose by the Permanent Commission. The summaries for all the sections are published in the April, 1922, number of the Bulletin of the International Railway Association.

Eight Questions for Discussion.

The summary of the various papers contributed to Question VIII Electric Traction was made by Ernest Gerrard, a vice-president of the Permanent Commission and a reporter for the secondary lines of the Belgian State Railways. The summary ends with a series of eight questions to be discussed at the meeting of the section which is expected to give answers to these questions, thus providing a set of international resolutions or conclusions on certain important points.

These questions included (1) the choice of system as between three-phase, single-phase and direct current, and the circumstances which make the choice of one of them proper; (2) the international standardisation of the costs of working electrified railways and the choice of a unit in terms of which those costs and other statistics could be expressed; (3) the relative advantages of catenary suspension and of simple transverse suspension for the overhead contact line, and (4) whether any particular type of current is more satisfactory than another where two or more locomotives are required to work one train.

The section proceeded to remove from the form in which the questions were put everything which could make the answers to them too definite. The answers were non-committal, and those who wish to see them are referred to the Bulletin of the I.R.A. when it is published.

Opinion and Experience.

But the discussions of these subjects were really interesting, and the value to the British electrical engineers of the meetings under Question VIII was the expression of opinion based on experience of the design, construction and maintenance of hundreds of miles of main line electrified railway by such men as Mr. George Gibbs (Chief Engineer for Electric Traction Long Island Railroad), the President of Section II, Signor Donati (Chief Engineer for the service of electrification, Italian State Railways), M. Huber (Chief Engineer for electrification to the Swiss Federal Railways), M. Sabouret and M. Parodi (both Chief Engineers of the Orleans Railway, the latter chief of the electrical service).

The general impression gained from the discussion on systems was that Mr. Gibbs was almost alone in wishing the section to declare that no one system of electric traction ought to be standardised as applicable in all cases, chiefly because it was assumed that he meant "all cases in one country." All those who spoke from experience appeared ready to argue that no one system was applicable to all cases, but they firmly believed that each European country should choose a system and stick to it.

Italy and the Three-Phase System.

In his paper on the electrification of the Italian State Railways (already referred to), Signor Donati shows that when the Valtellina line was electrified in 1901 the three-phase induction motor was the only motor which se med capable of performing heavy railway service, while when the mountain railways in Piedmont and Lombardy were equipped the problem was to find an equipment for an electric locomotive to give the necessary draw-bar pull with an axle load not exceeding 15 tons. Railways in the foothills of the Alps of necessity have many costly bridges. Axle loads on these bridges are limited to 15 tons. The three-phase locomotive fulfilled these conditions. When later a programme was drawn up which, when completed, will raise the length of main line track electrified in Italy to 2 800 miles, it was found that if any system other than the three phase would save as much as 10 per cent. in the locomotive working costs this would only affect the total working costs by 1·7 per cent. The Italians therefore decided to continue their three-phase system which had served them so well, and the programme is being rapidly carried out. For the most part hydro-electric power stations supply the two contact wires and the rails with three-phase current at 3 500 V between conductors at a periodicity of $16\frac{2}{3}$. The whole output of some of the hydro electric power stations is required for traction, but where an industrial supply is also required from the same station this is given from separate machines at 42 periods or 50 periods. Having effected savings by electric traction of the order of fifty million lire a year in locomotive coal and some million and a half lire in other expenses, the Italians concentrated on the improvement of the three-phase system and to its extension at least throughout Northern Italy.

The Position in Switzerland.

In Switzerland some 500 miles of main line have been electrified mostly on the single-phase system at 15 000 V $16\frac{2}{3}$ periods. The original frequency of 15 is in process of being changed to this standard. Mr. Huber, who is carrying out the electrification of the Federal Railways, was emphatic in stating that nothing would induce the State Railways to alter the decision come to in 1912 to adopt the single-phase system for all their lines as the system most suitable for Switzerland. As in Italy, the power stations are hydro-electric, and even to a greater extent than in Italy the whole output of many of the

stations is required for traction. The railways are therefore free to choose the best frequency for single-phase traction, which has been decided to be 16⅔ periods per second. This frequency is too low for industrial power and lighting, for which the Swiss have adopted the frequency of 50.

France, Belgium, Holland and Sweden.

The French, the Belgians and the Dutch have adopted 1 500 V direct current for electric traction, and though the Belgians and the Dutch have not actually carried out any main line electrification, schemes are being prepared on the basis of a uniform system throughout those countries. The French have co-operative schemes for using the extensive water power in the Pyrenees in the Central Plateau and in the Rhone Valley for the supplies of electricity, both for industry and for railway traction. The Orleans Railway system stretches from the Western Pyrenees to Paris, and both M. Parodi and M. Sabouret insisted that the proper thing to do was to electrify the railways throughout the country on one uniform system. The Scandinavian representative did not join in this part of the discussion, but it is well known that M. Ofverholm is a strong believer in the single-phase system and that it is being used and extended both in Sweden and in Norway. Generally, it may be said that in those countries where coal is an expensive import, and the generation of electricity from water power saves large sums of money in locomotive coal, the single-phase system of electric traction at 15 000 V is favoured. Italy began before the single-phase system was developed, and having spent large sums of money on three-phase equipment, which have proved most successful, and saved large sums in locomotive coal, continues to use the three-phase system because, as previously stated, even if another system saved them as much as 10 per cent. in their annual locomotive expenses the result on the total expenses of running the railway would be insufficient to decide the best system to use.

Single-Phase and Hydro-Electrics.

It is worth while considering why those countries which generate by water power have adopted single-phase. The importance of such large units of plant as are essential for the supply of cheap electricity from steam turbine stations does not exist to the same degree in hydro-electric stations, so that the railway alternating traction supply can be given at the low frequency of 16⅔ periods from part of the plant and an industrial and lighting supply at a frequency of 50 from the rest of the plant without much loss in economy. To obtain the full advantages of single-phase or three-phase traction this low periodicity seems on the Continent to be considered essential.

The Steam Turbine and Direct Current.

Those countries like Belgium, Holland and Great Britain, possessing little or no water power, where electricity for traction must be generated by the steam turbo-alternator, have adopted 1 500 V direct current (including in France 3 000 V in special cases, and in Great Britain a sub-multiple or multiple of 1 500 V), which permits the use of the most economical frequency for steam generating plant, namely, 50 periods, current at this frequency being at the same time most suitable for industrial electric motors and for lighting. The density of main line traffic which it would pay to electrify in Great Britain appears to require from 30 000 to 35 000 kW per 100 miles of double track railway. But with three-phase transmission it is doubtful if one generating station can economically feed to a greater radius than 25 miles. If, therefore, the 100 miles of double track is not contained within that radius, the steam generating station for the railway load alone is too small to be really economical and the combination of the railway load with the industrial load in one station becomes necessary for cheap supply. This steam turbine generator condition is quite different from the water turbine generator condition and illustrates the wisdom of the choice of the direct current system in Great Britain, Holland and Belgium, since the same station can supply electricity for railway traction, for industrial power and for lighting. So far as generating electricity is concerned, France appears to occupy an intermediate position between those countries where the choice of alternating current traction has been made as most suitable and those where direct current has been chosen. With her wealth of water power in the South centre and South-east, and with her intention to extend its present use for industrial purposes to electric traction, the best frequency for generation is not a governing feature. Nevertheless, after full consideration, France has decided to electrify on the direct current system, and the delegates who spoke at the Congress were highly satisfied with the choice.

This is no reflection on the American attitude of wishing to keep the open door—for America. The conditions in America are not the conditions in Europe—above all in Great Britain—and while America is not ready to decide on a uniform system and can go on trying to find the ideal system (which as Mr. Gibbs pleaded must be much better than any existing system) without stopping railway electrification on any of the existing methods, that is not the case in Europe.

No Great Difference in the Systems.

People have talked system so long that they have forgotten that the differences in the cost of working one system, as compared with any other system at present in use, do not exceed one or two per cent. on the total cost of running the railway while other great economies possible from electrifying certain dense main line systems are neglected. The Advisory Committee to the Ministry of Transport very properly left an open door in the matter of the choice of system. It is to be hoped that none of the new groups will use that door until someone has found that ideal system which is so much better than any other that it will be worth while for the railways of the world to scrap all that they have done and are doing in order to adopt it. Meanwhile the lesson to be learned from the discussions and talks at the Rome Congress seems to be that each country's choice as to system appears to have been wisely made to suit the conditions in that country, and that British railways might get on with the job of suburban electrification to meet the conditions of traffic which have overtaken and passed the abilities of steam traction to meet them, and of main line electrification under those particular conditions of traffic which would result in a substantial profit on the capital invested.

Overhead Equipment.

A short discussion on the relative advantages of catenary suspension for the overhead contact wire, as against the method generally adopted on the Italian State Railways, where the two contact wires required for three-phase traction are carried by insulators hung from the string of a bow structure which is itself fixed to the bracket arm of a post. These brackets are symmetrical either side of the post, and as many as 10 tracks have their twin contact wires so supported from one post. The maximum speeds on the Italian State Railways are not high, the latest electric locomotives having four speeds of 23, 31, 46 and 62 miles per hour, but it must not be forgotten that with three-phase traction, unlike single-phase or direct current traction for which the series motor is standardised, the speed is constant and the average speed and the maximum speeds are the same independently of grades. These maximum speeds are therefore also the average speeds, and compare with the average and not with the maximum speeds of steam or of electric traction by other systems. The general result of the discussion on contact wire suspension was that whereas the cross suspension adopted by the Italian State Railways was obviously a success with their speeds, nothing but catenary suspension was suitable for the higher speeds used in other countries with other systems.

On the question of a standard unit by which all the statistical and financial results of electric traction could be measured in all countries alike, the section adopted a motion by Sir Henry Fowler referring the question of the standardisation of the method of keeping accounts and statistics to a special commission to be set up by the Association under Section II.

No conclusion was come to as to whether any one system of electric traction was better than any other system in the case with which two or more locomotives could be employed in moving one train, it being generally considered that system had little or nothing to do with this matter and that such "multitraction" is equally satisfactory with all three systems.

Such are one delegate's impressions, for what they are worth, of the discussions at the electric traction meetings. The great use of such a Congress is not so much the official conclusions come to as the interchange of ideas and experiences with men engaged in the sale of transport in other countries where conditions are quite different from our own and the inspection and travel which make those conditions evident. Delegates who were neither reporters nor secretaries had also the opportunity of seeing beautiful things for part of every day and for the whole of some days, and it is possible that the uplifting of the spirit in the atmosphere of so much beauty, whether the work of nature or of man, may have done as much for the delegates as the Congress itself.

Some Reflections on the Lead Hydrate Accumulator.

By W. R. COOPER, M.A., B.Sc.

There is considerable difficulty in expressing definite views upon any new secondary cell when the critic is armed merely with a nodding acquaintance or a brief introduction to the newcomer. As a rule, the virtues that are claimed can only be decided in the light of a somewhat lengthy experience, running, it may be, into years. On mere inspection one can only say that a claim is possible, probable or improbable, as the case may be; or even impossible, if the inventor is sufficiently rash. The cautious inquirer, however, is generally loath to state frankly that some particular claim is impossible, for there have been many false prophets in the history of electro-technics. On the other hand, the history of the lead accumulator consists largely of magnificent claims which have failed to materialise; and although there has been progress over lengthy periods, and very solid progress too, this has been of the slow variety, and we have long since ceased to expect any claims of a revolutionary character. Readers of the technical press have therefore been somewhat startled recently to learn that the Lead-Hydrate Accumulator has properties far superior to those of other lead cells. Although it is not proposed in the present article to say just what this new cell can, or cannot, do (for the writer has not had the opportunity of deciding these points experimentally), it may be useful to consider some of the claims in the light of common knowledge.

Claims Examined.

First let us take the name. Upon first hearing the name "Lead Hydrate" Battery one is apt to suppose that lead hydrate is the active material. Since, however, sulphuric acid is the electrolyte there is no reason to suppose that we are dealing with any other cell than the well-known lead accumulator. The active material is still lead and lead peroxide on the respective plates. Consequently, the name can only mean that a special material has been used, like unto the old name "Chloride," which is still with us, although the cells so designated have for very many years ceased to have any acquaintance with chlorine. It would be equally pointed to call cells which contain ordinary pasted plates by the name "litharge" or "red lead." Still, a name is often commercially valuable, particularly if the buyer is led to wonder what it means.

So-called lead hydrate, so far as the author is aware, is not a novel ingredient. Perhaps it would be more correctly described as impure lead hydroxide. From the small amount of information that has been made public, the oxide in the present instance appears to be made directly from pure lead, and is lead sub-oxide, Pb_2O. This readily takes up moisture and changes to a mixture of the higher hydroxide and metallic lead. A paste of this material with water is suitable for pasting grids, and the plates so obtained can be "formed" electrolytically into positives and negatives in the usual way. Briefly, this is the Lead Hydrate Battery as made by Mr. C. W. Jenner, to whom the present development is due.

Certain Limiting Factors.

It is claimed that a much greater capacity is obtained by this method of manufacture. If this is actually the case it means that the material pasted on to the grid is utilised to a much greater extent than hitherto. This high degree of utilisation has always been the aim of every manufacturer. The difficulty is that the chemical actions involved are mainly surface actions, and consequently efficient utilisation of the material demands a high degree of porosity. This is not, however, the only difficulty. High porosity has often been attained, but beyond a certain point it leads inevitably to lack of strength; and, when this point is passed, disintegration and diminution of life are the inevitable consequences. But it does not follow that all methods of obtaining porosity give the same degree of weakness for the same degree of porosity. Any such idea is disproved by the superiority of present day batteries as compared with those of some 20 years ago. It may be that the paste obtained by the lead hydrate method may lead to greater porosity and to superior results.

Perhaps it may be well to point out that the porosity must in any case be sufficient not only to admit the electrolyte, but also to provide space in which the lead sulphate (and also peroxide) can be formed without blocking up the pores and thus preventing further action.

It may now be desirable to form some idea of what has hitherto been done, and what remains yet to be done, to secure the maximum utilisation of the active material.

Theoretical Limits.

Theoretically 1 ampere-hour should be obtained by converting 3·86 grs. of lead into lead sulphate; or 1 kilogramme of spongy lead should give 260 ampere-hours. Translating this into the more familiar unit of weight used in these matters it may be said that theoretically 1 lb. of spongy lead should give 102 ampere-hours, and 1 lb. of lead peroxide should give 117 ampere-hours. Actually, the capacities obtained are only about 25 per cent. of these figures; or, say, 25 for spongy lead and 30 for lead peroxide. This does not, however, mean that the specific output, expressed as watt-hours per pounds of complete cell could theoretically be four times the present figure (assuming that the character of the electrolyte remains the same), for there are many parts of the cell which would not be correspondingly affected by such an improvement.

In order to facilitate approximate calculations we may assume a mean figure of, say, 110 ampere-hours per pound of lead or lead peroxide, so that half this figure or 55 ampere-hours per pound of *total* active material (spongy lead plus lead peroxide) is the theoretical maximum. The figure is, of course, halved because both kinds of active material are required together. The percentage of active material in light pasted plates of the traction type varies somewhat with the make and with the plate, and is not necessarily the same in both plates. We may assume that the active material averages, say,

56 per cent. of the total weight of the formed plate, whether positive or negative. The figure varies, but the one here taken is commercially realised. If we start with a certain weight of active material, we must then add the weight of the grids, and something for the weight of the box, connections, separators, etc., leaving the electrolyte as the sole remaining ingredient. The weight of these sundries may be taken at, say, 12½ per cent. of the weight of the plates, but will be less in the largest cells. In round figures this means that the weight of grids + sundries is equal to the weight of the active material. The weight of the electrolyte depends simply on the range of specific gravity that is permissible. What is necessary is a certain weight of H_2SO_4 which may be removed by the action of the cell to provide the assumed number of ampere-hours. The calculation is not quite straightforward, because water is formed at the same time as H_2SO_4 is removed. On these assumptions the weight in terms of active material works out as shown in Table I.

TABLE I.—*Active Material Utilised, 25 per cent.*

	Lbs.
Assumed weight of total active material	1
Grids, connections, etc., 100 per cent. of active material ..	1
Electrolyte, assuming 13¾ amp. hrs. per lb. of total active material (*i.e.*, 25 per cent. of the active material is utilised) and range of spec. gr. from 1·280 to 1·170	0·65
Total	2·65

Assuming an average voltage of 1·95, this gives a specific output of 13·75 × 1·95/2·65 or 10·1 watt-hours per pound of cell at the 10-hour rate. Taking 1·93 volts as the average voltage at the 5-hour rate, and a drop in capacity of, say, 12½ per cent., the specific output at this rate is 8·8 watt-hours per pound.

Some readers may say that such calculations are not dependable; and in order to reassure the faith of such doubters it may be said that figures of this kind are not uncommon. They are, in fact, a little low, as an output of 10 watt-hours per pound at the 5-hour rate would, no doubt, be expected. This may mean that the conditions in practice are a little more favourable than those which have been assumed. But probably the difference is due to the fact that the acid range is really greater. The strength of acid in the pores of the active material is always greater or less, as the case may be, than that of the free electrolyte, because diffusion takes time.

Possibility of Securing Improved Results.

We may now consider how far these results may be improved with a given electrolyte. For this purpose there are two main lines of attack, one being to increase the extent to which the active material is usefully employed, the other being the reduction of the weight of the grid as compared with the weight of the active material. The results that are theoretically obtainable are shown in Table II.

TABLE II.—*Theoretical Outputs on Certain Assumptions.*

No.	Assumptions.			Weight in lbs.				Watt-hours per lb.	
	Active material utilised.	Grid. % of Plate.	Acid Range.	Total Active material	Grids, Box, etc.	Electrolyte.	Total.	10-hr. rate.	5-hr. rate.
1	25%	44%	1·280-1·170	1	1	0·65	2·65	10·1	8·8
2	50%	44%	1·280-1·170	1	1	1·3	3·3	16·3	14·0
3	75%	44%	1·280-1·170	1	1	1·95	3·95	20·4	17·6
4	100%	44%	1·280-1·170	1	1	2·6	4·6	23·3	20·2
5	50%	22%	1·280-1·170	1	0·44	1·3	2·74	19·5	16·9
6	100%	22%	1·280-1·170	1	0·44	2·6	4·04	26·5	23·0
7	25%	44%	1·350-1·170	1	1	0·41	2·41	11·8	10·2
8	50%	44%	1·350-1·170	1	1	0·82	2·82	20·2	17·4
9	75%	44%	1·350-1·170	1	1	1·22	3·22	26·6	23·0
10	100%	44%	1·350-1·170	1	1	1·63	3·63	31·4	27·2
11	50%	22%	1·350-1·170	1	0·44	0·82	2·22	25·7	22·1
12	100%	22%	1·350-1·170	1	0·44	1·63	3·07	37·2	32·0

Taking first the case of electrolyte with a working range of 1·280–1·170 and the grid forming 44 per cent. of the plate on the average, then if the active material is utilised to the extent of 50 per cent., instead of 25 per cent., the watt-hours per pound rise from 10·1 to 16·3. If the utilisation could be brought up to 100 per cent. the watt-hours per pound would only rise to 23·3, which seems a comparatively low figure.

If the grids were made relatively lighter, say half the weight, making 22 per cent. of the plate, and if the active material were used to the extent of 50 per cent., the watt-hours per pound would rise to 19·5, as against 16·3 in case No. 2. The corresponding figure for 100 per cent. utilisation is 26.5. In looking at these cases of high utilisation it will be noted how increasingly important the weight of the electrolyte becomes, being now well over 50 per cent. of the whole. It becomes evident that the only means of further progress is the use of a wider range of specific gravity.

The Use of Strong Acid.

One of the surprising features of the Lead Hydrate Cell is the use of unusually strong acid. The range of specific gravity in charging and discharging is stated to be 1·300–1·350. Such strong acid has hitherto been avoided because it tends to "self discharge," and the author is not acquainted with any manufacturer who would contemplate for a moment the use of such strong acid. In the case of lead cells of the usual type for automobile working the upper limit for the acid has commonly been 1·280, and often lower. The object in this case has been to reduce the weight of the electrolyte as far as possible; and since this can only be done by eliminating some of the water, a large working range is adopted, the lower limit of specific gravity being, say, 1·170, or somewhat lower. If the lead hydrate plates can stand up against an acid strength of 1·350 the cell should be capable of working through the great range of, say, 1·170–1·350, which would reduce the weight of electrolyte appreciably. The average voltage on discharge would also be greater, being, say, 2·07 volts for the 10-hour rate, instead of 1·95; and 2·05 volts for the 5-hour rate as against 1·93. This leads to a still greater output, but has the disadvantage that the variation of voltage over the discharge is necessarily greater. It should also be noted that the internal resistance of the cell is materially increased by the use of very strong acid, but the voltage drop becomes less as the acid becomes diluted, and therefore the discharge curve is flatter than would otherwise be the case.

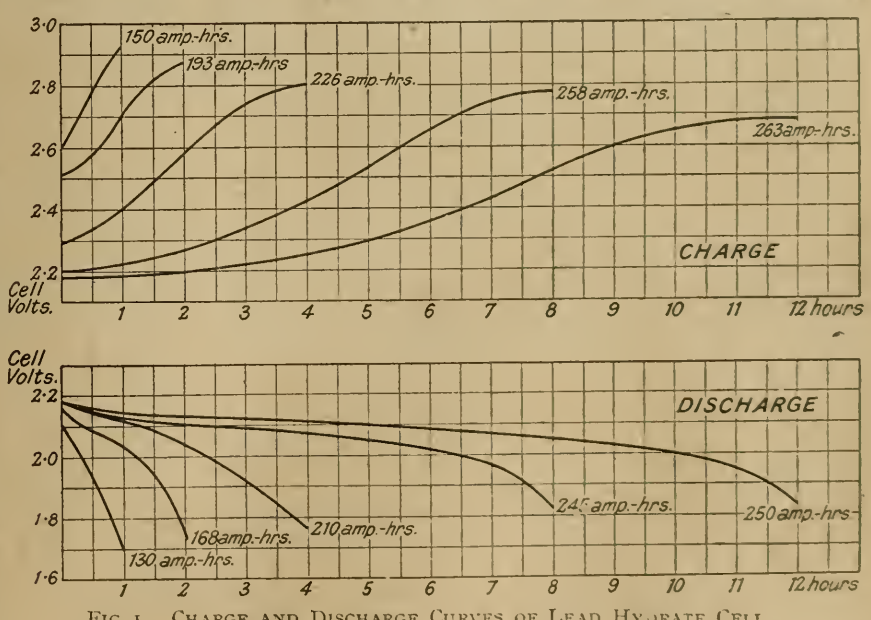

FIG 1. CHARGE AND DISCHARGE CURVES OF LEAD HYDRATE CELL.

Discharge Curves.

The results thus obtainable are shown in the lower half of Table II. There is a very considerable gain by the use

of the stronger acid in this way. But, curiously enough, the makers of the Lead Hydrate Cell state that the acid range is only 1·350–1·300, which means that the chief advantage of the stronger acid is not secured. This view is not altogether supported by the published discharge curves, which are reproduced in Fig. 1. Here the discharge starts at about 2·18, which is what would be expected having regard to the strength of the acid; but, although the voltage is maintained high for the greater part of the discharge it finally falls to about 1·83 volts at the 12-hour rate, which is about the commonly accepted figure for other cells. Now, for this low value the strength of acid should be, say, 1·170. If the acid does not fall below 1·300, or thereabouts, the only explanation of the phenomenon appears to be that the weak acid in the pores of the plates (which are stated to be much thicker than usual, up to $\frac{1}{2}$ in. for positives and $\frac{5}{16}$ in. for negatives) has not had time to diffuse out, and that the plates are really working in much weaker acid at the end of the discharge than is apparent. It is also noticeable that the capacity at the 12-hour rate is not as large in comparison with that at the 1-hour rate, as is usual, and this may possibly be due to some similar cause.

It will be noticed that, even under these conditions, carried to a very high ideal, the highest output is 37·2 watt-hours per lb. The author does not wish to set any particular limit beyond which we must not expect to go, for there may be conditions, or even new reactions, which cannot be taken into account in an analysis of this kind. But the figures here given are sufficient to show the great practical difficulties that are ahead of anyone who claims revolutionary results.

Purity and Sulphating.

The Lead Hydrate Cell is stated to be immune from "sulphating," and this characteristic is attributed to the purity of the active materials and consequent elimination of local action. It will be conceded at once that any local action must cause the plate containing the impurity to become discharged more or less slowly. But it is not at all so clear that "sulphating" is only due to local action. In fact, but little is known as to the real difference between "sulphate" and the normal lead sulphate that must be formed in the action of the cell. Be this as it may, we may bear in mind that other types of lead cell are also capable of remaining on open circuit for considerable periods without adverse effects, and that if greater purity gives advantages that are worth the money, the litharge and red lead that are commonly used in the manufacture of pasted plates can also be made highly pure, so that such advantages are open to any maker of lead cells.

As already stated, the active materials must in any case be spongy lead and lead peroxide, just as in every other lead cell. When the statement is made that the active material derived from lead hydrate does not change its volume under any condition of charge and discharge, and therefore no buckling can take place, it may perhaps be well to point out that certain changes in volume are inevitable. Both spongy lead and lead peroxide increase in volume when they are converted into lead sulphate, and the further this conversion is taken the more the pores of the active material are closed. This change is more serious with lead peroxide than with lead. Buckling will take place if this closing up of the pores is carried so far, and so unequally, as to set up serious stresses on one side of the plate. It is clear that if the porosity is sufficiently high no such stresses will arise. In any case the active material does not change its volume as a whole in normal working, but whether the active material of the Lead Hydrate Cell is so porous that no internal stresses can arise, the writer is not in a position to say.

The two statements that the battery is (1) indestructible and (2) that it has a much longer life than that of any other battery seem a little incompatible; or perhaps it would be more correct to say that the second statement is somewhat unnecessary if the first is true. The average cell comes to an end of its life through various causes, of which one of the most important is the shedding of active material. This is due largely, no doubt, to the persistent mechanical action of gassing, and it is usual to provide a considerable space in accumulator boxes so that the shedded material may collect without remaining in contact with the plates.

Electric Automobilism.

Some remarkable claims are made for the Lead Hydrate Cell in automobilism. In this connection it is well to remember that the specific output of a cell (or watt-hours per pound) is related very simply to the distance that can be travelled on a single charge. Assume that a specific output of 11 watt-hours per pound at the 5-hour rate is the specific output for ordinary lead cells, and assume that an electric vehicle requires on the average 110 watt-hours per ton-mile (which is about the figure for large commercial vehicles). Then 1 lb. of battery will give energy sufficient to run one-tenth of a ton-mile, or 224 pound-miles, or will propel 1 lb. for 224 miles. In other words, if a battery could be mounted on a massless chassis it could run 224 miles on a single charge. Actually the chassis will weigh, say, twice the weight of the battery, and the limiting distance is reduced to one-third, or, say, 75 miles; and in ordinary practice this becomes, say, 50 miles when the vehicle is loaded. Cells have been made, and are still listed, with an output of 14 watt-hours per lb., and with such cells the distance would be correspondingly increased, but this figure tends to fall as the cell becomes older.

According to figures which have appeared, the specific output of the Lead Hydrate Cell is over 27 watt-hours per pound, but this is at the 12-hour rate. The corresponding figure for the 5-hour rate may be taken as about 24 watt-hours per pound. This high specific output, if realised in practice, would be of great value and would mean that the distance an electric vehicle could travel on a single charge would be increased to about double the distance hitherto possible; or, say, 100 miles instead of 50 miles, or perhaps 150 miles instead of 75 under special conditions. This would be a marked advance, but it is very much less than the advance from 50 miles to 300 miles, as suggested in a recent article. The latter would require a specific output of six times what is now obtained, or something between 60 and 84 watt-hours per pound. But such a figure seems quite impossible, as already shown, even if the cell consisted only of active material and electrolyte worked over a large range—*i.e.*, if the grids, box, connections, etc., weighed nothing. The vehicle, of course, may be improved, so as to run more economically, but this will not alter relative positions.

It is also claimed that the cell can be recharged in 15 minutes. But does anyone want this? What would be the temperature of the cell? And would the station engineer be prepared to give charging currents at this rate?

Messrs. Siebe, Gorman and Co., who are manufacturing the new battery, are a firm of repute and are allied with Vickers, Ltd., so that we may reasonably suppose that all claims have been amply substantiated. On the other hand, for the reasons here given, the writer finds it difficult to accept some of the statements that have appeared. As already stated, time alone can decide whether many of the claims are justified, and pending this slow process of justification most users and manufacturers alike will prefer to await the verdict of time before accepting the view that the art of the lead accumulator has been wholly revolutionised.

The "Anglo-Swiss Review" states that the new electric transmission line, lately erected between Monthey (Valais) and Forclaz (Vaud) is connected with the Fridbourg transmission cables on one side and, on the other side, with the Monthey-Brigue cable. The latter conveys 45 000 H.P., and the surplus can be diverted over the Alps to the Fribourg and Berne cables. The Monthey-Forclaz cable is the last of the four connecting the power stations on the south of the Alps with those on the northern side; one runs through the Bernina, a second through the St. Gothard, a third over the Gemmi Pass.

Correspondence.

"BROADCASTING" PIONEERS.

To the Editor of THE ELECTRICIAN.

SIR,—In your Editorial Notes of May 19 you cite the Westinghouse E. & M. Co., of Pittsburg, as "the pioneer of radio broadcasting."

Their work along this line began in 1921. How many months, or weeks, are required in such an advancing art as radio to qualify one as a "pioneer"?

In 1909 the first "broadcasting" station was installed on the roof of the Metropolitan Opera House, N.Y.C. It was a temporary affair to seek to interest the Opera Company directors in my project of a free distribution of good music by radio-telephone. Microphones were installed in the footlights, and wires run to the arc transmitter on the roof. I recall that "Cavalleria Rusticana" was the opera chosen for the first broadcasting—and Caruso, as Turiddu, was thus the first singer whose voice was broadcasted.

The music from these first radio operas was picked up by ships near N.Y.C., but the cult of American Amateurs had then scarcely seen light, and lacking an audience this demonstration was logically shortlived.

There was more or less sporadic broadcasting from several San Francisco radio telephone stations, 1910–13. In 1916 the De Forest Radio Telephone Co. began a regular nightly radio programme, chiefly phonograph music, from its Highbridge, N.Y., plant, which service was maintained regularly until approach of our war cloud led the Government to close down all but official stations.

On "Election Night," November, 1916, two-minute bulletins of the election returns were broadcasted for several hours, being picked up as far west as Buffalo.

About this time the first "Radio Dances" were begun—parties in New Jersey, 35 miles distant, danced to music played in Highbridge. In 1920 the first regular broadcasting station in connection with a theatre was opened by my company in San Francisco, this service being maintained ever since. Each afternoon and night, and also on Sunday mornings, the very excellent orchestra music of the California Theatre is picked up by microphones carefully designed and located to best catch the various instruments, transmitted to an upper room, and there "put on the ether."

These concerts are frequently heard as far as Seattle and Los Angeles, and by ships half-way to Honolulu.

To some little mountain villages, where an enterprising amateur has an amplifier and loud speaker, ranchers drive in for miles to hear the Sunday morning concerts played in San Francisco.

It is indeed a keen gratification to observe how enthusiastically that early idea of radio-phone broadcasting has, at last, "caught on."—I am, etc.,

LEE DE FOREST.

Berlin.
May 22nd.

THE SEA RETURN OF A SUBMARINE CABLE.

To the Editor of THE ELECTRICIAN.

SIR,—On going over the interesting work of Messrs. John R. Carson and J. J. Gilbert on "The Sea Return Impedance of a Submarine Cable" referred to in your issue of April 28, 1922, may I be permitted to note that the form of solution given obtains only for stationary waves, as against a combined stationary-progressive wave on the cable.

In view of the fact that hysteresis, real or effective, plays quite an important part, especially in connection with high-frequency phenomena, it would seem that a loss of generality results by taking account only of the usual R L G C line parameters.

In a paper which appeared in the April, 1921, issue of the Journal of the I.E.E. on "The Radiation Resistance of Various Types of Antenna Construction," the writer disclosed a mathematical method taking elliptical hysteretic phenomena into account. As a consequence, on page 441 of the above journal, it stated that "it appears that the voltage-distribution curve lies on a rotating helical sheet winding about the antenna as an axis." In the Carson-Gilbert case, where hysteresis, real or effective, is ignored, the locus lies in a rotating plane passing through the antenna as an axis.

The above distinction is of some consequence in cable and antenna work as the writer has later pointed out mathematically. For in the general case considered it was necessary not only to solve Maxwell's equations for the field external to the line conductors, but also at one and the same time satisfy the line characteristic *à la* Heaviside. This study was made possible by making use of the concept of complex capacitances and inductances.—I am, etc.,

A. PRESS.

Chavy Chase, U.S.A.
May 16, 1922.

ELECTRIC PROPULSION METHODS.

To the Editor of THE ELECTRICIAN.

SIR,—It is interesting to note in your current issue (May 12, 1922) that the new U.S. super-Dreadnoughts are to be driven by two-speed motors, at 23 knots and 15 knots. This speed ratio is met by the "Cascade" Motor with a single winding. Yet our American friends obtain this result "by the use of two entirely separate stator and rotor windings." At the present moment there is a strong likelihood of two-speed "Cascade" motors being used on British-driven ships in the near future.—I am, etc.,

ERNEST W. ASHBY.

Hawarden,
May 19, 1922.

HENLEY'S CABLES.

To the Editor of THE ELECTRICIAN.

SIR,—We regret that there was an error in our advertisement on the front cover of your journal last week, and we trust you will grant us the hospitality of your columns to correct it. We described the illustration of the 33 000 V. Birmingham cable as a "Split Conductor" cable. This, of course, is not correct. It is a three-core cable for use with a pilot, on the Beard-Hunter System of Automatic Protection.

We always endeavour to state only the truth in our advertisements, and we regret that this rather silly slip should have got in.—I am, etc.,

W. T. Henley's Telegraph Works Co., Ltd.,
W. F. BISHOP,
Manager, Sales Department.

London, E.C.
May 29, 1922.

Exponentials Made Easy.

Some fifty years ago the teaching of mathematics in this country suffered severely from programmes rigorously mapped out, departure from which meant loss of official recognition. In the old days every Cambridge student had to learn Euclid's proofs, and in the first part of the mathematical tripos the student was forbidden to use the calculus. It was no wonder that many gave up the study of mathematics altogether once they had got through their examination, the official diet provided having proved both uninteresting and indigestible. Then Perry, and later on Silvanus Thompson, made the study—at least for engineering students—more attractive. They laid stress on its practical applications and successfully showed that many mathematical theorems were of human interest and could be understood by the average reader without much difficulty.

This volume* is written as a companion volume to Silvanus Thompson's "Calculus Made Easy." The titles of the various chapters indicate the way in which the author treats the subject. For example, the titles of Chapters IX., XI., and XIII. are "Epsilon's Home: The Logarithmic Spiral," "Epsilon on the Slack Rope: What there is in a Hanging Chain," "Where Epsilon Tells the Future: The Probability Curve and the Law of Errors." We welcome a book of this nature. It will clear up some of the mathematical difficulties of the junior reader, and will both widen his knowledge and encourage him to make further mathematical research. It is both well written and accurate.

A. R.

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* "Exponentials Made Easy, or the Story of Epsilon."—By M. E. J. Gheury de Bray. (Macmillan & Co., Ltd., 1921.)

Institution of Electrical Engineers.

Annual General Meeting.

The Annual General Meeting of the Institution of Electrical Engineers was held on Thursday, May 25, at the Institution building, the President (Mr. C. S. Highfield) in the chair.

The PRESIDENT, commenting upon the Council's Annual Report (which is abstracted below) said the Council had just managed to arrange to have the ceremony of unveiling and dedicating the Institution's War Memorial on June 28, the Wednesday just preceding the Conversazione.

He then announced the following awards of premiums for Papers presented to the Institution during the session.

Institution Premium of £25 to Mr. J. G. Hill, for his paper on "Phantom Telephone Circuits and Combined Telegraph and Telephone Circuits Worked at Audio Frequencies." *Ayrton Premium* of £10 to Mr. L. H. A. Carr, for his paper on "Induction-type Synchronous Motors." *Fahie Premium* of £10 to Mr. E. S. Byng, for his paper on "Telephone Line Work in the United States." *John Hopkinson Premium* of £10 to Mr. F. P. Whitaker for his paper on "Rotary Converters, with special reference to Railway Electrification." *Kelvin Premium* of £10 to Mr. P. Torikai, for his paper on "Abnormal Pressure Rises in Transformers, and its Remedy." *Paris Premium* of £10 to Mr. J. A. Kuyser, for his paper on "Protective Apparatus for Turbo-Alternators." *Willans Premium* of £14 6s. to Mr. K. Baumann, for his paper on "Developments in Steam Turbines." *Extra Premium* of £10 to Mr. F. J. Teago, for his paper on "Test Results obtained from a Three-Phase Shunt Commutator Motor." *Extra Premium* of £5 to Mr. J. Anderson, for his paper on "Electric Motor Starters." *Extra Premium* of £5 to Mr. W. Wilson, for his paper, "Some Notes on the Design of Liquid Rheostats." *Duddell Premium* of £20 to Mr. T. L. Eckersley, for his paper on "An Investigation of Transmitting Aerial Resistances." *A Premium* of £10 to Mr. E. M. Moullin and Mr. L. B. Turner, for their paper on "The Thermionic Triode as Rectifier." *A Premium* of £10 to Mr. C. S. Franklin for his paper on "Short-Wave Directional Wireless Telegraphy."

Mr. HIGHFIELD, resuming his comments on the Report, said he had visited all the Territorial Centres except Glasgow, which he would visit next week, and Dublin, to which he had not been asked to go. In every centre he found the same keenness for the well-being and good name of the Institution that was found at the meetings in London. Members of other societies envied the radio-active qualities of their membership. He was glad to say nothing had been done in the way of exacting German reparations by requiring Germans to put up electric power stations here. With regard to electrical engineering training and examinations, the Committee, of which Mr. Gill was chairman, hoped to put a scheme forward which would be useful to the Students. There was a gratifying increase in the number of subscribers and donors to the Benevolent Fund, the total being 1 351 during the past year, compared with 884 in the previous year, while the sums they contributed amounted to £1 693, compared with £440.

The Report having been adopted, Sir JAMES DEVONSHIRE (Hon. Treasurer) explained and moved the adoption of the Accounts, and, after some remarks by Mr. F. W. PURSE, who referred to the increased revenue, increased contributions to reserve, &c., and suggested that the Council should consider the question of reducing members' contributions, the motion for the adoption of the Accounts was agreed to.

Votes of thanks were accorded the Hon. Secretaries of Local Sections, the Hon. Secretaries abroad, the Hon. Treasurer, and the Hon. Solicitors, and Messrs. Allen, Attfield & Co. were reappointed Auditors.

Annual Report.

Membership of the Institution.

After references to the Royal Charter, the new seal, and the liquidation of the old Institution, it is stated that on April 1, 1922, the total number of members of all classes was 10 275, a net increase of 826.

The average annual increase of membership for the last three years is over 1 000, and the Council express gratification at this rapid growth, notwithstanding the increasing stringency of the qualifications for admission.

Deaths.

The deaths of 54 members occurred during the year. Amongst them were M. J. Carpentier, Prof. F. B. Crocker, Dr. Edward Hopkinson, and Mr. R. E. Winkfield (Past Chairman of Calcutta Centre).

A design for two bronze tablets to be placed in the entrance hall has been approved as a war memorial. The War Memorial Book containing the biographical notices and portraits of members who fell in the war is now in an advanced state of preparation. The editing of the book has been undertaken by Lieut.-Col. W. A. J. O'Meara.

Wireless Aerial on Institution Building.

On the recommendation of the committee of the wireless section, a permanent aerial has been erected on the Institution building, the dimensions of which we have already given. The natural wavelength is about 200 metres.

National Electrical Convention.

The Council have approved a suggestion made to them that a National Electrical Convention be held under the auspices of the Institution. In view of the postponement of the British Empire Exhibition to 1924, the Council will reconsider the question of the date for the first Convention.

Territorial Centres and Sub-Centres.

The attendance reported at the meetings held at the Territorial Centres and Sub-Centres afford evidence of the interest taken by members outside London in the work of the Institution. During the Session the President paid visits to the Centres at Birmingham, Cardiff, Leeds, Manchester and Newcastle, and to the Sub-Centres at Loughborough, Liverpool and Sheffield. The Council regret the discontinuance of the Aberdeen Sub-Centre on account of the small number of members in that district.

Mr. R. V. Picou has resigned the office of Local Honorary Secretary for France, and Mr. J. Grosselin has been appointed in his place.

Wireless and Informal Meetings.

The Wireless Section of the Institution has held seven meetings, and seven papers were read, and ten informal meetings have also been held. The Council are highly gratified at the success of the latter meetings, and congratulate the Informal Meetings Committee on their excellent work.

Students' Sections.

The number of students on the Register of the Institution has reached a record total of 2 455. The Council have recently granted permission for the formation of Students' Sections at Leeds and Sheffield. The latter Section has held two meetings. A students' tour in Switzerland, organised by the London Students' Section, took place towards the end of July, 1921, and several works were visited.

The following Scholarships have been awarded by the Council: *David Hughes Scholarship*—Mr. W. T. Slater; *Salomons Scholarships*—Mr. G. R. A. Murray and Mr. P. G. A. Voigt.

War Thanksgiving Education Research Fund.

A grant of £100 for educational purposes has been made under the provisions of the Trust Deed to Mr. J. D. Cockcroft (College of Technology, Manchester).

Return Visit of Dutch Engineers.

The return visit of Dutch Electrical Engineers took place from the 23rd to the 28th May last. The party consisted of representatives of the Royal Dutch Society of Engineers and of the Association of Managers of Dutch Electricity Undertakings. After being shown over various places of interest in London, the visitors travelled by motor via Henley, Oxford, Hereford and Chester, and to Manchester.

Library.

After a period of over four years, the Institution and Ronalds Libraries were again accessible to members last summer, and the number of readers from September, 1921, to March, 1922, inclusive, was 1 202, of whom 52 were non-members. The Council have decided to keep the Library open on the evenings on which ordinary meetings of the Institution, informal meetings and meetings of the Wireless and Students' Sections are held.

Electrical Appointments Board.

The Electrical Appointments Board report that the number of unemployed members on the Register is 120, as against a total of 51 last year. The Council hope that firms having vacancies will assist them by reporting them to the Secretary of the Board at the Institution offices.

The Journal of the Institution.

The number of pages in the 1921 volume was 852, compared with 944 in 1920. In addition, a supplementary volume of 336 pages was printed in 1920, making a total of 1 280 pages for that year. The net cost of printing and publishing, after allowing for sales, was £4 936, compared with £6 739 (including the supplement) in 1920. Owing to the trade depression of the past twelve months, the publication in the *Journal* of the Classified Index of British Manufacturers has been delayed, but a preliminary issue will appear at an early date.

The contribution of the Institution towards the cost of publishing *Science Abstracts* in 1921 was £978, compared with £261 in 1920, but the average for the two years was approximately the same as the average annual contribution since its conception in 1898.

Wiring Rules.

The Editing Sub-Committee have completed the revised draft of the Rules, and it is now being considered in detail by the Main Committee. In connection with the revision, specifications for certain electrical apparatus are being prepared by Committees of the British Engineering Standards Association. It is hoped that these specifications will be available before the new edition is finally published, so that reference may be made to them in the Rules. It is proposed to issue the revised "Conductor" section in advance of the remainder of the Rules.

Model Conditions for Contracts.

On the suggestion of the British Electrical and Allied Manufacturers' Association the Council have appointed a committee to prepare model conditions of contract for (*a*) " Home " orders when no erection is included in the contract, and for (*b*) " Export " orders, with or without erection.

Sea-going Electricians.

A deputation of the Ship Electrical Equipment Regulations Committee has been received by the Board of Trade in connection with the steps that are being taken by the Institution, at the request of the Electrical Trades Union, to urge the Board to hold examinations and grant certificates to sea-going electricians.

British Electrical Proving House.

The Wiring Rules Committee have reported to the Council as follows :—

" Very grave difficulty is found by this Committee in dealing with inquiries as to the conformity of appliances and fittings with the Wiring Rules, and the Committee are strongly of opinion that a body for dealing with questions of this kind should be set up, and they recommend the Council to reconsider the question of a National Proving House."

The Council have referred the matter to a committee for consideration and report.

Registration of Electrical Contractors.

The Council have set up a committee consisting of representatives of the Institution and other interested bodies, to prepare and report on a scheme for the voluntary registration or certification of electrical contractors.

Power Lines Committee.

The Regulations Sub-Committee have been engaged in the revision of the Board of Trade Regulations, for (*a*) securing the safety of the Public, and (*b*) ensuring a proper and sufficient supply of electrical energy ; also the Overhead Line Regulations for (*a*) high pressures and (*b*) low and medium pressures. Drafts of the revised Overhead Line Regulations have been completed, and that for high pressure has been circulated amongst the associations interested. Various criticisms and suggestions have been received, and the draft Regulations are consequently being reviewed. A similar course will be followed in regard to the low and medium pressures Regulations, and it is hoped that a report on both sets of Regulations will be ready before next Session.

German Reparation Payments.

On November 17, 1921, *The Times* published a letter from Sir Henry Strakosch proposing that German reparation payments be made in kind, principally in the form of electrical machinery. The Council addressed a letter to the Prime Minister and to the Chancellor of the Exchequer taking strong exception to the proposals.

City and Guilds of London Institute (Grade I).

The Council have been glad to give their support to an application to the Board of Education from the Council of the Electrical Contractors' Association for the temporary reinstatement of the examination in electrical installation work. The Board have granted the application for the year 1922, and have left the question of the future of the examination for discussion between the Board and the Association.

Electrical Engineering Training.

The Council received last year a letter from the Board of Education inviting the Institution to appoint a small body of representatives to discuss with representatives of the Board the possibility of the co-operation of the Institution with the Board in the regulation of courses of study and the issue of certificates and diplomas to successful students.

The Council appointed a committee to meet representatives of the Board, and five conferences were held. As a result a scheme to give effect to the objects in view was submitted to and approved by the Council. The proposals are now under consideration by the Board of Education. The main points of the scheme are :—

(1) The abolition of single-subject examinations and the substitution of grouped courses in electrical engineering.

(2) A joint board of three members appointed by the Institution and three by the Board of Education will be set up to manage the scheme, including the curriculum and the examinations.

(3) The entry of any school into the scheme is entirely voluntary, but no school can be included unless approved after detailed inquiry by the Institution, and such approval may be withdrawn by the Institution at any time, if found necessary.

(4) The holding of internal examinations by the approved schools and of a final internal examination with external assessors appointed by the Institution. These assessors will review the questions set and give the final marks to the answer papers.

(5) National certificates and diplomas bearing the names of the Institution of Electrical Engineers, the Board of Education and the School will be issued to successful candidates.

The Council regard this matter as one of very great importance, tending to bring the schools more closely into touch with the educational needs of the industry, affording a guide to young men as to lines of study, and providing for a certificate, the value of which will be recognisable all over the country.

Similar arrangements have been made by the Institution of Mechanical Engineers and the Institute of Chemistry.

Co-operation among Engineering Institutions.

The Council have appointed the President and Mr. K. T. Smith to represent the Institution at a conference summoned by the Institution of Civil Engineers to examine the question of co-operation among engineering institutions.

Development and Research Association.

The membership of the Association has reached a total of 610. Members of the Institution interested in development work are recommended to communicate with the Director of the Association, who will be glad to give particulars of membership, &c.

The Council of the British Electrical and Allied Industries Research Association now consists of twenty members, of whom seven are nominated by the Institution. The work is divided under eleven sections, and there are over forty research committees. The Association has the regular assistance of about 150 experts and the occasional assistance of many others. The expenditure on research now amounts to about £16 000 per annum.

The B.E.S.A.

Seven British Standard Specifications for electrical purposes were issued during the year.

Considerable work has been done in connection with the co-ordination of the electrical specifications of eight Government Departments, and much of this work will become available for general use.

The revision of the Standardisation Rules for Electrical Machinery (B.S.S. No. 72) has been in progress for over a year, and it has been decided to sub-divide the Rules and draft them in the form of specifications as follows : (*a*) Large machines ; (*b*) transformers ; (*c*) industrial machines. These should be available during the coming year.

The list of " Terms and Definitions " originally prepared by the Institution in March, 1916, has been reviewed and greatly enlarged. It will not be issued until it has been considered by hte International Electrotechnical Commission.

International Electrotechnical Commission.

The changed conditions in all countries have made the work of the International Electrotechnical Commission during the past year proceed at an apparently slower rate than formerly, each country with its own national standardising body now finding it necessary to consult all the various interests before instructing delegates to attend the meetings.

The revision of the I.E.C. standard of resistance of copper has been completed. Proof copies can be seen by those interested on application to the Secretary of the Commission. A corresponding standard for aluminium is in course of preparation.

A request for the co-ordination of the rules and regulations relating to distribution systems (overhead and underground) in the various countries has been acceded to. A questionnaire is being prepared for circulation, and each national committee will be asked to prepare replies.

Benevolent Fund.

On December 31, 1921, the capital account of the Benevolent Fund stood at £7 859 7s. 3d., and the accumulated income at £1 583 16s. 9d. Donations and subscriptions in 1921 amounted to £1 424 17s. 3d.

Grants were made to 14 persons amounting to £525 5s.

Reference was made in the last annual report to the generous offer of Mr. E. M. Hughman (late of Bombay) to present £250 to the Fund, provided 19 other donations of a similar amount were received by June 30, 1921. Mr. Hughman was good enough to extend the date to December 31, 1921, and entirely to waive his conditions, both as to the number and the amount of the other donations. An appeal based on the offer was widely circulated, and the result has been that the Fund has already benefited to the extent of £2 306 6s. 5d.

The Institution's Annual Accounts.

After making provision for contingencies, as in the previous year, there is a margin to the good on the revenue account for 1921 of £639 2s. 10d. This amount, which has been carried to the credit of the general fund, compares with £673 7s. 1d. in 1920. In the accounts for 1920 mortgages stood at £29 284 15s. They now stand at £24 331 19s. 11d.

The total of the Life Compositions Fund on January 1, 1921, was £5 676 11s. Out of this the sum of £86 1s. has been transferred to the general fund on account of Life Compositions of members deceased during the year, leaving to the credit of the Fund £5 590 10s.

Taking the Tothill Street property and the investments at cost, and the Institution building and lease, the library and furniture, etc., at the values standing in the books after writing off depreciation, the assets amount to £115 354 15s. 10d. against liabilities £6 415 7s. 11d., leaving a surplus of £108 939 7s. 11d., which compared with £102 696 0s. 10d. in the previous year.

A diagram is attached to the report. This is a truly imposing list showing the organisation of the Institution and its representation on other bodies.

The Fullagar Oil Engine.

The demand for oil engines of relatively high powers has led the English Electric Company to take up the manufacture of the Fullagar oil engine for the driving of dynamos, water pumps, air compressors, and for similar purposes.

The arrangement of exhaust and air inlet ports used in this engine is diagrammatically shown in Fig. 1. Here there are two pistons moving in opposite directions in one cylinder—one piston first uncovers the exhaust ports, which extend all round the cylinder bore, then the other piston uncovers a set of scavenge ports at the other end of the cylinder. These ports also extend all round the bore, and fresh air at a low pressure, supplied by a pump, flows from one end of the cylinder to the other, sweeping out the burnt gases and leaving the cylinder filled with fresh air. This method of scavenging has been used for many years by the employment of three cranks per cylinder, the centre crank being connected to the piston nearest to it, and the two outer cranks coupled to the piston more remote.

The special feature of the Fullagar engine consists in having only one crank and connecting rod per cylinder, in place of the cumbersome arrangement of three cranks just described. Fig. 2 shows two cylinders exactly similar to that in Fig. 1, each having two pistons working in it. By connecting the lower piston in the first cylinder to the upper piston in the second cylinder, and the lower piston in the second to the upper piston in the first by pairs of oblique rods external to the cylinders themselves, the need for three cranks per cylinder is overcome.

Further Advantages of the Engine.

Apart from the air scavenging arrangements, the following are among the many advantages obtained from the Fullagar system of

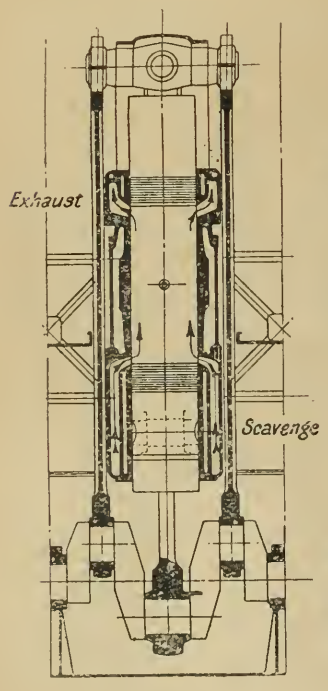


Fig. 1.

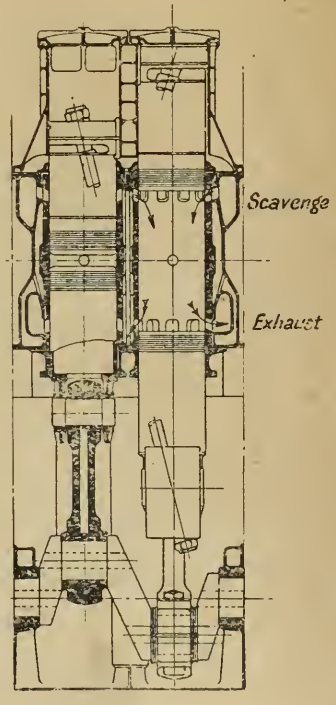


Fig. 2.

opposed pistons cross-connected: (1) the direct stresses caused by the pressure between the pistons are not transmitted to the framing. There is thus an important saving in weight, the stresses on the framing being only those due to the side thrust of the upper and lower crossheads; (2) the work which has to be expended in compressing the air in the cylinder adjoining that in which combustion is taking place is done directly by means of the external oblique rods, instead of being transmitted through the crankshaft, as in all other types of engine; (3) the lubrication of the main bearings of the crankshaft and the connecting rods is rendered easier by the connecting rods being alternately in compression and tension, for the reversal allows the lubricating oil, which is under pressure, to flow freely all over the bearing surfaces; (4) the loads on the main bearings are greatly reduced, the pull of one connecting rod being largely counteracted by the thrust of the adjoining rod; (5) the balance of the engine is excellent, owing to the fact that the centres of gravity of the reciprocating masses working side by side nearly coincide; (6) the engine, owing to its construction and balance, is suitable for working at higher rotating speeds than the ordinary reciprocating engine; (7) the turning effort of a 4-crank Fullagar engine is equal to that of an 8-crank engine working on a four-stroke cycle. Both this point and the previous one are of special importance in connection with the driving of dynamos; (8) the engine occupies a relatively small floor space. The outline general arrangement drawing in Fig. 4 indicates the saving in floor space of a 750 B.H.P. Fullagar engine as compared with a compact four-stroke cycle

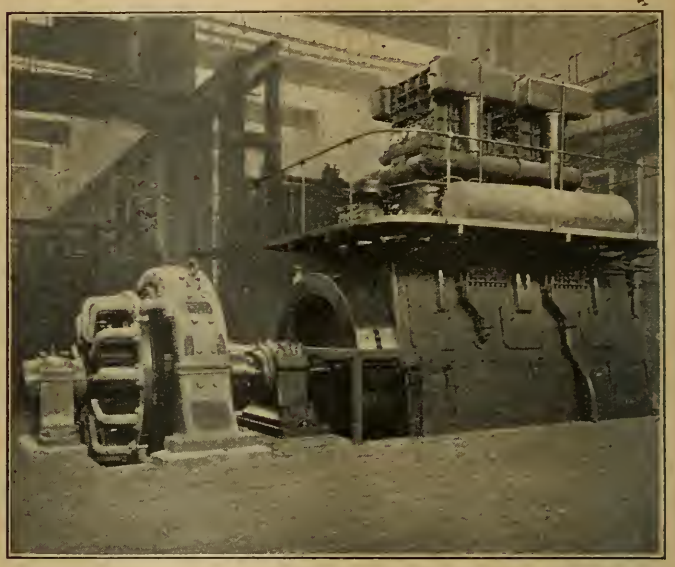


Fig. 3. 750 B.H.P. 4-Crank Fullagar Oil Engine, Running at 250 R.P.M.

Dicsel engine of 500 B.H.P.—*i.e.*, two-thirds of the power of the Fullagar engine. The length of a six-crank Fullagar engine of 1 125 B.H.P. would be only one-third greater than that of the 500 B.H.P. Diesel engine referred to; (9) the total weight and the individual weights of the various parts of this engine are less than those of the standard 500 B.H.P. Willans Diesel engine. The lower weight facilitates handling during transport and erection, and also overhauling; (10) although the Fullagar engine, owing to the opposed piston construction, is decidedly higher than an ordinary Diesel engine, the height required to the crane hook for getting out the pistons is less than is necessary to withdraw the piston of the standard 500 B.H.P. Diesel engine complete with its connecting rod clear of the top of the cylinders. The oblique rods do require more head room, but these can be drawn out when necessary by a light fitment attached to the crab of the crane. The pistons can be readily withdrawn without disturbing any high-pressure joints, and, of course, there are no cylinder covers to be removed.

Fig. 4 shows a four-crank Fullagar oil engine which develops 750 B.H.P. at 250 revs. per min. This engine is coupled to a 500 kW dynamo, and is used for supplying current for power and light in the Rugby Works of the English Electric Company. The engine works on the Diesel system—*i.e.*, the air in the working cylinders is compressed to raise the temperature of the air to about 1 000° F., in order to ignite the fuel oil, which is atomised and blown in by compressed air. A three-stage air compressor driven from the end of the crankshaft supplies the air required for starting the engine and for injecting the oil. The scavenging air is supplied from the chambers in which the upper crossheads work. The crossheads

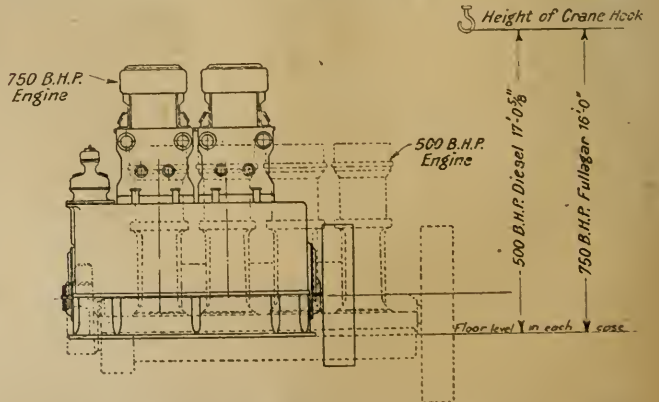


Fig. 4. Comparison of 750 B.H.P. Fullagar 2-cycle and 500 B.H.P. Diesel 4-cycle Engines.

thus act as pistons, the automatic air inlet and delivery valves being contained in the boxes in front of and behind the chambers in question.

Valve Gear.

The valve gear is illustrated in Fig. 5. The only mechanically operated valves are the fuel admission valves, of which there is one

per cylinder. The starting air valves fitted on two of the cylinders are opened by compressed air, these valves being in operation only during the first few revolutions at starting up. All the main bearings, connecting-rod bearings and lower crossheads are forced lubricated. The main pistons, upper crossheads, air compressor and practically all other parts are lubricated by mechanically operated lubricators driven from the camshaft.

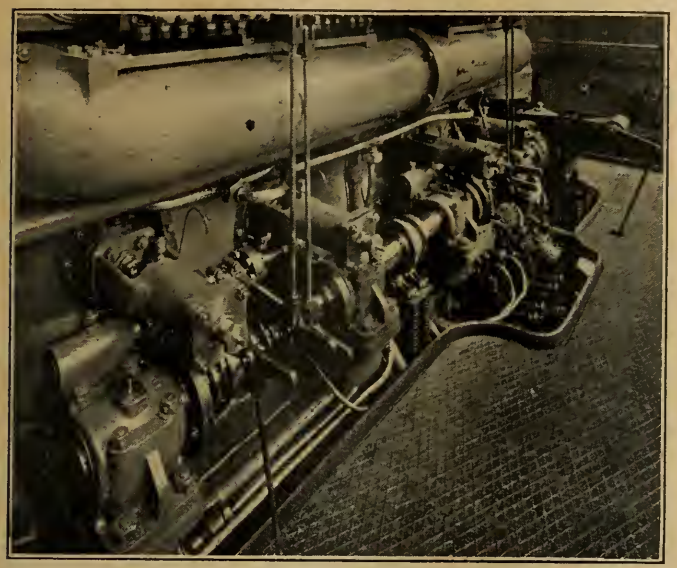
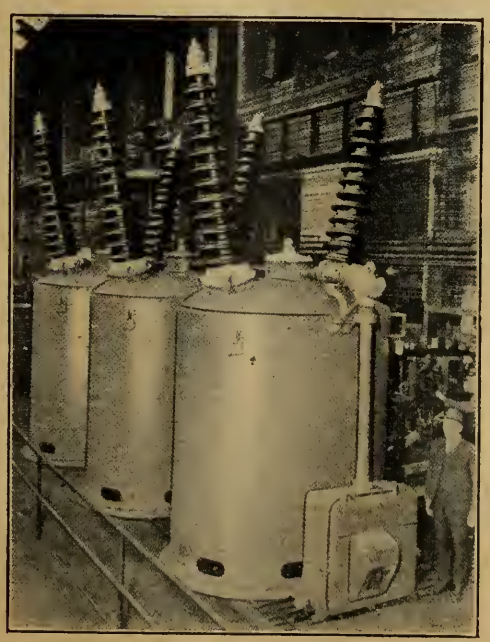


FIG. 5.—VIEW OF VALVE GEAR.

The fuel oil used in the engine is that normally supplied for use in Diesel engines built by this company. It has been demonstrated by extended trials that the fuel economy of the Fullagar engine per B.H.P.-hour is at least equal to that of a Diesel engine having the same size of cylinder.

A Large h.t. Oil Circuit Breaker.

The WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY has just shipped to the Pacific Gas and Electric Company what is believed to be the largest oil circuit breaker yet built. The breakers were built for the 220 000 V Mount Shasta developmnet, and are for use



THE H.T. OIL CIRCUIT BREAKER FOR THE MOUNT SHASTA DEVELOPMENT.

on a 220 000 V system having a solidly earthed neutral. The breaker has stood a 350 kV wet test.

The gross shipping weight of the apparatus, including oil, is 90 000 lb. or 45 tons. The net weight of the unit, erected on foundation, is 75 000 pounds. The breaker requires 2 000 gallons of oil for each pole and its net weight exclusive of oil is 30 000 lb. The height from the ground to the top of the bushing is 17 ft. 6¼ in., and from the ground to the top of the tank is 9 ft. 8⅛ in. The long diameter of the tank is 8 ft., while its short diameter is 5 ft. 8 in.

The "Posterlite."

The poster which tells its story by night as well as by day has obvious advantages over its rivals whose appeal ceases at sundown. In some cases, however, hoardings cannot be illuminated by means of floodlights fixed at a distance, and for these conditions the "Posterlite," a new bracket unit which can be fixed above the top of the surface to be illuminated, has been designed by the BRITISH THOMSON-HOUSTON CO.

This unit consists of a sheet copper trough with silvered glass reflectors bent to correctly designed contours to give a concentrated flat beam. The mouth of the trough has across its length louvres of

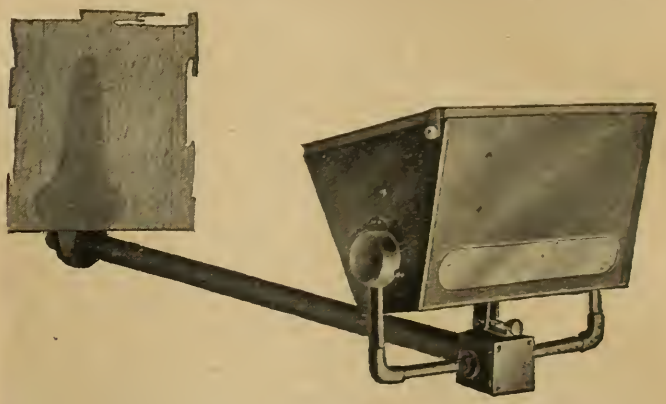


FIG. 1.—B.T.-H. "POSTERLITE" UNIT (PATENT APPLIED FOR) SHOWING BACKPLATE FIXED TO BACK OF HOARDING, WHICH IS 'GHOSTED" IN THE PICTURE.

diffusing glass and metal. These modify and diffuse the light on the upper portion of the hoarding without in any way interfering with the main beam of light which illuminates the lower portion. In this way an even illumination is produced over the entire vertical surface.

Lateral Distribution of Light.

The lateral distribution of light is very wide, allowing the units to be spaced as much as 10 ft. apart. Each unit takes two 250 W projector type Mazda lamps, which can be connected either in series or parallel for use on high or low voltage circuits. "Posterlite" units can be used on all hoardings from 10 to 20 ft. deep. Where hoardings stand alone and have no brightly illuminated surfaces adjacent these units will be found satisfactory for depths up to 25 ft. For average conditions, units spaced 10 ft apart will give good results.

The Backplate.

The backplate is so designed that it may be attached either to the front or back of the hoarding, the tube being secured in position

FIG. 2.—SWAN VESTA POSTER, STRAND, LIGHTED BY MEANS OF TWO "POSTERLITE" UNITS.

by two taper pins passing through the boss in the backplate. An entry (tapped 1 in. conduit) is provided through which the supply can be brought into the bracket. An insulated connector is provided in the head of the bracket to which connection can be easily made, the unit being sent out with the holder wired to this point.

Retirement of Sir William Noble.

On Wednesday Sir William Noble, Engineer-in-Chief at the G.P.O., retired, after 45 years in the postal service. Beginning his official career in 1877 as a telegraphist in Aberdeen, William Noble was not content to be a manipulator all his life. He devoted his spare time to acquiring a proficient knowledge of Pitman's shorthand and to studying English, mathematics, the principles of electricity and magnetism, and other kindred sciences. He won medals in both the ordinary and honours grades in the City and Guilds examinations in telegraphy and telephony and was appointed lecturer in those subjects at Gordon's College, Aberdeen. His classes were remarkably successful. In one year three of the five medals offered went to Aberdeen. Later in his career Sir William was appointed examiner in telegraphy by the Institute of the City and Guilds of London and held the post for some ten years.

His success attracted attention throughout the service and in 1893, after a short training in routine procedure in the Engineering Department in Edinburgh, he was appointed engineer-in-charge of the Aberdeen Section. Four years later he was promoted to a first-class engineership at Headquarters, and in 1900 he was appointed second-class technical officer. The Post Office had just undertaken the task of installing a telephone system in London, and in 1901 Mr. Noble was selected to act as assistant superintending engineer in the newly created Central Metropolitan District. He had a large share in the work of the "telephoning of London," the magnitude of which is not generally appreciated.

Steady Promotion.

In 1905 he was recalled to headquarters as first-class staff engineer and placed in charge of the Telegraph Section, which included wireless telegraphs in those days, the operations of radio work not then having reached the magnitude and importance now attained. The comparative seclusion of a section at headquarters did not act as a sedative to his energy. It was during this period that central battery working was introduced. He also vigorously promoted the development of machine sending and printing telegraphy. In 1907 he returned to the London District as superintending engineer of the Central Area. After improving and consolidating the organisation of that district he recommended the amalgamation of the three London districts into one, in order to reduce the overhead charges and to simplify the transfer of the National Telephone Company's system and staff to State control. The recommendation was not accepted at the time, but after the transfer two districts were formed out of three and eventually his original proposals were adopted and a single London Engineering District covering the entire area came into being.

During the years in which he held the post of superintending engineer, Sir William was called upon to serve on many departmental committees. For five years he was chairman of the Factory Works Committee. He, in conjunction with Mr. Sinnott, was responsible for the present system of joint examination which deals with the examination and repair of all apparatus used by the department. Prior to the transfer of the National Telephone Company he was appointed engineering representative on the Staff Transfer Committee, set up for the purpose of grading into the existing Post Office classes the members of the national company's staff.

Services Recognised.

In 1902 Sir William was appointed assistant engineer-in-chief The engineering staff by the transfer of the company had increased threefold, and the new assistant immediately set himself to organise the combined staffs into a homogeneous whole. The next few years were years of great activity. New exchanges were installed everywhere, underground schemes were provided in almost every industrial centre, obsolete lines and plant had to be recovered, and a vast network of main underground trunks was planned and commenced. But for the war the telephone service in this country might by this time have been equal to the best in the world. For his services in connection with the work done by the Signals, R.E., during the war, which was largely Post Office, the King of the Belgians created him a Chevalier de l'Ordre de la Couronne for "constant and generous help" during the war.

In 1919 Sir William Slingo retired and was succeeded by Mr. Noble. One of the most remarkable tributes to Sir William's success during his tenure of office has been the fact that the telephone industry has been entirely free from disturbance or dislocation due to trade disputes. His services were recognised by the King in 1920 by the conferment of knighthood, an honour which came to him earlier than to any of his predecessors in office.

In the course of his career Sir William has visited many European countries on telegraph and telephone business and has reported on the methods and apparatus used by Continental administrations. He is president of the Institution of Post Office Electrical Engineers and is also a Member of Council of the Institution of Electrical Engineers, and last year read a paper before that body on "The Long Distance Telephone System of the United Kingdom" for which he was awarded the Fahie Premium. He is probably the best known Scot in London to-day, outside the ranks of the Parliamentarians; and it is not at all unlikely that even this exception may be omitted in the near future.

Barton Power Station.

Mr. S. L. Pearce, chief engineer and manager to Manchester Electricity Department, gave a description of the new Barton power station and other electrical developments in south-east Lancashire to the Manchester Rotary Club last week. The designs of the station, he said, had been most carefully thought out. Thanks to the generosity of the Manchester Electricity Committee, he had been enabled to see some of the large plants not only in other parts of this country but also on the Continent and in the United States, and he assured them that the best features which could be embodied in a modern power station would find a place at Barton; Every factor they knew of which made for efficiency had been introduced. They were installing some 120 000 h.p. of the plant in three large units of, approximately, 40 000 h.p. each. The capital outlay on and incidental to the station had been very heavy, totalling about 3½ million pounds sterling—on the station about £2 400 000, on the transmission lines £630 000, and on distributing stations about £230 000 to £240 000. Roughly speaking, the cost of every kW installed at Barton, as compared with what the cost would be in 1915 and 1916, was about 2½ times as large. Some of them might ask whether the Corporation was justified in embarking upon the scheme at such a time of high prices. He thought there could be only one answer. Manchester was a most important growing industrial centre, electricity entered into the life of its people at every point and stage, it could not buy its electricity elsewhere, and it was necessary to make provision to-day for the needs which would arise when trade improved. The effect of the high capital outlay could be minimised to a great extent. The station had been designed to reduce to the lowest possible basis the coal bill and labour charges and to ensure a high degree of reliability. The plant must be run for the maximum number of hours possible. It must become what the Americans called a "base load" station. The ideal station would, of course, run at full load for 8 760 hours per annum, giving 100 per cent. load factor. This was impossible, of course, but the aim should be to get as near that figure as practicable. There was no reason why 60 per cent., and possibly more, should not be attained. At Stuart Street it was about 40 per cent. At Barton, as compared with Stuart Street, the coal consumption would be reduced by at least 30 per cent.

Tariff Reduction.

Referring, lastly, to the subject of prices, Mr. Pearce said that the average prices obtained in Manchester during the last financial year did not compare unfavourably with those of other large undertakings, such as those of Liverpool, Glasgow and Birmingham. They were lower in all respects, excepting that of lighting in Glasgow. Still, they recognised that prices would have to come down, and a start was to be made in June. He hoped that as Barton came into operation and energy became available the Electricity Department would adopt a more forward sales policy with regard to the supply of electrical apparatus for household use. Last year's results, notwithstanding the industrial slump, were better than might have been expected. Although sales fell to the extent of 42 million units there was a substantial sum on the right side.

In the course of some discussion the opinion was expressed by two speakers that Manchester was the most backward city in the north in the use of electricity for cooking purposes, and that the cost of electricity might be considerably reduced. One speaker said he was obtaining it in Grimsby at half the price he had to pay in Manchester, and that in a new factory his firm was using oil in place of electricity.

The Institute of Physics.

At the Annual Meeting of the Institute of Physics, held on May 23, the following officers and board were elected to serve for the year beginning October 1, 1922. *President*—Sir J. J. Thomson. *Past-President*—Sir R. T. Glazebrook. *Vice-Presidents*—Sir Charles Parsons, Prof. W. Eccles, Prof. C. H. Lees, Mr. C. C. Paterson. *Non-Official Members of Board*—Dr. R. S. Clay, Prof. C. I. Fortescue, Prof. A. Gray, Major E. C. Henrici, Sir J. E. Petavel, Dr. E. H. Rayner, Sir Napier Shaw, Mr. R. S. Whipple. *Representatives of Participating Societies*—Physical Society, Mr. C. E. S. Phillips, Mr. F. E. Smith; Faraday Society, Mr. W. R. Cooper; Optical Society, Mr. John Guild; Rontgen Society, Dr. G. W. C. Kaye; Royal Microscopical Society, Mr. J. E. Barnard.

The annual report stated that there were 408 members of the Institute at the end of the year, of whom 258 were fellows. The Institute is watching the possibility of establishing a central library for physics, although the financial difficulties in the way of its realisation are stated to be considerable.

In the course of his presidental address Sir J. J. Thomson, after dealing with the project to establish a Journal of Scientific Instruments, spoke of the present depression in industry, but he made the reassuring statement that out of 67 students who graduated with distinction in physics and chemistry in 1921, 40 had obtained suitable positions, while 14 were doing research work. He hoped that the series of lectures on Physics in Industry which had been established would act to some extent as "Refresher Courses."

Speaking of the difficulties which the Safeguarding of Industries Act had in many instances placed in the way of research, he characterised research as a "key industry," and he hoped that the Government would put every facility in the way of research workers being able to obtain without delay the apparatus they required.

Railway Companies' Electric Power.

The South-Eastern and Chatham Railway Companies' and West Kent Electric Company's Schemes have been before the Electricity Commissioners (Sir John Snell and Sir Harry Haward) during the past three days at an inquiry at the Middlesex Guildhall, Westminster.

Mr. W. D. Clode, K.C. (for the S.E. Railway Company, the L.C. and D. Railway Company and the South-Eastern and Chatham Railways Managing Committee), opening the case for his clients, said it was proposed to erect a station at Angerstein's Wharf, Charlton, 20 acres of which were available for the generating station. The energy would be supplied to a sub-station at Lewisham, about 3½ miles away. The railways he represented were included in the 1921 Railways Act in a group which also included the South-Western and the Brighton Companies. The L. and S.W. Company were generating their own energy and the L.B. and S.C. Company were taking a bulk supply from the London Electric Supply Corporation. Both were using a.c. at 25 cycles. The Companies Act of 1903 scheduled six sites which his companies might use for generating stations, but these did not include Angerstein's wharf. As soon as the cloud caused by the war began to pass away, their friends in the neighbourhood around London began to jog their memories with regard to their intention to electrify their lines, and several local authorities decided to support the application of the railway companies for sanction to the electrification of the North Kent and loop lines. A deputation waited upon the Chairman of the Companies' Committee on May 23, and impressed the urgency of the matter upon him. The Managing Committee applied to the Advisory Committee under the Trade Facilities Act asking if the necessary capital could be guaranteed by the Treasury, and the Advisory Committee agreed that the capital could be raised on much better terms if a guarantee were given.

Lines to be Electrified.

The railway lines proposed to be electrified in the first instance were the North Kent and Greenwich line, the Bexley Heath line, the Dartford loop line, the main line down to Orpington, the Bromley North Branch line, the Mid-Kent and Hayes line, the main line to Bickley and Orpington, the Crystal Palace and Greenwich Park line and the Catford loop line. These amounted to 94 route miles (210 single line miles). Ultimately the electrification of 241 route (640 single line) miles was contemplated. His clients might be able to cater for the Brighton Railway when the present agreement of the latter for bulk supply ran out. The Advisory Committee found the proposals technically sound, and referred the matter to the Minister of Transport, who appointed a committee of experts, presided over by Sir Philip Nash, and including Sir Alex. Kennedy Sir Philip Dawson and Mr. Stevens, who approved proposals to erect the generating station at Angerstein's Wharf. The estimate of the total cost was from 6 to 6½ millions. The Treasury were satisfied that the estimate was reasonable, and the Government had intimated that they were prepared to give a guarantee for the payment of principal and interest, provided a satisfactory agreement could be arranged. The generating station would be erected by the Construction Company, which was being formed with a capital of £10 000 and borrowing powers of 6½ millions, and would be leased to the Managing Committee, who would pay an annual rent to cover the interest on the debenture (which would be the form of the loan from the Bank of England) and a sum of not less than £95 000 per annum for redemption, taxes and expenditure in connection with the formation of the Construction Company. The maximum period during which the Treasury guaranteed the payment of principal and interest was four years. The provisional agreements would be put before the Minister of Transport, and an application would be made for an order under the 1903 Railways Electrification Act.

Necessity for New Station.

Counsel agreed with Sir John Snell that the present inquiry might make the Minister of Transport's inquiry unnecessary. The companies could not afford to wait for other supplies to be provided, as their opportunity for getting the Treasury guarantee would be gone by November 22 next. The West Kent Company had not yet got the Commissioners' consent to their station, and he understood the West Kent Company's proposal was strongly objected to. Their negotiations with the Advisory Committee and the agreements were based on the completion of the station and the line in three years. In the agreement between the Construction Company and the Treasury it was provided that the Railway Companies should have the option of taking over the station, on terms specified, at June, 1927, or any subsequent five years until 1942, and the Treasury guaranteed the payment of the principal and interest of the loan. The plant was to be wholly of British manufacture. They had had communications from the West Kent Company, which took current in bulk from the South Metropolitan Electric Light and Power Company. The West Kent Company was a small company with a large debt and was not now in a position to raise a large sum of money. It proposed to erect a station at Belvedere, and the proposal was opposed by London County Council. He intimated that he proposed to call Mr. Cosmo Bonsor, Chairman of the South-Eastern Company and of the Managing Committee, to deal with the financial proposals, but he suggested that he should not give full technical details showing the cost of generation until the West Kent Company had given evidence on their scheme. After which the figures as to cost of energy for both schemes should be put in simultaneously.

Mr. W. E. Tyldesley Jones, K.C. (for the West Kent Company), said this procedure was ridiculous. It was essential that they should know first what the railway companies offered.

Sir John Snell ruled that the railway companies must call evidence to prove the cost at which they could supply energy. They would have the last word after other parties had been heard.

Evidence for Companies.

Mr. H. O. Cosmo Bonsor confirmed counsel's statements as to the necessity for the electrification, and said it was only after the Trade Facilities Act was passed that they were in a position to go to the Treasury. The Advisory Committee said this scheme was one of the best put before them. The arrangement with the Treasury was that the Construction Company would create a debenture which would be lodged at the Bank of England with a Treasury minute attached. They would borrow the money as they wanted it. They could get their money in the cheapest market, but they could if they wished get their money at the current bank rate, which was 4 per cent. at present. The Treasury Bill rate was only 2¼ or 2½, and he could get money at a slight fraction over that. Therefore he could get his money cheaper than anybody else.

Cross-examined by Mr. Tyldesley Jones, witness said he did not think Sir Philip Nash's Committee considered the questions of erecting a power station and of purchasing electricity in bulk.

Answering questions by Commissioners, Mr. Bonsor said the practice of the Bank of England was to lend money for three months, after which it had to be repaid or the loan renewed. In this case they had gone out of their way to lend it for three years. At the end of that time they would probably only renew for three months. He still had no intrinsic objection to taking current from an outside supply if the price were as cheap and the guarantees were as good.

To Mr. W. S. Kennedy (for the London Electricity Joint Committee) witness said when the proposed Joint Electricity Authority was in working order it might be in the public interest for the railway companies' station to be taken over for general supply.

Replying to Sir Harry Haward, he admitted that he would only get the money cheaply so long as the Bank rate was low, but he always borrowed at less than the Bank rate. At the end of the three years the temporary loan would be turned into a permanent loan. Before that time the Southern Group would have taken over the whole thing. The annual amount for redemption, taxes, etc., would be nearer £110 000 than £95 000. The Treasury had made no requirements with regard to turning the temporary loan into a permanent one. There would have to be a sinking fund set up after the three years to liquidate the indebtedness in 22 years.

Questioned by Sir John Snell, he said he thought the only discussions between his companies and the Brighton company were as to whether they were to link up with the London Electric Supply Corporation's station at Deptford. As to the desirability of getting part of the supply for the Southern Group from Wimbledon, part from Deptford and part from Angerstein's Wharf, witness said they might all get it from Angerstein's Wharf when the station was developed.

Mr. C. P. Sparks then gave technical evidence.

Branch Factories in Canada.

In a letter to "The Times," based on the recent correspondence on "What can we do with our Sons," Mr. Frank Carrel, member of the Legislative Council of the Province of Quebec, and proprietor of the "Quebec Telegraph," who is now in England, urges British manufacturers to take more interest in the establishment of branch factories in Canada. During the last 25 years some 700 American and foreign factories have been established and are doing well. New labour-saving machinery is being rapidly introduced. Such modernism does not (he states), as Labour representatives say, cut down general labour, but increases production, at a less cost, with the same capital and plant. While it is perhaps, true that Canada is not ripe for every class of such branch factories, there is no doubt that there is room for a large number of them, particularly in a province like Quebec, where, within the next 25 years, the greatest electrical development of any part of the world is about to take place. In this short period of time millions of pounds will be invested in developing the immense waterfalls to generate electricity for railways and factories. This will again reduce manufacturing costs.

Speaking on this subject, a Government official over here, Mr. Carrel states, enumerated all kinds of reasons why British manufacturers did not go to Canada, among them the difference in electrical apparatus or appliances. This, he says, may be true, but asks, would it not be in order to adopt the American product to fill the branch factory with orders?

"From existing facts, staring us in the face," he concluded, "it seems to me that all offices engaged in preserving British trade should be most optimistic relative to the establishing of branch factories, particularly in Canada, where, all things being equal, they would be assured of a thriving business and protection of capital in a growing country, whose population will soon rival the British Isles."

Opening up Europe.

By SIR ERNEST J. P. BENN.

THE ILLIMITABLE POSSIBILITIES OF EUROPE as a market are at long last beginning to attract the serious attention of commercial men. The continent of Europe, the centre of civilisation, with 1 000 000 000 human souls, has, from a trade point of view, for nearly eight years been dormant. From a business point of view there never were such opportunities and openings as now present themselves in Europe. The people have learnt that Peace Treaties and Supreme Councils cannot provide food and houses and clothing and all the little luxuries on which they have set their hearts; the eyes of the world are coming round to the business man, and the business man will undoubtedly show himself worthy of the opportunities that now confront him. Mr. Lloyd George, on his return from Genoa, told us that all the peoples were yearning to get back to business, and that they looked to England to give them a lead.

Potential Trade Openings.

Apart from these general considerations, a study of the problems in detail and an examination of the situation in each of the thirty sovereign States which now compose the Continent of Europe lead to the same conclusion. Everywhere one finds potential trade openings of unprecedented magnitude, and everywhere one also finds that the eyes of the populace are turned towards England in this connection. Take as an example the new State of Poland, a vast area almost as large as the United Kingdom. Less than four years ago the new Poland was partly German, partly Russian and partly Austrian, and it is now a mighty new nation anxious to build up a great commerce on its own. This new sense of independence which fills its blood makes it turn to new quarters in commercial matters and seek in England and in France for trade connections. By transferring trading interests in this way a new independence is established on a more solid and a firmer basis than a mere Treaty of Peace. Similar considerations and similar circumstances are found wherever one turns.

Englishman's Hazy Idea of Europe.

The average Englishman knows something of Paris and Brussels, he is vaguely aware of the location of Berlin, and if he is a young man he is closely and painfully acquainted with the geology of Flanders; but, apart from that, our ignorance of Europe as a whole is little short of appalling. Most people are surprised when they are told that Warsaw is a town which rivals Manchester in importance and astonished when they find its fine, broad streets swarming with hundreds of thousands of clerks and messengers, and its postal and transport and telegraph services buzzing and humming with an activity which is only equalled by our own. Yet Warsaw is one of thirty towns within a couple of days' journey of London all of equal commercial importance. Very few people know that there is a daily train which runs from Ostend to Constantinople, or that you can get into a train de luxe at Riga and run straight through to Madrid any day of the week that suits you. There is hardly a corner of Europe which is not to-day oozing with business opportunities; all along the thousands of miles of Soviet Russian frontier are squatted eager traders, profiteers if you like, engaged in illicit business with the unfortunate Russians, and this commerce has assumed such vast importance that a big international exhibition is to be held this year at Reval.

The Americans have, as might be expected, not been slow to realise these possibilities, and Europe is to-day literally swarming with visitors from the United States. The farther east one goes the more one seems to meet these enterprising people Constantinople is full of them, and every town on the way has its quota.

Difficulties *v.* Opportunities.

There are difficulties—of course there are difficulties—grave difficulties, but the chief difficulty is surely that the manufacturer and the trader of our generation has been so spoilt, so spoon-fed, so cared for and looked after, that he cannot work up the energy to attempt any business except that which is positively smooth, easy and certain. There is first of all the question of currency. It is far too commonly supposed that a fluctuating currency or a depreciated currency is a bar to business. It is an inconvenient circumstance, but nothing more. The risks of fluctuation can be covered by the purchase of currency at any moment in any market. The way in which the peoples of Europe have accommodated themselves to the instability of currency conditions is one of the marvels of the age. If the people of Austria can still live in comfort with a money which has depreciated to a ten-thousandth part of its former value, surely the British merchant is not incapable of accommodating himself to similar conditions. All these difficulties do not really count when measured by the opportunities which exist. If the English trader still insists on having his business made fool-proof before he will proceed, then others will supply the needs of Europe; but, if that fine, commercial spirit, which was at one time England's pride would to-day arouse itself, both England and Europe might be very much better off in the next few years.

A European Trade Paper.

These are the considerations which have led BENN BROTHERS, LTD., to take the bold step of establishing a commercial weekly paper in the very centre of Europe. The "European Commercial," which will make its appearance from Vienna in the first week in September, will have a dual mission. On the one hand, it will set itself to inform the merchants of England and America of the actual conditions in the various States of Europe. On the other hand, it will be acclaimed throughout commercial circles in Europe as a link between them and England and will enable them to do the thing which to-day they most desire—to get into touch with English merchants, manufacturers and financial houses, and open up business negotiations. The "European Commercial" comes upon the scene at the moment when Europe is ripe for a commercial revival; the business men of all countries now realise that they must get together and get busy if civilisation is to be saved, and the "European Commercial" is the first big important step in that direction.

The Palestine Water Power Concession.

THE New York correspondent of *The Times* gives some particulars of the CONCESSION OBTAINED BY M. P. M. RUTENBERG, a Russian engineer, for the exclusive development of the water power resources of Palestine and for the general supply of electricity. It is unfortunate that we should have to go to New York for information on a subject of such interest to British engineers, but it is not the first time in recent years that we have had to rely on foreign sources for our knowledge of British and Imperial affairs.

It appears that M. Rutenberg is at present in New York in order to raise capital for the first part of his project, which includes the erection of a hydro-electric station on the Jordan below Lake Tiberias, and the construction of three power houses at Haifa, Jaffa and Jerusalem. These three stations will be equipped with Diesel engine sets, and for the whole project about one million pounds will be required. The terms of the concession, according to M. Rutenberg, provide for the retention by the Palestine Government of a large measure of control—both financial and technical—over the company, which will be formed to exploit the concession. The financial organisation of the company, and its methods of generation and supply, must be approved by the Palestine Government. Dividends up to 10 per cent. will be retained by the company, but from 10 to 15 per cent. they will be divided equally between the company and its consumers in the shape of a reduction of rates. All profits above 15 per cent. will be paid to the Government of Palestine.

In the course of an interview M. Rutenberg said he believed that when the country was at peace sufficient electrical energy would be available, and industries at once could be established to provide work for large numbers of people. Both Jewish and Arab labour could be employed in the construction and operation of the power-houses. The Palestine Government had arranged to grant loans, which the company would guarantee, to municipalities in Palestine, to enable them to participate in the scheme as shareholders. A loan to the municipality of Jaffa had already been arranged. In addition to £100 000 each subscribed by the London Economic Board, Baron Edmond de Rothschild, and the Palestine Development Council, £200 000 had been subscribed by the Jewish Colonial Trust of London. No orders for machinery and materials had been placed, and none would be given until the £1 000 000 had been obtained. M. Rutenberg stated that he had written to the Colonial Office stating that he was willing to pay British firms up to 10 per cent. more than was asked by firms of other countries.

In a further interview M. Rutenberg stated that all consumers (Arab and Jewish) would enjoy equal privileges, and municipalities would be entitled to buy electricity in bulk and have their own distributing systems; with Jaffa and Jerusalem municipal authorities negotiations have been opened and they will both probably participate in the scheme. The directors will be elected by the shareholders according to the amount of capital invested.

Orders have been placed in Germany for two Diesel engines and electric generators for the Jaffa station, which will be the first to be erected. The cost of this plant is given as £15 954, but cables and wires of the value of £2 743 have been ordered from Great Britain. The reason for placing the orders for the generating plant in Germany is stated to be due to the fact that British prices were over 120 per cent. above those of the accepted tender. The German quotation for a 500 H.P. set was £5 235 c.i.f. Palestine, and the lowest British tender was £11 610 f.o.b. British port.

Crime Detection by Wireless.

Wireless telephony is being USED EXTENSIVELY IN NEW YORK AND CHICAGO for the detection of crime and the capture of criminals. Both cities possess research departments for studying the adaptation of wireless to police work. The police have wireless distributing stations, from which news of crimes is flashed over a wide area every day, and they also possess high-power motor-cars equipped with receiving and transmitting sets, enabling conversations with police headquarters to be kept up even when the cars are travelling at fifty miles an hour. As soon as sufficient equipment can be manufactured every Chicago policeman will, it is stated, be equipped with a miniature receiving set. Wireless receiving sets have been ordered for each of the fifty police stations of Chicago.

The Chief Commissioner of the London Metropolitan Police is also keeping in touch with wireless telephone developments. For the past three months experiments have been made at Scotland Yard to test the use of wireless as an aid to directing the movement of officers in search of criminals. The Chief Engineer of the Yard is in charge of the experiments.

Brighton's Electricity.

In an address at the weekly luncheon of the Brighton and Hove Rotary Club last week Mr. JOHN CHRISTIE, electrical engineer to Brighton Corporation, traced the history of the Brighton electricity works. He mentioned that when an electricity company began operations in 1882, before the Corporation had obtained a Provisional Order, there were 200 consumers and the approximate cost was 2s. per unit. The goodwill of the company was purchased for £5 000 the Corporation Order (obtained in 1883) was put into force in 1890, and the first section of the North Road works opened in September, 1891. In 1900 an Act authorised the new power station at Southwick, which was opened in June, 1906. In 1892 the number of consumers was 213, the price 7d. per unit, the capital expenditure £55 000, and the total revenue £4 680, while in 1921 consumers numbered 8 441, the units output (at 8d. per unit) was 11 261 408, the capital expenditure £897 787, and the total revenue £202 117. During that period £575 000, or 64 per cent. of the total capital, had been set aside for repayment of loans, £32 492 (including £8 000 of this year's surplus) had been applied to relief of rates, and the reserve fund stood at £30 000.

With regard to the policy of finance he was up against his Council and Committee, because he held—as a ratepayer and not as an official—that the consumers were really being super-taxed by paying higher prices than they should pay for the benefit of a large proportion who were non-consumers of electricity. Would not they as business men rather have a 10 per cent. reduction on their electricity account than a paltry 3d. off their rates ? The Gas Company were the biggest ratepayers, and their keenest competitors but they did nothing in the way of helping the electricity undertaking to get new business. The Corporation ran the undertaking for the benefit of their users and with the object of supplying at the lowest possible rates, and when they had a reasonable surplus it should be put to a reserve fund and not to the relief of the rates. The plant would probably outlive the period of the loan, but it did not pay to utilise plant all that time. It paid them to scrap it and use modern machinery, so that they could generate cheaply. Ultimately all ratepayers would be users of electricity, and they therefore wanted a substantial surplus available. They must get rid of obsolete plant, and, having secured a system of oil fuel firing and suction coal-handling, they hoped to be able to effect a good deal of labour saving, and at the same time to ensure a supply of electricity for the trams, public lighting, and various industries.

Brighton's Front was the finest in the world, but he thought the lighting should be brought up to date, and was confident that if the Corporation would see their way to substitute for the present lights a modern type of lantern at a comparatively moderate cost the lighting could be greatly improved. Their shops were the finest in the country, but it was pitiful to see the lack of enterprise on the part of shopkeepers after dark. In the early evening the shop windows were brilliantly lighted, but the tradespeople appeared to give little consideration to the scientific lighting of their premises after the closing hour, although it could be easily and simply arranged.

Efficiency Exhibition at Birmingham.

The Lord Mayor of Birmingham opened on Thursday last an industrial and commercial efficiency exhibition at Bingley Hall, Birmingham, which will remain open until to-morrow (Saturday). The venture has attracted a good deal of attention, for it is recognised that if firms are to make headway when trade revives business must be run efficiently and economically on taking advantage of scientific and modern methods.

In addition to the system, shown by MANIFOLDIA, LTD., for ensuring perfected supervision and record keeping of electrical installations, of which we propose to give a fuller description next week, there are a few other exhibits of interest to the electrical industry. In a comprehensive display of goods, by the BRITISH INSTITUTE OF INDUSTRIAL ART, the object of which is to show the importance of a close alliance of art with industry, there are some choice electric light pendants, lamps, etc. ; and the RELAY AUTOMATIC TELEPHONE CO. show a complete installation for an interdepartmental automatic telephone system, giving facilities for connection to fifty telephones. It comprises the automatic switchboard, power board, two sets of 24 V batteries and telephone instruments all connected up for use. The functions of the power board and accumulators are to store and distribute the electric energy for working the switchboard ; the power used for this purpose is supplied from a 24 V battery of accumulators, which can be charged from the existing electric light system, either direct or through a motor generator. A variety of scientific instruments are exhibited by the FOSTER INSTRUMENT COMPANY, including thermometers of the electrical resistance type, in fixed indicating form ; and Delco-Light plants are displayed by F. S. BENNETT, LTD., with generator direct connected to engine for 32 V or 110 V service.

The ZENITH MANUFACTURING CO. have just issued Leaflet Z.M.55, giving prices and particulars of their new range of " Zenite " vitreous embedded resistance units. Since this firm started the manufacture of these units nearly a year ago, they have had frequent demands for them in similar sizes to those hitherto imported from abroad, and are able to meet all requirements.

Wireless Developments at Trafford Park.

A practical demonstration of the possibilities of the radio receiving sets which will be manufactured at the METROPOLITAN-VICKERS COMPANY'S Works at Trafford Park, was given to a representative of THE ELECTRICIAN a few days ago. When the arrangements for broad-casting are completed and the formal permission of the Post Office is given the company will proceed to manufacture three types of receiving apparatus.

The simplest and cheapest type comprises a small crystal detector fitted with an ordinary telephone head-piece. It is expected that this will sell well at about £5 to £10 and will pick up messages roughly over a range of 25 to 40 miles. The next size, which is a valve set, will have a range of 50 to 70 miles and will probably cost about £20. The largest set will cost about £75 and will have a range of at least 150 miles and will probably pick up all over the British Isles. This set is extremely well finished and resembles a cabinet gramophone in appearance. It contains four thermionic valves.

The manipulation of these sets is very simple. The pressing of a button and turning of a small control handle through 180° are all that is necessary, the latter operation being to tune the set to pick up a particular wave length. Slight detuning diminishes the sound without altering the pitch.

A demonstration was given in the company's research department, waves being sent on an improvised transmitting apparatus from one part of the building to another ; the largest receiving set was employed, no aerial being necessary. Songs, violin solos, etc., were reproduced faithfully on the gramophone, and ordinary speech was rendered quite naturally.

An Electric Scaling Hammer.

Representatives of shipowning and ship repairing firms in South Wales witnessed at the Mount Stuart Dry Dock, Cardiff, last week the first demonstration in the Principality of a new electrical labour-saving tool. This is known as the Sandblom electric scaling hammer and rust remover, placed on the market by the ELECTRIC SCALING HAMMERS, LTD., London, and the demonstration was given by the International Paint Compositions, Ltd. The Sandblom hammer is practically a spindle making about 1 200 revs. per min. equipped with a number of short chains with hammer heads at their free ends. The number of chains varies from two to eight, according to the class of work to be done. The driving power is supplied by a small electric motor of such light weight that it can be conveniently held by the workman operating it. When the motor is started the chains are thrown outward by centrifugal force and the revolving spindle is held parallel to the work so that the hammer heads come into contact with the surface to be scaled. The hammer strikes 10 000 blows per minute, and actual tests made at Copenhagen are stated to have demonstrated that the machine does the work of from 10 to 25 men with hand hammers. The current consumption of the hammer is 330 W, and with current at 1½d. per unit the cost is therefore only ½d. per hour. Hand and pneumatic scaling have, it is stated, been supplanted by electric scaling in Norway and Sweden, for not only are ships' plates scaled electrically at a much more rapid rate, but they are left with an absolutely smooth surface, the small hammer heads entering all the badly corroded indentations and cavities and removing from them thoroughly all the smallest particles of rust without weakening the surface. The demonstration on Wednesday was watched with great interest by the assembly, although the apparatus could not be shown to its best advantage in consequence of the fact that a restricted supply of current did not allow the spindle to revolve at more than 90 revs. per min. However, large portions of thick scale were quickly and easily removed. The machine, which is so portable that it may be employed as part of a ship's equipment for chipping and scaling decks and holds, is not yet in use in this country, but the Admiralty is considering its adoption.

Radmolite.

Makers of electric cooking and heating apparatus who use refractories of various kinds for supporting the heating elements will be interested in Radmolite, a material which the MOLER FIREPROOF BRICK AND PARTITION CO. have now placed on the market. Mr. B. P. Deane, the general manager of the company, claims that this material offers marked advantages over ordinary fireclay and steatite formers for heating elements. Radmolite is largely composed of diatomaceous earth and is remarkably efficient as a thermal insulator. When made up into a firebar it absorbs heat at such a low rate that the element springs into life almost as soon as it is switched on, and with fires which rely on a high temperature element for their popularity this feature is of immense importance. With ordinary fireclay a considerable time elapses before the element attains its maximum temperature, because fireclay absorbs heat at a much higher rate than Radmolite. Recent tests by the National Physical Laboratory indicate that the new material, which can be supplied in moulded form in any of the shapes now common to electric fires employing a fireclay bar will greatly increase the efficiency of electric cooking and heating apparatus, and it also scores heavily over fireclay in the matter of weight, being at least half that of any firebar of similar volume. Lionel Robinson and Co. have been appointed selling agents for this material.

D

Legal Intelligence.

Electricity Commissioners' Powers.

On Friday last a Divisional Court (the Lord Chief Justice, Greer and Acton, JJ.) heard an *ex parte* application by Mr. Ross-Brown, K.C., for a rule *nisi* for a mandamus directed to the Electricity Commissioners requiring them to show cause why they should not hear and determine, according to law, an application by Ealing Corporation, as the authorised suppliers of electricity for the Borough, for leave to enter into an agreement with Hammersmith (London) Borough Council for a supply of electricity. He also asked for a rule for *certiorari* to bring up to the Court to be quashed an order made by the Commissioners refusing them leave to proceed with the agreement which had been provisionally drafted. Counsel said that his ground of application was that the Commissioners, in arriving at their decision, were influenced by extraneous and irrelevant matters, and therefore their assent to the agreement which they could give under Sec. 19 of the Electricity Supply Act 1919 was not properly or judicially exercised. By the Act of 1919 the Commissioners were appointed to regulate and supervise the supply of electricity. From an affidavit of the Town Clerk of Ealing, counsel said it appeared the load on that Corporation's station was up to 75 per cent. of its full capacity and the safety margin had been reached. If during the coming winter there continued to be an increase of consumers the supply capacity would be overtaxed. In the meantime an arrangement had been made with Hammersmith for a bulk supply to augment that of the Ealing District. The terms for this supply in bulk were more favourable than those offered by the Metropolitan Electricity Supply Co. The provisional agreement was put before the Electricity Commissioners, who were told that Hammersmith Borough Council were quite willing to stand by their bargain. The Commissioners, however, refused to allow the agreement, even though the combination of the two boroughs in the supply of electricity would have made a great financial difference to Ealing. Counsel argued that the Commissioners, in considering the merits of the two proposals (one from Ealing and the other from the Metropolitan Electric Supply Co.), went beyond the jurisdiction given them by the Act of 1919, and that if a satisfactory agreement was put before them the Commissioners should accept it.

In reply to the Lord Chief Justice, counsel said he submitted that the Commissioners were dealing with extraneous and irrelevant matters and they went beyond the discretion vested in them if they went into the question whether a supply should not be supplied by another authority.

The Lord Chief Justice said it looked as if the Commissioners had made enquiries into the proposed arrangements and into other matters bearing upon them, and on the whole had come to the conclusion that, although there might be slight financial benefit, it was more than counterbalanced by other objections. "What is it you are persisting should be done?" he asked. "What is the rule you are asking for—that the Commissioners shall approve?"

"Not necessarily," replied Mr. Ross-Brown, "but that they shall consider the application apart from the consideration of the relative advantages of rival schemes. I submit that the section of the Act which I have quoted empowers authorised undertakings to come to such arrangements as they think proper."

The Lord Chief Justice: With the approval of the Commissioners.

Mr. Ross-Brown agreed, but he said it did not say anywhere in the Act that the Commissioners should have a voice in selecting the specific undertaking.

Mr. Justice Greer: They have not; they have refused to approve because they think there is an opportunity to have something better.

The Lord Chief Justice: How can a body or individual who is required to decide on a question of approval consider one particular plan to the exclusion of all others? Is it not material to the question to compare it with others?

Mr. Ross-Brown: In the present case there was no other application before the Commissioners; the question was whether Hammersmith's application was such as should be granted.

Mr. Justice Greer: It seems to me that your argument is like an application for a rule to exclude from Sec. 19 of the Act the words "with the approval of the Electricity Commissioners." Of course, you do not mean to ask for that, but your argument goes to that.

After further argument, the Lord Chief Justice said the rule could not be granted.

Mr. Ross-Brown asked for leave to appeal, but the Lord Chief Justice replied that leave was not needed. "If it were," he added, "this Court would not encourage it."

On Monday, Mr. S. J. Turner, on behalf of Ealing Corporation, applied to the Court of Appeal for a rule *nisi* for a mandamus directed to the Electricity Commissioners to show cause why they should not give their approval to the provisional agreement entered into between the Ealing Corporation and the Hammersmith Borough Council. The application was made to a Divisional Court on Friday last but it was refused. Having referred to the fact reported above, counsel said the ground of the Corporation's objection to the decision of the Commissioners was that, in considering the application, the Commissioners had taken into consideration purely extraneous matter which they were not entitled to consider at all. Applicants said that the discretion given to the Commissioners by sec. 19 of the Electricity (Supply) Act, 1919, had not been exercised by the Commissioners judicially.

In the result their lordships granted a rule and directed that the form of the rule should be settled in the Crown Office.

Electricity Company's Claim.

At Stamford County Court, last week, Judge Dobb heard the claim of the Urban Electricity Supply Co. to recover from Alfred Cade £34 4s. 6d., alleged to be due for electricity supplies. An affidavit by defendant admitted £23 9s. of the claim, and the dispute arose over the difference in price for electricity consumed for lighting and that for heating.

It was stated that in Sept., 1919, a contract, which had been in existence, was cancelled by the company. They were prepared to enter into a fresh agreement, but after several letters had been sent, a postcard was received stating that it had been decided to have the current on the flat rate. For three quarters in 1920 an allowance had been made for the current used for heating, but afterwards the company said that if a rebate was expected defendant must have a separate meter for the electricity consumed for heating.

Defendant said that the business had been transacted by his wife and daughter, who had come to an arrangement with the company to have the current for heating at a lower rate, but the company's engineer (Mr. Holman) denied any agreement had been come to by his wife who was away at present.

In the absence of proof of a verbal agreement, his honour gave judgment for plaintiffs for the amount claimed.

Award Against Herr Stinnes.

The Anglo-German Mixed Arbitral Tribunal has issued its decision on the claim by Mr. Arnold Lupton, mining engineer, against Herr Hugo Stinnes, of Mühlheim-Rühr, Germany. Mr. Lupton sought to recover £2 000 (with interest at 5 per cent. per annum from October, 1913) under the provisions of Article 296 of the Treaty of Versailles. The claimant entered into an agreement with Herr Stinnes on June 19, 1913, to secure a lease of 900 acres of a coal area near Barnsley, in consideration of the above-mentioned sum being paid to him if negotiations resulted successfully.

It was contended on behalf of respondent that the terms had not been finally negotiated before August 4, 1914, the date of the declaration of hostilities, and that claimant had not completed his part of the contract.

The tribunal, however, decided that the contract had been performed by the claimant, and ordered that £2 000, with interest at 5 per cent. per annum from October, 1913, should be credited to the British Clearing Office, together with £50 to cover the costs.

Damage to Telephone Wires.

In the Court of Appeal (Lords Justices Bankes, Scrutton and Atkin) last week Liverpool Corporation appealed from a judgment of a Divisional Court reversing a decision of the County Court Judge of Liverpool who had found against the Postmaster-General on his claim against the Corporation to recover the agreed cost (£40 8s. 7d.) of repairing damage done to telephone wires and plant by an electric light main belonging to the Corporation. The electric light cable had been laid in 1889 and enclosed in an iron pipe or conduit; the telephone wires were in an adjoining iron pipe but underneath the electric cable. On August 6, 1918, there was an escape of electric current through a breakdown of the insulating material of the electric cable, causing an explosion which damaged both the cable and the telephone wires.

At the conclusion of the legal argument their lordships reserved judgment.

Theft of Wire.

Two youths, named Leslie Isaacs and George Haines, were charged at Cardiff Police Court last week with stealing three coils of wire (valued at £3 9s. 8d.) from John Ryan, a local electrical contractor. Arthur Lawrence, an electrician, was also charged with receiving the coils from Isaacs. Lawrence pleaded that he purchased the material and also other electric fittings (the subject of further charges) from Isaacs, who told him he was in business and represented that he wanted to dispose of the goods because there was no trade. He paid a fair price for everything and had no knowledge that it had been dishonestly obtained.

Isaacs was fined £10, or two months' imprisonment, and Haines £3, or one month's imprisonment. Lawrence was committed for trial at the next Quarter Sessions.

A reduction is announced in the Canadian duties on 50 articles. The reduction applies almost entirely to imports under the British preferential tariff, the exception being agricultural implements, which, being imported wholly from the United States, are also reduced in the general tariff. On a number of items the British preference is increased by an average of 2½ per cent. To provide additional revenue the sales tax is increased 50 per cent., and other taxes are also increased. The regulation requiring foreign goods to be marked with the name of the country of origin is repeated as a general law, but will be applied in special cases by an Order in Council. Henceforth also goods will be valued for duty at the market price in the country of production, while the exchange rate is to be as certified on the invoice by the Consul or commercial agent at the port of shipment.

Parliamentary Intelligence.

Torquay Corporation Bill.

A Select Committee of the House of Lords has passed this Bill, which authorises the transfer of the Newton Abbot electricity undertaking of the Urban Electric Supply Company to Torquay Corporation.

Mr. W. J. Jeeves, K.C. (for the promotors), urged that Torquay needed a more adequate station than it possessed in order to meet the demand for electrical energy in the district. A big station within the borough might be detrimental to the town as a whole, and they had to get outside the borough to find a site for new works. The Urban Electric Supply Company would also have to extend their works. For some reason they declined to supply the Council's workmen's dwellings with electrical energy. In the end Torquay Corporation and Newton Abbot Urban Council met and came to the conclusion that it would be to the interest of both areas that the Newton Abbot Council should exercise their option of purchasing the company's undertaking, and that Torquay should find the necessary money. All the Bill desired was that Torquay Corporation should purchase the undertaking at Newton on terms on which the owners were bound to sell to the Newton Urban Council.

Mr. H. F. G. Woods gave evidence in support of the Bill and said that the scheme would provide Newton with a cheaper and better supply of electricity.

In the course of discussion between counsel and the committee in regard to the price of the undertaking, Mr. Jeeves said £66 000 was suggested, but Mr. Woods considered this sum far too much.

Mr. Tyldesley Jones, K.C. (for the Urban Electric Supply Company), said the Bill was absolutely unprecedented. But for the world war the company would be in a very different position, and when the option to purchase by Newton Abbot was agreed to, quite a different set of circumstances was contemplated. He was going to ask their lordships' protection from what could only be a partial measure of confiscation. Torquay was not even an agent in the purchase. It was a fraud, and Torquay sought to avail itself of what was intended for Newton. The local authority in the case (Newton Abbot) was a mere shadow. Torquay was seeking to obtain permission to buy his client's undertaking, and for an alien corporation to come in and expropriate his undertaking upon terms which were unjust, and for the benefit not of the local inhabitants but of the flourishing borough of Torquay, was the grossest injustice.

No evidence was called for the opposition, but the Committee found the preamble of the Bill proved, and suggested that the terms of purchase be arranged by arbitration.

Electricity (Supply) Bill.

In the House of Commons on the 24th ult. this Bill was read second time without a division, Mr. Geo. Balfour having withdrawn his motion for its rejection on a promise that amendments would be considered in Committee.

In the course of the debate, Mr. Marriott said that local inquiries had been held by the Electricity Commissioners at Birmingham, Manchester and Barrow, and the result proved that those progressive industrial districts were strongly opposed to the setting up of joint electricity authorities on anything approaching a compulsory basis, though they were anxious for co-operation between authorised undertakers on a voluntary basis. The best hope of a rapid progress in the development of electricity supply was to be found in the encouragement of private enterprise. It had been computed that the joint electricity authorities would have to borrow £110 000 000 for the purpose of taking over the existing generating stations, transmission lines, &c. The Bill was a gigantic experiment in municipal trading. Instead of the financial procedure being by resolutions of the House, it should be by way of provisional orders.

Mr. Neal said the Government desired to retain Parliamentary control over finance, and he was advised that they had done so. But, as the matter was one of great importance, he was quite prepared to consider with an open mind, in Committee, any amendments to secure that reasonable and adequate protection was given to the House to control expenditure.

Mr. J. D. Gilbert said that if London was to have a cheaper supply of electricity there must be some kind of working arrangement by which many of the smaller suppliers—municipal and others—would be merged into larger suppliers. At present there was chaos, with different prices in different London areas. The system needed reforming, and the Bill would help in doing that.

Wireless Communication on Railways.

Mr. F. Roberts asked the Postmaster-General (House of Commons, May 24) (1) whether he could indicate the results of the experiments undertaken by the Midland Railway Company and the London and North Western Railway Company with regard to the establishment of wireless communication between the more important points on their railway systems; (2) what progress had been made as the result of the extended trial of wireless communication in connection with the British railway system, which was undertaken by the Marconi Company with his consent?

Mr. Pease: Permission was given in 1920 to the Midland Railway Company to establish wireless communications between certain points on their system and to the Marconi Company to conduct tests of such communications on the system of the London and North Western Railway Company. The Marconi Company proposed last year to supplement the preliminary tests on the London and North Western Railway by a more extended trial, and they were offered a licence for the purpose, but the proposal was not proceeded with. So far as I am aware, no experiment in wireless communication on railways have since been carried out.

London-Switzerland Wireless Service.

Mr. T. Griffiths asked the Postmaster-General (House of Commons, May 25) whether the new wireless service which has been instituted between London and Switzerland in competition with the Government Land Line and Cable Service is being conducted under a temporary or permanent licence; and whether, having regard to the importance of this question, he would cause the terms of the licence to be laid upon the Table of the House?

Mr. Kellaway: No licence has yet been issued. Temporary permission has been given to the Marconi Company to start a service between London and Switzerland, but this is subject to withdrawal if a suitable agreement is not arrived at between the Government and the company as to the conditions on which such licences may be granted. The question of the conditions under which licences can be issued is still under consideration. Should such licences be granted their terms will be laid before Parliament.

On Tuesday Mr. Pike Pease gave a somewhat similar reply with regard to the London-Paris service.

Wireless on the s.s. "Egypt."

In reply to Mr. Mills (House of Commons, May 24) Mr. Baldwin stated that no reports had yet been received by the Board of Trade from ships' captains who received the wireless message SOS from the "Egypt," to the effect that they were unable to obtain details of latitude and longitude from the vessel, but reports on the subject were being obtained. The "Egypt" carried three fully qualified wireless operators. Ocean-going passenger vessels which carry more than 200 persons in all were required to have three fully qualified operators. Ocean-going vessels, whether passenger or cargo, which had less than 200 persons on board, carried one or two fully qualified operators, as the case might be, and, in addition, one or two certificated watchers.

Yorkshire Electric Power Bill.

This Bill has been passed by the Unopposed Bills Committee of the House of Commons. Powers are conferred for the sub-division of the shares for the doubling of the capital of the company, &c. The Electricity Commissioners have authorised the erection of a new generating station at Ferry Bridge, and as the company are to proceed with the scheme the additional powers are necessary. The share capital will be increased from two to four million pounds, with the usual borrowing powers.

The Bill was read a third time on Monday.

Select Committee's Telephone Report.

Replying to a question by Major Glyn in the House of Commons on May 25 Mr. Chamberlain stated that an opportunity for a discussion on the Report of the Select Committee set up to inquire into the telephone services of the Post Office was afforded on the Post Office Estimates, and the Postmaster-General himself dealt with the most important recommendations of the Report. He (Mr. Chamberlain) could not give special facilities for a further discussion.

Wireless on Passenger Aeroplanes.

In reply to Sir H. Brittain (House of Commons, May 22), Captain Guest said that he hoped that long before the end of the year all machines, British and foreign, travelling between this country and other countries would be equipped with wireless.

Progress of Private Bills.

The Ayr Burgh (Tramways, etc.) Order Confirmation Bill passed its third reading in the House of Lords last Thursday.

The Ayr Burgh (Electricity) and the Torquay Corporation (Electricity) Bills were read a first time in the House of Commons on Tuesday. The Grampian Electricity Supply Bill and the L.C.C. (Tramways and Improvements) Bill have been read a third time and passed, and the London Electric and City and South London Railway Companies Bill has been read a second time. The House of Lords have agreed with the Commons amendments to the Nottinghamshire and Derbyshire Tramways Bill.

Aids to Rural Contentment.

In a communication to "The Times," a correspondent strongly advocates, as Aids to rural contentment, new and better houses, a better system of lighting, and better means of transport between towns and villages. Improvements in methods of lighting have not received the attention they deserve, especially in the small towns and villages. No doubt if Joint Electricity Authorities could be formed much would be done to extend electric lighting, but in the meantime there are many places where electric light plants could be established with success and private houses and streets would be lighted better than at present, and at no great cost. It is important to have improved lighting, for better light would compel better houses. Better lighting would mean fuller opportunity for social intercourse, and for so many of the amenities of life, fuller use of the institute buildings, which at present depend for artificial light upon oil lamps. Better means of transport would also aid by widening the intellectual interests of village life and putting neighbouring villages in touch with one another.

Electricity Supply.

During the year ended March 31 last 846 new consumers were connected at WILLESDEN, bringing the total up to 6 636.

Terms have been arranged for the supply of electricity by the Accrington Corporation to OSWALDTWISTLE. For a period of five years an extra charge of 5 per cent. is to be made, but afterwards the same price will be charged in both districts.

HEMEL HEMPSTEAD Rural District Council has sealed an agreement with Watford Urban Council for the supply of electricity to the parishes of Kings Langley and Bovindon. Under the agreement the charge may be 12½ per cent. over and above the price for the time being charged for a corresponding supply at Watford, but the maximum charge must not exceed 9d. per unit.

A conference of electricity authorities in SOUTH-EAST LANCASHIRE will be held in Manchester on June 20, in order to consider the preparation of a draft Order for giving effect to the scheme for the reorganisation of electricity supply in the District which was recently approved by the Electricity Commissioners. The Commissioners will be present at the conference, and it is expected that the Order will come before Parliament in the autumn.

Last year BIRMINGHAM Electric Supply Department made a surplus of £40,858, against £68 160 in the previous year. The accounts last year had to bear heavy charges in the way of interest on the temporary unproductive works at Nechells which are not yet in operation. The proposed system for extending the supply to the eastern and southern districts of Birmingham (at an estimated cost of £100 000) has been altered to a system by which low tension direct current can be made available. A saving will thus be made of £15 000.

The accounts of BEXHILL-ON-SEA Electricity Department for the year to March 31 last show a gross profit of £10 145, an increase of £2 684 on the previous year. After making provision for repayment of loans, income tax, etc., there remains a net profit on the year's working of £2 122 (£517). The credit balance carried forward is £2 639. The committee have decided to reduce the charges for lighting from 10d. to 9d. per unit, and for power from 3d. to 2½d. per unit, the reductions to take effect as from the beginning of the current quarter. Application is to be made to the Electricity Commissioners for sanction to borrow £15 083 for new plant, etc., and the erection of a small sub-station at Cooden to supply the western area, necessary to deal with the requirements of the forthcoming winter.

The Electricity Commissioners have notified CHESTER Electricity Committee that the Draft Order for the North Wales and Chester Electricity District is in the hands of the printers, and that, having regard to the lateness of the Parliamentary Session, the Commissioners had decided to issue the Draft Order not only to the members of the Provisional Committee, but to all interested parties, and to hold the second inquiry at Llandudno on June 13. At their meeting last week the Committee resolved (1) to enter a protest both against the procedure which the Commissioners propose to adopt and against the date on which it is proposed to hold the second inquiry, as not allowing sufficient time for consideration of the terms of the Order; (2) that the services of Mr. J. H. Rider, of the firm of Preece, Cardew and Rider, be retained to advise the Corporation on the technical portion of the scheme.

Arising out of a statement made at a recent meeting of the HULL City Council by Mr. B. Pearlman, that five members of the Corporation had shares in the Melton Cement Company, which had been given exceptionally good terms by the Electricity Committee, it was moved by Mr. E. E. Keighley, at a meeting of the committee last week, that all the members should give the chairman a list of firms or undertakings in which they are interested. The resolution was seconded by Mr. A. Digby Willoughby, and carried without any dissent. With regard to reducing the tariff it was stated that this would not be entertained until the reserve fund was brought up to a reasonable figure. Compared with last year, there had been an increase in the sales of 28 per cent., and the gross revenue had increased by 15 per cent., while the revenue expenses had decreased by 3 per cent. The reserve fund amounts to £13,000, half of which is earmarked for the purchase of inter-connecting machinery.

New Schemes and Mains Extensions.

MULLINGAR Motor Co. have submitted to the Town Commissioners a scheme for the electric lighting of the town.

A company has been formed at TREGARON to carry out an electric lighting scheme, promoted by Dr. J. T. Lloyd.

CHULMLEIGH (Devon) Parish Council have decided to have the town lighted by electricity, and to install eighteen 100 c.p. lamps.

GOUROCK Town Council have agreed to accept the offer of Greenock Corporation to supply the town with electricity, on the same terms as those on which electricity is being supplied to Port Glasgow.

The Minister of Transport proposes to confirm the CAERPHILLY ELECTRICITY SPECIAL ORDER, 1922, authorising the supply of electricity by Caerphilly Urban Council, and any objections must be sent to the Secretary, Ministry of Transport, by June 10.

The proposal of SALFORD Electricity Committee to erect a generating station at AGECROFT was finally approved by Salford Council last week and application is to be made to the Electricity Commissioners for sanction to borrow £709 287 to cover the cost of erection. A heated discussion took place concerning the financial details of the Committee's proposals, but the scheme itself met with little opposition.

The Electricity Commissioners will hold a LOCAL INQUIRY at the Guildhall, Nottingham, on Tuesday, July 11, at 10.30 a.m., and following days, with reference to the area to be included in the proposed East Midlands Electricity District and to consider a scheme which has been submitted by the Conference of Municipal Electrical Undertakers for the improvement of the organisation for the supply of electricity within the said district and for the establishment of a Joint Electricity Authority. Anyone interested may attend the Inquiry. Any representations or objections with regard to the scheme should be addressed to the Secretary, Electricity Commission, Gwydyr House, Whitehall, London, S.W.1, not later than Tuesday, June 27.

GLASGOW Corporation has agreed to apply to the Electricity Commissioners for a Special Order extending the limits of supply of the Corporation so as to include the districts of Killermont, Lambhill, Bishopbriggs, Robroyston, Millerston, Ruchazie, Baillieston, Mount Vernon, Broomhouse, Carmyle, Cardonald, Hillington and the other areas adjacent thereto in the counties of Lanark and Renfrew. The Corporation has had no important extension of its electric lighting area since the original Electric Lighting Order was obtained in 1890. Various districts have been added to the area by Corporation Extension Acts, but a number of these districts were at the date of annexation already possessed by the Strathclyde Electricity Supply Co., and the Clyde Valley Electrical Power Co., and the extension of the city boundaries over these districts was, so far as concerned electricity, subject to the rights and powers of these companies in the annexed areas.

Diverse views were expressed at a combined meeting of the BARRY Urban Council, the Property Owners and Ratepayers' Association, and the Chamber of Trade held last week to consider further the question of the council entering upon an electrical scheme. Mr. W. Seabrook, representing Sir Charles Bright and Partners, who are advising the council, said that as a commercial proposition the installation of an electrical supply was one that required careful consideration. The council were relying upon the local ship-repairing and engineering firms and the authorities in control of the docks to take a supply of electricity, but the council would not be able to produce power as cheaply as the dock authorities could. Mr. Seabrook's firm had previously reported that an electrical scheme at Barry would prove remunerative and that a capital outlay of £20 000 would be required for generating plant and £20 000 for mains. It was suggested that current for industrial purposes 4d. per unit, but workshop proprietors would not look at it at that price, as they required it at about 2½d. Replying to a question, Mr. Seabrook said the lowest cost of installation and wiring was now 22s. per point. Eventually it was decided to defer the matters for a conference between a sub-committee composed of members of the council, the Chamber of Trade, the Ratepayers' Association and the general public.

Alteration of Charges.

DERBY Electricity Committee recommend a reduction in the price of electricity from 2d. to 1¾d. per unit from July next. This will mean a saving of £10 000 a year to users.

Messrs. J. & W. Purves are applying to the Electricity Commissioners for a Special Order to amend the TEIGNMOUTH ELECTRIC LIGHTING ORDER, 1915, by increasing the prices which may be charged, and providing for a periodical revision of such increased prices.

ILFORD Urban Council has adopted the following scale of charges for electricity supplied to cinemas:—Primary charge of 5s. per kW of maximum demand per week; secondary charge, up to 10 000 units per quarter, 3d. per unit; 10 000 to 20 000, 2½d., beyond, 2d. Accounts are to be paid weekly.

STIRLING Town Council has made the following reductions in the charges for electricity: private lighting, from 8d. to 7d. per unit (reduction of 12½ per cent.); slot meters, from 8d. to 7d. (reduction of 12½ per cent.); power 4d. to 1¾d., plus 25 per cent. instead of 57½ per cent. (reduction of 32½ per cent. in the war increase; heating, first 160 units, per quarter, 2¼d. per unit, all over 160 units, per quarter, 2d. per unit (a decrease of from 16½ to 33⅓ per cent.).

RAWTENSTALL Electricity Committee has revised its system of charging for electricity supplied to dwelling houses of £20 rateable value and under. Instead of the present flat rate, a consumer may elect to have a fixed charge of £2 12s. per annum (payable quarterly) for 82 units, including meter rent, but all units used in excess of 82 are to be charged at 1½d. per unit. For houses on the Corporation's housing estates a weekly charge of 1s. will be made and collected each week with the rent.

Business Items, etc.

Mr. C. M. Cosby, northern district office manager of The Westinghouse Morse Chain Co., has joined (as from June 1st) the firm of Jenks Bros., Ltd., of Wolverhampton, who have been appointed sole agents for Yorkshire for the Westinghouse Morse inverted tooth rocker-joint chain drives. Mr. Cosby will be located for the time being, at Standard Buildings, City Square, Leeds.

Shenton and Company announce that they have been appointed agents by the Mullard Radio Valve Company for all their manufactures such as valves, grid leaks, etc., for the districts of Newport and Cardiff. Shenton and Company have been developing wi less apparatus during the past twelve months, and have just issued a four-page list of their receiving sets, accessories and parts for use where it is desired to make up receiving sets complete by the user, as well as for additions to existing sets.

Lionel Robinson and Co. (partners: Lionel Robinson and W. E. Warrilow), 3, Staple Inn, London, W.C.1, have been appointed selling agents for the Moler Fireproof Brick and Partition Co., Ltd., for the handling of their Moler refractory material which they are putting on the market for electric cookers, fires, grills, hotplates, etc., under the trade name of Radmolite. Enquiries will be welcomed at the above address and samples of solid Radmolite can be supplied on application. The company also handles "Moler" in porous and granular form for the thermal insulation for electric ovens, furnaces, etc.

Mr. Ernest A. Marx has resigned his position with Pope's Electric Lamp Co., and has joined the Z Electric Lamp and Supply Co., of 73, Newman Street, W., as joint managing director as from June 1. Mr. Marx first became associated with the Pope's Electric Lamp Co. sixteen years ago, and at the time of his retirement from the firm occupied the post of general manager. He has an unrivalled experience of the electric lamp industry, an experience not confined to this country alone, for he spent over seven years in Australia and New Zealand. He is a member of the Electric Lamp Manufacturers' Association and also of the Executive and Council of the E.D.A. The object of his present change is to extend his operations. As joint managing director with Mr. James Scrivener he will still be in a position to handle Pope Elasta Lamps, as well as all other association makes, together with other electrical supplies, such as moonstone glassware, heating and cooking apparatus, etc.

Electric Traction.

Radcliffe (Lancs) Council has decided to reduce the price of electricity for tramways from 1·9d. to 1·7d. per unit.

A swarm of bees stopped the tramway service at Maidstone on Tuesday by settling on the trolley-pole of a car in the main street. A local bee-keeper had to remove the swarm.

Ayr Town Council have agreed to purchase from Manchester Corporation five single-deck cars at the price of £120 each. The carriage will be £30 per car, and about £100 will have to be expended to make the cars suitable for local conditions.

During the recent intense heat 1 000 000 c. ft. of air was pumped per minute through the tube railways by means of huge electrical fans. The system of ventilation is thoroughly scientific. Some of the fans used are exhaust fans, to draw out exhausted air. Others are pressure fans, to force in fresh supplies, and in the latter case all the air is first washed and ozonized.

The Department of Overseas Trade report an opportunity for British nationals or organisations to purchase certain shares in the Posen Tramway Company, which are held by the Reparation Commission, in accordance with Article 260 of the Treaty of Versailles. A provisional allocation of these shares will be made at the office of the Reparation Commission in Paris on June 10th in favour of the highest offer received up to that date, and any further offers (which must be at least 5 per cent. higher than any previous offer) will be considered on June 17th. Further particulars can be obtained from the D.O.T.

A statement of the works proposed for the improvement and extension of the railways of the Underground Railways Company of London has been issued by the chairman, Lord Ashfield. Particulars of these have already appeared in The Electrician. It is stated that when the new works are finished the capacity of the train service upon the sections of railway concerned will be more than doubled, and it will open up for development a new territory in the north of London. Contracts have been placed for a large part of the works. In about a year the first portion will be completed and opened for public use, the remaining portion being finished in about two years from now. The whole of the rolling stock, rails, bridges, turbo-alternators, machinery, cables, etc., with the one exception of certain parts of the escalators, will be manufactured in this country.

In reference to our article on the 19th ult. relating to the New Zealand national scheme of electricity supply, we are informed that the transformers for Mangahao scheme were ordered from Ferranti, Ltd., and they are now approaching completion. The order comprises seven 4 000 k VA single-phase 50-cycle oil-immersed forced-cooled transformers, ratio 11 000/110 000 V.

Personal and Appointments.

Mr. H. Leigh Mossley has been elected chairman of Willesden Electricity Committee in succession to Mr. W. A. Hill.

Mr. A. J. Abraham, tramway manager and electrical engineer to the Aberdare Urban District Council, intimated to the council at a special meeting on Friday that he had been offered a post elsewhere, but was prepared to remain at Aberdare provided his salary did not fall below £600 per annum. It was stated that Mr. Abraham's basic salary was £460, plus bonuses, making it in all £700 a year. The council accepted the resignation with regret, and resolved to advertise for a manager at a basic salary of £450 per annum, plus bonuses.

Mr. Marconi, with two technical assistants, left Southampton on Friday on board his yacht "Elettra" for America. At New York he will conduct a number of tests in co-operation with some of the modern American stations, and show what can be accomplished in the high speed dispatch and reception of messages. Over long distances, such as from America to England, messages are now received at a rate of eight to ninety words a minute, and Mr. Marconi will use improved instruments by means of which speed can be increased up to one hundred words a minute and over. Besides his other experiments, Mr. Marconi will carry out tests for the Meterological Office in London during his voyage. These will have special reference to the collection of reports of the weather in the areas of the Azores and the Bermudas. He expects to be absent from England until the middle of July.

Wireless and Telegraph Notes.

Arrangements have now been completed for the establishment by the Commercial Cable Co. of a base at Queenstown for the repair of Transatlantic cables.

The wireless station at Abu Zabel is now open for full wireless public service between Egypt, the Sudan, Syria, and the British Isles, and the Continent of Europe.

The English wireless concert transmitted each Tuesday evening from Writtle, Essex, will take place in future at 8 p.m. British summer time, on a wave length of 400 metres; not at 7 p.m. on a wave length of 700 metres, as hitherto.

Marconi's Wireless Telegraph Co. announce that the telegraph office at Marconi House is now open at the following times only:—Monday to Saturday inclusive, from 7 a.m. to midnight; Sundays and Bank Holidays, from 8 a.m. to 11 p.m. During the time Marconi House is closed cyclists will collect messages on receipt of a call to London Wall 3606.

Nauen wireless station is being extended to meet the increasing traffic in the United States and the Argentine. Twenty five million marks additional capital is being raised by the Trans-Radio Co., and a beginning has already been made with the constructive work. The plans include the erection of seven new masts, each 210 metres high (689 ft.), and the dismantling of four of the existing masts.

An Exchange Telegraph message states that the Deutsch Atlantische Telegraphen Gesellschaft, which lately absorbed two other German cable companies, has announced its intention to lay a submarine cable from Emden to Horta (Azores) and from there to New York. An agreement with this object has already been entered into. Negotiations are proceeding with the German Government for compensation to the three companies for losses caused by the war.

Imperial Notes.

Last year the Ontario Legislature passed an Act authorising the Government to bear 50 per cent. of the cost of extending primary distribution lines of the Hydro-Electric Commission in rural areas, but in a Bill recently introduced this privilege will be extended to municipalities that may be in a position to purchase power from private companies. It is not intended to allow a rebate to a private company that may be constructing rural primary lines, but a township or a group of farmers may build primary lines and own them, the Government paying 50 per cent. of the cost.

A Bill has also been introduced into the Ontario Legislature dealing with the construction and operation of municipal electric railways. On the demand of the corporations of two or more municipalities, in any locality in which electrical energy is supplied by the Hydro-Electric Commission, the latter as the agent of and at the expense of such corporations, may investigate the cost and advisability of constructing the desired railway. The proposal must be submitted to a vote of the electors and conditions are laid down for raising money for the work, and for the appointment of an Association to control the equipment and operation of the railway. Any group of municipalities may build electric railways, but the Hydro-electric Commission must approve of the work, and power to operate the system must be purchased from the Commission. The Government desire to assist municipalities to build radial lines where there is a reasonable guarantee of financial success.

Foreign Notes.

The scheme for utilising the water power of the Rhone and many smaller rivers is likely to cause great activity in the FRENCH ELECTRICAL INDUSTRY, and it is stated that soon manufacturers will find difficulty in supplying the country's requirements in electrical machinery and apparatus.

In an article in the last issue of "Eclairage et Force Motrice," M. Paul Basiaux estimates that at least 100 000 H.P. could be obtained from the WATER POWER of the MEUSE and its affluents, of which 50 000 H.P. could be developed in Belgium, and he pleads for the collection of data on the subject.

The accounts of the SOCIETE BELGE POUR LA FABRICATION DES CABLES ET FILS ELECTRIQUES show a net profit of 750 000 frs. in 1921, compared with 1 248 000 frs. in the previous year, and the dividend is only 36.10 frs. per share against 45.62 frs. Owing to the French tariff a subsidiary company, the Société des Cables et Tubes du Nord, of Roubaix, has been obliged to erect a factory in France.

DUTCH MANUFACTURERS OF ELECTRICAL MACHINERY and apparatus continue to complain of the disastrous effects of German competition. The N. V. Nederlandsche Kabelfabriek attribute the drop in their profit in 1921 to 1 106 000 florins, compared with 1 588 000 florins in 1920, to this cause, and the dividend is only 17 per cent. compared with 23 per cent. in the previous year.

LUXEMBOURG will shortly decide upon the offers recently submitted for the electrification of the whole of the Grand Duchy. About 15 tenders were received and the concession will be for 30 years. A commission of three officials, presided over by the Director-General of Public Works (M. Leidenbach), is investigating the various schemes which have emanated from Belgium, French and German firms. Two foreign engineers, one of whom is a Belgian, have been called in, and it is anticipated that a Belgian offer will be accepted.

Ma Hui-chieh and other capitalists have raised a sum of $5 000 000 for the establishment of the KIAO-AO ELECTRICITY COMPANY, LTD., at Tsingtao. The company will undertake electrical enterprises along the Kiaochow-Tsinan Railway. Its head office will be situated at Tsingtao with branches at Tsinan, Shanghai and Tientsin. The TIAO HUA ELECTRIC LIGHT COMPANY, LTD., at Tipu, Chekiang, has been established by Lang Er-k'ang and others. Application for registration has been sent to the Ministry of Agriculture and Commerce through the Board of Industry of Chekiang.

The BUDAPEST correspondent of "The Times" reports that a Hungarian engineer named Szabo claims to have invented a device for printing at limited distances by electric current as well as by wireless. The apparatus can be fitted to any telegraph transmitter. Complete sentences are set up in lines and columns in the transmitting apparatus, and a corresponding impression is conveyed to the receiver either by electric current or by wireless waves. The invention, it is said, will make it possible for newspapers to appear simultaneously in different parts of the world.

There are 1 121 miles of SWISS ELECTRIC RAILWAYS, including 700 miles of light railways. Of the main lines 317 miles are equipped on the single-phase and only 82 on the three-phase system. The mean annual consumption of energy per ton kilometre in 1920 ranged from 48 to 51 units. Electric locomotives are cheaper to maintain than steam locomotives. On the Loetschberg line maintenance is 17 per cent. lower, and on the narrow gauge Rhaetian railways 27 per cent. lower. The Loetschberg electric locomotives are of from 2 000 to 2 500 H.P., and the comparison is with steam locomotives of less than half that power. Swiss opinion favours the single-phase system, using current direct from the generating station supplied at high tension to the contact wire.

In connection with the MARSEILLES COLONIAL EXHIBITION an interesting congress on the applications of electricity is being organised by the Association des anciens élèves de l'Institut Electrotechnique of Grenoble, and will be held in Marseilles from the 17th to the 20th inst. Papers (followed by discussions) will be read on the generation and transmission of electrical energy, including large power units, high tension transmission, switchboards, insulators, and safety devices; electric traction systems; domestic electrical apparatus; electricity in mining, iron and steel works; use of blast furnace gases, electric propulsion of ships, &c., radio-telegraphy and telephony, and electro-chemistry and electro-metallurgy. Particulars may be obtained from the Director of the Institut Electrotechnique, Grenoble.

The "Journal" of the British Chamber of Commerce of Turkey and the Balkan States reports that the CONSTANTINOPLE market is flooded with CHEAP FOREIGN ELECTRICAL GOODS, German to a very great extent, and the prices charged are from 30 to 50 per cent. lower than British prices. Shortly after the armistice a British make of lamp was to be seen in most of the retail shops, and it held its own until the rise in the exchange and the reduction in price of Dutch and German lamps made further business impossible. Many orders for cables have been placed in Germany, Czecho-Slovakia and Italy. Lately few orders have gone to the United Kingdom. British firms are handicapped by the fact that the public utility companies in Constantinople are mostly French or Belgian.

Miscellaneous.

Mr. Henry Chitty has applied for the RESTORATION OF PATENT No. 121 320, dated December 5, 1917, for "Improvements in or relating to commutators for dynamo electric machines," which expired on December 5, 1921, owing to non-payment of renewal fee.

Members of the brass and nickel silver trades last week attended demonstrations of a new type of ELECTRIC ROTATING FURNACE designed and made by T. H. Watson and Co., of Sheffield, for the proprietors of the Greaves-Etchells electric steel furnace. The furnace is of independent arc type of 2 cwt. capacity, in the form of a barrel, which is rotated when a bath of metal is formed, in order to ensure the complete mixing of the alloy. The demonstrations showed a considerable reduction in cost on present methods. This is said to be the first British-made electric furnace adapted for the melting of non-ferrous metals to be put on the market.

For the purpose of thanking the tramway employees for their assistance to his distress fund the Lord Mayor of CARDIFF (Councillor F. H. Turnbull) gave a reception to the tramwaymen on Sunday at the City Hall, and announced that the conductors had collected over £950 since the scheme of selling distress tickets on the system was inaugurated. He hoped the efforts put forward would not be diminished as, owing to the unemployment benefits being restricted, there was still urgent need for more funds. The Lord Mayor was supported by Councillor Sydney Jenkins (chairman of the Tramways Committee), Mr. R. L. Horsfield (general manager), Mr. Howell David (traffic superintendent), and about 200 employees.

Alden Lighting Plants at the Royal Counties Show.

At Stand No. 35 at the Royal Counties Show, Guildford, the ALDEN ENGINE CO. have a representative exhibit of their lighting plants for country-house work, designed to compete with the small high-speed American and other sets, and selling at prices substantially below the quick-speed installations. The engines furnishing the motive power for driving the Alden sets run at slow speeds of 500 to 600 revs. per min., and they are consequently suitable for general power purposes as well as generating electricity.

The sets exhibited include the Alden-Light Plants: Model "C," 2 kW, 50 V, capable of supplying 100 lights, consisting of a 5 B.H.P. Alden vertical oil engine mounted on extended girder frame, and belted to dynamo, complete with water-cooling tank, tool-box, etc., and hand-operated switchboard, including shunt regulator. (The standard battery for this set is one with a capacity of 200 Ah. at the 10-hour continuous rate of discharge); an Alden-Light plant, model "C," 2 kW, 50 V, capable of supplying 100 lights, which is the same as the previous model, except that the engine and dynamo are direct-coupled; and an Alden-Light Plant, model "A", ¾ kW, 25 or 50 V, capable of supplying 30 lights or more.

On the same stand is exhibited one of the Company's new semi-automatic switchboards for use in connection with small electric lighting sets, which permits of the engine being started up automatically from the battery by merely turning a starting switch.

Electricians' Wages.

It is announced that, in accordance with the National Wages Agreements between the National Federated Electrical Association and the E.T.U. (under date August 7th, 1920 and September 22nd, 1921) the variation in cost of living now justifies a 22 per cent. reduction in wages in place of the previous reduction of 16 per cent., the net hourly rates of pay applicable to the respective grades of the agreements are as follows: Grade A, 1s. 11½d. (this rate includes a travelling allowance); Grade B, 1s. 9d.; Grade C, 1s. 7½d.; Grade D, 1s. 6d. The above rates come into effect to-day (June 2nd), for the period covered by that pay day, and will remain current up to and including the period covered by the first pay day in October, 1922.

At the meeting of the N.J.I.C. held on May 24th, 1922, the agreement to vary the grading of Sussex from Grade "C" to Grade "D" was ratified.

Obituary.

We regret to announce the death of MR. JOHN MARTIN, head of the Alternating Current Designing Department of the British Thomson-Houston Co., Rugby, who died on May 23 at his residence in Rugby. Mr. Martin was born at Little Arduthie, in 1878 and was educated at Stonehaven and Aberdeen, studying engineering afterwards at Glasgow University, where he took the degree of B.Sc. On leaving the University he joined the works of the British Electrical Plant Co., at Alloa, as a pupil, and later entered the British Thomson-Houston Works at Rugby in 1903. Shortly after joining these works he entered the designing office and became associated with the design of induction motors and allied apparatus. From 1914 he was in charge of this work, and the high reputation that the B.T.H. induction motors have enjoyed for many years is the result of his energy and ability. Mr. Martin was an Associate Member of both the British and the American Institution of Electrical Engineers.

Tenders Invited and Accepted.

UNITED KINGDOM.

MANCHESTER ELECTRICITY COMMITTEE. June 15.—Cable for six months. Specifications, etc., from Mr. F. E. Hughes, Town Hall, Manchester.

DUBLIN ELECTRICITY COMMITTEE. June 14.—Magazine flame arc lamps. Specification, etc., from the City Electrical Engineer, Fleet-street, Dublin.

TYNEMOUTH CORPORATION. June 26.—One a.c. booster. Particulars from C. Turnbull, Borough Electrical Engineer, Electricity Works, Tynemouth.

PRESTON ELECTRICITY DEPARTMENT. June 28.—E.H.T. switchgear for the Ribble Power Station. Particulars from the Town Clerk, Town Hall, Preston.

METROPOLITAN ASYLUMS BOARD. June 21.—(*b*) installation of electricity for lighting and power, telephones, etc., at Tooting Bec Mental Hospital extension.

MIDDLESBROUGH CORPORATION. June 26.—Laying double line of tramways, equivalent to 1 630 yards of single track. Specification from Borough Engineer.

WEST HAM CORPORATION. June 13.—10 000 kW turbo-alternator and 10 000 kW surface condensing plant. Specification, etc.,from Mr. F. W. Purse, 84 and 86, Romford Road, Stratford, E.15.

DUBLIN UNITED TRAMWAYS CO. (1896), LTD. June 12.—Six months' supply of car fittings, electrical stores, etc. Forms of tender from the General Manager, 9, Upper Sackville Street, Dublin.

ST. PANCRAS ELECTRICITY DEPARTMENT. June 15.—Two sets of motor generator balances, each of 1 000 kW; l. t. cables. Particulars from the offices of the Electricity Department, 57, Pratt Street, Camden Town, N.W.1.

KENT COUNTY MENTAL HOSPITAL, BARMING HEATH, MAIDSTONE. June 30.—Two 3-phase back-geared electric motors and two centrifugal pumps and accessories. Particulars from Handcock & Dykes, 11, Victoria Street, Westminster, S.W.

MANCHESTER ELECTRICITY COMMITTEE. June 28.—Subsidiary cables between generators, auxiliaries, transformers and switchboards in the Barton power station, together with materials for fixing tail-end boxes and pot heads for all the cables as scheduled. Particulars from Mr. S. L. Pearce, Chief Engineer and Manager, Dickinson Street, Manchester.

INDIA.

HIGH COMMISSIONERS OF INDIA. June 23.—(1) Cable, switchboard, lead sheathed, and cable for wiring buildings; (2) cable, dry core, lead sheathed, armoured; and cable, underwater, unarmoured, lead sheathed. Particulars from Director-General, India Store Department, Belvedere Road, Lambeth, S.E.1.

NEW ZEALAND.

PUBLIC WORKS DEPARTMENT OF NEW ZEALAND. July 4.*—Manufacture, supply and delivery of 1 pelton wheel of 225 h.p. direct-coupled to a.c. generator of 150 kVa (120 kW at 0·8 power factor), 3-phase, 2 200 V, 50 cycles, adapted to run in parallel with a 100 kW alternator, all in accordance with specification.

SOUTH AFRICA.

MUNICIPAL COUNCIL OF JOHANNESBURG. June 28*.—Electric lamps and fittings as follows: 5 000 210 V 60 W, 4 000 210 V 100 W, 1 000 210 V 20 W, 5 000 240 V 60 W; one watt metal filament lamp fitted with bayonet type cap, and marked with the letters "J.M.C." The 210 V lamps are required for use on a.c. circuits and the 240 V lamps on d.c. circuits. The following cast iron street lighting suspension fittings are required:—100 fitted with 8½ in. refractor bands and Goliath screw holders, 100 fitted with 8½ in. refractor bands and bayonet holders, 100 fitted with 6½ in. refractor bands and bayonet holders.

LLANDUDNO Electricity Committee have accepted the tender of Whipp and Bourne for l.t. switchboard, £825.

DUBLIN Corporation have accepted the tender of Babcock and Wilcox for two water-tube boilers for the Electricity Department at £35 533.

FARNBOROUGH Urban Council has accepted the tender of Burch and Vertue for wiring and fitting the large hall at the Town Hall at £37 7s. 6d.

BRIGHTON Corporation have accepted the tender of W. H. Allen, Son, and Co., for 400 kW. house service turbine for Southwick power station, £4 662.

WEYMOUTH Town Council has accepted the tender of the BRUSH ELECTRICAL ENGINEERING COMPANY for a commutator for the turbo-generator at £195.

WARWICK TOWN COUNCIL have accepted the tender of the Leamington & Warwick Electrical Company for lighting certain streets in the Stratford-road district.

WOLVERHAMPTON Corporation have accepted the tenders of the English Electric Company (£2 639) and the General Electric Company (£2 902), each for a 1 000 k.W. rotary converter.

* Particulars from the Department of Overseas Trade.

LONDON County Council have accepted the tender of Bolling & Lowe for tramrails, £9 12s. 6d. per ton, fish plates 15s. 3d. per cwt., bolts and nuts £1 12s. 6d. per cwt., and points and crossings £10 5s. per set.

GLASGOW Tramways Committee have accepted tenders of the Western Electric Company and Pirelli General Cable Works, Ltd., for cable, and British Insulated and Helsby Cables, Ltd., for globe strain insulators.

BURNTWOOD Parish Council has accepted the tender of the Cannock Chase Colliery Co. for public lighting by electricity at Chase Town and Chase Terrace at £205 for the season, against £226 12s. 6d. paid for gas.

STEEL, PEECH & TOZER recently quoted the Sheffield Tramways Committee £11 10s. per ton for 500 tons of basic steel rails. As the committee required only 200 tons they placed an order for that quantity at £12 10s. per ton.

EDINBURGH Tramways Committee have accepted the following tenders: Brush Electrical Co., Loughborough, for 119 trucks at a cost of £13 310; and Dorman, Long & Co., Middlesbrough, for tramway rails and fish plates at a cost of £13 456.

BEXHILL-ON-SEA Electricity Committee have accepted the following tenders:—R. Hornby & Co., 150 meters at 36s. each; Landis & Gyr, Ltd., 50 meters at 45s. 8d. each; Crompton & Co., new circuit breakers to No. 5 generator panel, £72 10s. complete with marble panel.

ST. PANCRAS (London) Council have been recommended to accept the tender of the British Thomson-Houston Co. for h.t. switch-gear for Grafton Road and Regent's Park sub-stations, at £3 044. Thirteen tenders were received varying from £3 000 to £5 429. The Council have also accepted tenders of Palmer and Co., Merton, for the supply of 10 switchboard frames, £11 10s.; Northcote, Heaver and Co., 33, King's Road, N.W.1, for 10 l.t. direct-current switchboards, £799 15s.; and Holden and Brooke for an electrically driven 8-stage centrifugal pump, £914 15s.

The "Electrician" Tables of Electricity Supply.

A good idea of the steady growth of the electricity supply industry may be gained from a study of THE ELECTRICIAN Tables of Electricity Supply Undertakings, the 1922 edition of which has just been published. On the present occasion information of about 30 new stations has been included in the British section and over 100 in the Colonial and Foreign Tables. Not only has there been a considerable increase in the number of entries, but substantial progress has also been made in the connections to the mains, in the number of fresh consumers, in reductions of prices, and in other ways.

Apart from the particulars of the chief officials, the systems of supply, consumers' voltage, motors and total connections, public lamps, steam raising and generating plant, prices charged for electric current, etc., hitherto given, information has now been added concerning the types of mains and distributors, converting plant, showrooms, motor hiring and assisted wiring schemes. The whole of the entries, as well as the statistics of the British Power Companies have been carefully revised, and it is confidently believed that the new edition of the Tables will prove indispensable to manufacturers of plant and apparatus, to electrical contractors and suppliers, to power users and others interested in electricity supply.

The Colonial and Foreign Tables have been greatly extended, and no effort has been spared to make the statistics as accurate and as complete as possible for those parts of the British Empire in which there is a demand for electric plant and apparatus. Many Australian, New Zealand, South African and Canadian entries are included for the first time, and through the courtesy of the Overseas Trade Department we are able to give brief particulars of all the supply undertakings in Chili. With the great expansion of hydro-electric supply there should be an increasing market for electrical goods overseas, and the Tables will prove invaluable to manufacturers and exporters who want to open up new colonial and foreign connections.

The present edition also gives particulars of the principal electric tramways and railways in the British colonies and in foreign countries. The Tables are published at the usual price of 10s. 6d., post free, by Messrs. Benn Bros., Ltd., 6 and 8, Bouverie Street, Fleet Street, London, E.C.4.

LICENCES OF RIGHT have been granted to F. Loewenstein for Patent No. 122 040 (1 392 19) for "improvements in electromagnetic wave signalling arrangements"; to Vickers, Ltd., and others for Patent No. 137 379 (1 206 19) for "improvements relating to turbine blades"; to the Vapor Car Heating Co. Inc. for Patent No. 147 177 (19 243 20) for "improvements in electric contact thermostats"; and to Geb. Stork and Co. for Patent Nos. 6 732 15 and 6 733 13 for "regulating and safety apparatus for boiler feed pumps" and "condensing plant."

Companies' Meetings, Reports, etc.

Siemens Brothers.

Addressing the shareholders at the annual meeting of SIEMENS BROTHERS AND CO., on Tuesday, Mr. G. Mure Ritchie (the chairman of the company), who presided, said that their expectations in respect of volume of business and gross profits for 1921 were not realised, because owing to the general decline in industry, so acutely aggravated by the great coal strike, the wave of depression caused their order book to shrink severely, particularly during the second half of last year. Nevertheless, as 1921 results were not subject to excess profits duty, they were able, after making the appropriations already detailed, to carry forward to 1922 a larger amount than was carried forward from 1920 after eliminating the excess profits duty liability for that year.

As to manufacturing operations in 1921, the year's turnover although less than in 1920, exceeded £3 000 000 sterling, and the average profit on the turnover was under 7 per cent. In previous years he had given details of the work in their principal departments, and now, without repetition, it need only be said that throughout, though in most directions on a smaller scale, similar work had been done with similar results. As soon as necessary they hoped to have in substitution for the "Faraday" another cable-laying and cable-repairing steamer of modern type and adequate dimensions, but which would be kept afloat with much lower running charges than was possible with so old a craft as the "Faraday." Business in telephonic apparatus, especially in automatic exchanges, increased substantially during 1921, and, in addition to British orders, included three exchanges for public service in Canada—they had also secured against strong competition from the United States a large contract for a 6 000 line automatic exchange for Winnipeg, but that order was secured in 1922; they had in 1921 contributed substantially towards the progress of submarine telephony by designing and manufacturing cable of the continuously loaded type, their manufacture of ebonite fully maintained its high standard of excellence and their Stannos system of house-wiring continued to make satisfactory headway.

Relations with their employees continued of the most friendly nature, notwithstanding that a comparatively small section of workers connected with one of the engineering unions ceased work some time ago, no doubt out of loyalty to their leaders, whose policy was controlled by a small number of extremists. As compared with the later months of 1921, their orders during the earlier months of 1922 had on the whole increased, and they were, therefore, hopeful that as far as volume of work was concerned they were past the worst. Taking a long view, he thought that in their particular lines of industry the prospects were good. Omitting submarine cables, which might be laid anywhere—though fortunately the chief cable companies had their headquarters in England—their products were delivered in 1921 to Britain 72 per cent., against 67 per cent. for 1920; to their overseas Dominions 17 per cent. in 1921, against 20 per cent. in 1920, and to foreign countries 11 per cent. in 1921, against 13 per cent. in 1920. In their overseas Dominions they had, partly in connection with the English Electric Company, a network of important agencies through which they hoped to build up an expanding and satisfactory business in the future.

An abstract of the accounts was given in our last issue.

Johnson and Phillips.

In the course of his speech at the annual meeting of JOHNSON AND PHILLIPS, LTD., last week, Mr. W. Claude Johnson (the chairman), who presided, said that although the year's profit of £4 737 showed a considerable reduction on last year's profit of £98 405 it was satisfactory to be able to say with confidence that the profit on the year's working would have compared quite favourably with that of the previous year had it not been for the heavy fall in prices of raw materials and stocks which necessitated the writing down of values to current market prices. The year under review, which looked so promising at the beginning, soon became very seriously hampered by the coal strike. The works practically came to a standstill for a time for want of coal. In the meantime some important orders were unfortunately cancelled, with the result that raw materials were left on their hands. Not only were their own works affected, but many firms with whom they did a large business were also compelled to shut down. The reduction in profits would not, however, have prevented the payment of a dividend, as they had an abundance of funds accumulated from undivided profits which would have justified the payment of a dividend. Having regard, however, to the prospective outlook and the present state of trade caused by the engineers' lock-out, and the consequent falling-off of business, the anticipated recovery in trade was being indefinitely deferred. The lock-out had lasted now just over eleven weeks, with the result that the greater part of the works had been closed down during this period. In view of these facts the directors regretted that they could not recommend the payment of a dividend on this occasion. Although a great number of their employees had been locked out in common with those of other federated firms in the engineering trades, they had not given the slightest trouble or anxiety to the management by picketing or interfering with the few non-union men and apprentices who remained in the works. Indeed, they had been helpful and sympathetic in settling the one or two minor incidents. This feeling of good fellowship still prevailed between the workpeople and the management and would have a beneficial effect on the results when a new start was made in the works.

Mr. John Macgregor (managing director) said the strike outlook was rather black at present, but they were hoping that a way out of the difficulty would soon be found and work resumed. There was no doubt that a large amount of work had to be done. Take, for instance, the electrification schemes prepared by the home and Colonial railways, most of which were ready to go ahead immediately financial arrangements had been made, and the Government Electricity Bill for bulk supplies which was now before Parliament, and which, when passed, would mean the erection and installation of huge central stations. There were also the many municipal extensions, which should bring a large amount of work to the industry and incidentally to themselves. There were likewise the proposed extensions of the telephone service by the General Post Office, which would mean new cables, of which they hoped to get a share. There was no doubt that electrical engineering would be one of the very first industries to feel the effects of a trade revival.

An abstract of the accounts appeared in our issue last week.

British Thomson-Houston.

Presiding at the annual meeting of the BRITISH THOMSON-HOUSTON CO. on Tuesday, Mr. H. C. Levis (the chairman and managing director) stated that the volume of unfilled orders on hand at the end of 1920 was such that, notwithstanding the fact that during 1921 the orders received were less in volume than for the previous year, the output for 1921—that was to say, the amount billed to customers—was the greatest in the history of the company. In spite of the general depression throughout the country, the volume of orders received by the company this year to date was over 37 per cent. in excess of the orders received for the corresponding period of 1921. The company now had on hand orders to the value of over £2 250 000. With regard to inquiries, the volume was very large, and while the proportion which had resulted in orders was not as great as in 1920, nevertheless there was still a great demand for electrical machinery, which must be satisfied sooner or later, and from which they confidently expect to get their fair share of business.

In the latter part of the year under review, it was deemed wise to make provision to liquidate the floating debt of the company. An issue of £3 000 000 of debenture stock was authorised, and £1 500 000 par value was issued on satisfactory terms. The issue was largely over-subscribed, and it was satisfactory to note that this stock stood at a substantial premium to-day. Although on the balance sheet there still appeared an amount of £764 000 due to the International General Electric Company, this had since been liquidated, and the only debt which the company had, in addition to debenture stock and employees' savings certificates, was sundry creditors, retentions, etc., which was covered more than three times over by apparatus, supplies, etc., finished and in progress of manufacture, and the sundry debtors, retentions, money, and other outstanding accounts.

A scheme of "Employees' Savings Certificates" had been instituted during the year, which enabled employees to invest their savings by purchasing certificates bearing a fixed rate of interest, and pay for same on an instalment plan. The number holding the Certificates was now over 1 300. During the year the expenditure on factories was over £150 000, all of which was in connection with works started or authorised prior to the year under review, and principally in connection with the new Birmingham factory, the new Glass Works at Chesterfield in connection with the company's electric lamp business, and extensions to the Rugby plant, all of which would be completed during the current year.

The total cost of property, buildings and plant to the end of December last was £2 670 000. From this cost there has been written off sums aggregating £793 286, or over 29 per cent. of the total cost. Owing to the expansion of the company, the offices at Cannon Street had been given up, and the company were now in larger quarters at Crown House, Aldwych.

The memorial to the employees who fell in the war had been completed, and was unveiled by Field-Marshal Sir William Robertson.

An abstract of the accounts appeared in our last issue.

Callender's Cable and Construction.

Addressing the shareholders at the annual meeting of CALLENDER'S CABLE AND CONSTRUCTION CO. last week Sir J. Fortescue Flannery (the chairman), who presided, said that they had been compelled to close their works for more than two months during the year owing to the stoppage in the coal trade. Advantage had, however, been taken of the interruption to institute reforms in their organisation which should lead to permanent and substantial economies both in administration and manufacturing. The net result of the trading, namely, £217 012, was approximately £35 000 more than at the end of 1920, in spite of the trade depression which had continued throughout the year. Their business in India, in spite of grave unrest there, had been carried out successfully. Business from Australia and South Africa had at times been much restricted, but in South America they showed more advance. In their Continental business their most serious diminution of trade had occurred. One of the great difficulties there was the depreciated exchange. The far more important disadvantage which this country had felt the effect of during the last two or three years was the unwillingness of the worker, which had yet to be overcome. The current year showed a reasonable prospect of a successful result, but that must largely depend upon developments during the next few months. The company must depend for its success not only upon a substantial

home trade but upon large orders coming from abroad. The sooner, therefore, that an effective international agreement was reached and industrial peace in this country was secured the sooner the company and others like it would be able to get to work without let or hindrance.

Sir T. O. Callender (managing director) said it had been an exceedingly difficult year for the management, but to a certain extent the stoppage of the coal trade had tended to their advantage. They had not only taken the opportunity thoroughly to reorganise their factories and administration but they had found that when they had resumed work, after nearly ten weeks, their men had thrown off many of the pernicious doctrines which had been upsetting production, and that the ca' canny policy was conspicuous by its absence. It was disappointing that the large extensions in the electrical field, of which so much had been heard, had so far not materialised. From the city of Manchester certainly their company had received the largest order which had ever been placed in the cable industry, and they had had important contracts in various other parts of the country, but the general great development of electricity was still in the lap of the gods, although from his intimate knowledge of what was going forward he thought they could look forward with great confidence to excellent business in the near future. His view was that the long outlook for their trade had never been better than it was at present.

An abstract of the accounts was given in our issue of May 19th.

Oriental Telephone and Electric.

The net revenue of the ORIENTAL TELEPHONE & ELECTRIC COMPANY for the year to December 31 last amounted to £49 228, to which is added the balance from 1920 of £10 492, making a total of £59 720. After deducting £13 076 for interim dividends paid, there remains a sum of £46 644, which the directors recommend should be appropriated as follows:—£24 652 in payment of a final dividend of 6 per cent. on the ordinary shares and a bonus of 2 per cent., and a final dividend of 3 per cent. on the preference shares; £10 000 to depreciation and general reserve; £2 000 to staff pension fund; leaving £9 992 to be carried forward. The business at all the branches of the company—viz., Madras, Rangoon, Moulmein, Singapore and Mauritius, and of the associated companies—continues to expand, and shows increased revenues for the past year. Owing to the fall in the rupee exchange, however, the net revenue from the branches does not stand at so high a figure as in the previous year, but compares favourably with that for the year 1919, in which no abnormal movement of exchange rates occurred. The Government of India have now definitely decided not to purchase the undertakings of the company and its subsidiaries in India in 1923. As the result of prolonged negotiations which have recently been concluded in India by Mr. G. Parker Ness, the vice-chairman of the company, in conjunction with the local companies, the Government have decided to grant security of tenure to the companies until March, 1943. At December 31 last the company had a total of 10 071 stations in operation, an increase of 1 054 during the year. The Indian local companies have declared the following dividends for the year 1921—viz., the Bombay Telephone Company, 14 per cent., and the Bengal Telephone Company, 10 per cent. The annual report of the Bombay Telephone Company has not yet been received, but according to advices already to hand that company had, on December 31 last, 9 885 exchange and private lines in operation, being a net addition of 176 during the year. The directors of the Bengal Telephone Company report that the demand for new telephone services continues to increase and that the prospects for the future are excellent. At December 31 that company had 8 272 stations in operation, being a net addition of 1 434 during the year. The net revenue of the China and Japan Telephone and Electric Company shows a substantial increase over the previous year and a dividend of 10 per cent., free of income tax, for the year has been declared, as well as a bonus of 10 per cent., also free of income tax, in view of the passing of the dividend by that company last year. At December 31, 1921, that company had 6 785 stations in operation, an increase of 673 during the year. The liquidation of the Telephone Company of Egypt, Ltd., has now been completed.

Vera Cruz Electric Light, Power, and Traction.

Presiding at the annual meeting of the above company last week, Mr. Vincent W. Yorke (the chairman of the company) said that the net profits in Mexico for the year 1921 were the highest yet earned since the company was incorporated, and were practically $200 000 (Mexican) higher than they were in 1920. After providing out of the profits for the year for debentures and corporation profits tax there remained a balance of £64 752. An interim dividend of 5 per cent. had already been paid in respect of 1921, and it was proposed to pay a further 5 per cent. dividend, making 10 per cent. in all, and in addition a bonus of 2½ per cent. for the year. This total dividend and bonus would absorb £43 750. £20 000 had been transferred to depreciation and reserve account, this being £5 000 more than they had transferred in any previous year, and £22 983 was being carried forward, approximately £1 000 more than the amount brought into the accounts from last year. The depreciation and reserve account now stands at £95 000. The rate of exchange ruling between London and New York had for the last three years resulted in a profit in respect of all money remitted to London, and profit on exchange for the year 1921 amounted to some £13 000. The bonus to be paid really represented profit on exchange and might not be possible in future years. During the year their investment in the company which owns and operates the bathing establishment at Balneario had been increased by approximately £5 000. Negotiations had been opened with their management in Vera Cruz for a lease of this property. Owing to the popularity of Balneario and the consequent heavy demand for transport and also to cope with increasing traffic generally, orders had been placed for six additional tramcars. The company had received practically the whole of its power from the Tuxpango plant of the Puebla Tramway Light and Power Company, which continued to afford a very satisfactory service.

The GLOBE TELEGRAPH TRUST COMPANY announces a final dividend of 5s. per share net on the ordinary shares.

ALTRINCHAM ELECTRIC SUPPLY COMPANY have declared a dividend of 7½ per cent. for the year. £726 is carried forward.

DOULTON & COMPANY recommend a dividend of 5 per cent. on the ordinary shares for the year. The sum of £53 243 is carried forward.

ALLEY & MACLELLAN announce a dividend of 6 per cent. for the year less tax. £26 227 has been set aside for depreciation, leaving £5 564 to be carried forward.

The directors of the CHLORIDE ELECTRICAL STORAGE COMPANY announce a final dividend of 5 per cent., actual, tax free, making 10 per cent., tax free, for the year. Last year the dividend was the same.

The directors of the ELECTRIC CONSTRUCTION COMPANY recommend a final dividend at 9 per cent. per annum on the ordinary shares, making 7½ per cent. for the year ended March 31 last, plus a bonus of 2½ per cent., both less tax.

The directors of the MADRAS ELECTRIC SUPPLY CORPORATION recommend a dividend at the rate of 8 per cent. per annum, free of tax, for 1921. The CORPORATION on Monday offered for public subscription £200 000 of seven per cent. second (registered) debentures at 95. The issue was more than ten times over-subscribed within a few minutes after the opening of the lists.

The net profit of the THOMSON-HOUSTON (CIE. FRANÇAISE) for 1921, less debenture and other interest and general and miscellaneous charges, was 23 522 422 frs., making with 610 765 frs. brought in 24 133 187 frs. The directors propose to place to redemption fund 3 512 405 frs., to reserve 1 000 500 frs., administrative expenses 900 951 frs., to pay a dividend of 45 frs. per share and carry forward 719 329 frs.

The accounts of DICKSON & MANN for the year ended March 31, after providing for all usual charges, depreciation and half-year's dividend on the preference shares, show a total deficit brought up to £9 000, largely due to heavy fall in value of stock. From reserve the directors have transferred sufficient to meet this deficit. The company have a recognised claim for return of income tax paid, which will considerably reduce the deficit. No dividend on the preference shares can be paid for the half-year. The directors report that as regards volume of business the year has opened favourably.

The accounts of MIRRLEES, BICKERTON & DAY for the year ended March 31, after providing for depreciation and directors' fees, show a loss of £10 552, reducing the balance of £14 369 brought in to £3 817. In arriving at these figures the directors believe they have made sufficient provision for depreciated values of stock and work in progress, and have not over-estimated amount of excess profits which will be recovered. The directors recommend the withdrawal of £10 525 from reserve, paying a dividend on the ordinary shares at 5 per cent., less tax, for the year, carrying forward £2 858 and leaving reserve at £25 000.

The report of the REES ROTURBO MANUFACTURING COMPANY for the eleven months ended August 31 last states that the final adjustments in respect to the Finance Act, 1921 (winding up excess profits duty), under which the company claimed approximately £5 000, has not yet been settled and was therefore not included in the balance sheet. The balance to the credit of the profit and loss account, including £6 727 brought in, was £10 255. A dividend of 5 per cent., less tax, on the preference shares for twelve months ended September 30, 1917 (£2 837), was paid in December, leaving £7 417, out of which the directors recommend payments of a dividend of 5 per cent. on the preference shares for the year ended September 30, 1918, less tax; £2 000 to depreciation reserve, making £17 000; £1 013 to taxation reserve, making £10 000, carrying forward £1 507. £7 555 has been added to capital expenditure for patterns and loose tools.

Addressing the shareholders at the annual meeting of the LANCASHIRE ELECTRIC LIGHT AND POWER COMPANY last week, Mr. Alfred Shepherd, who presided, said that the net result of the company's working, after crediting the interest and dividends received and debiting the interest on the company's debentures and other expenses, and adding the balance brought forward from last year, gave a sum of £40 988 available for dividends. The directors recommended that dividends should be declared upon the 6 per cent. cumulative convertible first preference shares and the 7 per cent. cumulative participating preference shares, after which there would be a balance to carry forward of £8 458. As regarded the future, he hesitated to prophesy. But the returns received from the Parliamentary Company up to date indicated that next year the accounts of this company should show considerably better than those for the past year.

COMMERCIAL INTELLIGENCE.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

BEVAN MANUFACTURING CO., 146, Gooch Street, Birmingham, makers of electro-plate wares. £14 2s. 6d. March 29.

BRADBEER, John E., 2C, Englands Lane, N.W., electrical engineer. £26 5s. 2d. March 14.

CARTER (HUBERT D.), LTD., Edison House, Colwyn Bay, electrical contractors. £11 11s. 1d. March 29; and £57 5s. 9d. April 9.

FISHER, Mr. N., 1, Victoria Square, Holmfirth, electrical dealer. £21 3s. 10d. March 30.

GREENFIELD, Mr. F., 47, Goldhawk Road, Shepherd's Bush, electrical engineer. £15 17s. 6d. March 29.

JOHNSON, Frederick, Esher Street, Upper Kennington Lane, S.E., electrician. £24 12s. April 3.

LEPPARD, F. H. (trading as ELECTRIC EXCHANGE), 45, St. Nicholas Street, Bristol, electrical dealer. £19 15s. 1d. March 23.

ROYSENTUL, Mr. J., 46, Balls Pond Road, N., electrical engineer. £23 15s. 6d. March 28.

SMART, William Nathan (trading as W. N. SMART AND CO.). 19A, Cross Street, Oldham, electrical engineer. £10 0s. 7d March 30.

VENN, Robert (trading as VENN BROTHERS), 39, Turnham Green Terrace, Chiswick, electrician. £21 7s. 5d. March 24.

Bills of Sale.

[The undermentioned information is from the Official Registry. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice has been entered on the Register.]

CHAPPELL, William, 26, Alldis Street, Great Moor, Stockport, electrical and mechanical engineer and contractor May 27. £40.

RECEIVERSHIPS.

B.E. MANUFACTURING CO., LTD.—J. E. Pritchard, of 115, Colmore Row, Birmingham, was appointed receiver and manager on May 19, under powers contained in debentures dated February 28, 1922.

CORONA LAMP WORKS, LTD.—V. G. Teale, F.C.A., of 65, Chancery Lane, W.C., was appointed receiver on May 15, 1922, under powers contained in trust deed dated April 10, 1919.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

BRITANNIC ELECTRICAL CO., LTD., Solihull Lodge.—Registered May 11, £250 debentures, balance of £1 000; general charge; also registered May 11, £1 000 second debentures, present issue, £650; general charge. *£750. February 24, 1921.

KELVIN-HARDY ELECTRIC CO., LTD., Liverpool.—Registered May 10, £1 500 debentures, present issue £1 000; general charge. *Nil. December 31, 1921.

NORTHAMPTON ELECTRIC LIGHT AND POWER CO., LTD. —Registered May 6, £40 000 second debenture stock; general charge. *£110 000. March 10, 1922.

RODD (R. J.), LTD., Walton-on-Thames, electricians.—Registered May 16, £4 000 debentures; present issue, £3 500; general charge. *Nil. June 17, 1921.

Satisfaction.

BOMBAY ELECTRIC SUPPLY AND TRAMWAYS CO., LTD. —Satisfactions registered May 9, £600 000 registered November 18, 1905; £150 000 registered May 17, 1909; £50 000 registered March 17, 1911; and £10 000 registered February 17, 1915.

I. T. E. ELECTRIC CO. (1907), LTD., London, E.C.—Satisfaction registered May 23, £2 400, registered December 18, 1907.

Private Meetings, etc.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

AQUA ELECTRIC CO., LTD. (in voluntary liquidation), electric geyser, etc., manufacturers, 116, Putney Bridge Road, London, S.W.15. A meeting of creditors was held on Monday, at the Chartered Institute of Secretaries, 59A, London Wall, London, E.C. Mr. C. H. McKnight, 36, New Broad Street, London, E.C., the liquidator, stated that he had prepared a statement of affairs, from which it appeared liabilities totalled £1 586 (trade creditors, £580). Assets estimated to realise £250, or a deficiency of £1 336 so far as the unsecured creditors were concerned. A resolution was passed confirming the voluntary liquidation of the company, with Mr. McKnight as liquidator.

PARK BROS., LTD., electrical engineers, Spring Bridge Road, Ealing, London, W.—Creditors were called together on Friday at the offices of Corfield and Cripwell, accountants and auditors, Balfour House, Finsbury Pavement, E.C. Mr. W. A. J. Osborne, the liquidator in the voluntary liquidation of the company, submitted a statement of affairs which showed liabilities of £277, all due to the trade. The assets were estimated to realise £119, or a deficiency of £158. Mr. Osborne stated that the stock included a quantity of old material which would be very difficult to dispose of. The business was an old-established one, previously carried on under the style of Park Bros., and was converted into a company in December, 1900, with a nominal capital of £1,000, of which £334 represented preference shares and £660 ordinary shares. The vendors received 603 ordinary shares as the purchase price of the business, while 250 preference shares had also been issued. For some years the business was successful, but during the last three or four years there had been losses on the trading. Efforts had been made to introduce further capital, but without success. The creditors passed a resolution confirming the voluntary liquidation of the company with Mr. Osborne as the liquidator.

THOMAS, John, 19, Porth Street, Porth, Rhondda Valley, electrical engineer, etc. At a meeting of creditors held recently in Cardiff, sympathy was expressed with the debtor, and it was decided to accept a composition of 6s. 8d. in the £, payable as to 2s. 6d. in three months, 2s. 6d. in six months, and 1s. 8d. in nine months. It was also decided that the matter should be carried through under a deed of assignment, with Mr. S. E. Clutterbuck, of Messrs. Clarke, Dovey and Co., as trustee, and a committee of inspection. A statement of affairs presented showed liabilities of £1 305 (trade creditors £822), net assets estimated to realise £212, deficiency £1 093. Debtor commenced business in January, 1920, with a capital of about £630, and took over an existing business. At the outset the turnover was £33 per week, but it went up to £45 weekly, but had now dropped to £28 a week. The gross profit was estimated at about 15 per cent., while the outgoings were £13 weekly. The following are creditors:—Baxendale and Co., Manchester, £150; Catterson and Sons, S. P., London, £27; English Electrical and Siemens Co., London, £116; General Electric Co., Cardiff, £26; Rose Bros., Bristol, £34; Siemens Bros., London, £36; Shenton and Co., London, £61; Smith, J. and W. B., London, £25; Witty and Wyatt, Cardiff, £17; Wholesale Fittings Co., Bristol, £23.

TOFIELD AND ROBINSON, LTD., electrical engineers, Edmund Street, Birmingham. At a conference of creditors held recently in Birmingham it was unanimously decided to leave their accounts in abeyance for a period of six months, during which time they would not exercise any pressure, subject to the directors reporting to a committee of inspection every three months, and to a report being issued by the committee at the end of six months. The committee consisted of the representatives of the Callander Cable Co., Sterns Electric Co., W. R. Henley Telegraph Co., the English Electric Co., and the Wholesale Traders' Association. A statement of affairs presented showed ranking liabilities of £10 755 (unsecured creditors, £2 476; bankers, £8 079). Assets consisted of cash in hand, £30; book debts, £2 000; stock in trade and work in progress, £4 500; furniture and fittings, £200; and plant and machinery, £270, or a deficiency of £3 755 7s. 10d. With regard to the claim of the bank, they held debentures to the extent of £8 000. The business was incorporated in May, 1920, and took over the Birmingham business of another concern as from November 1, 1919, paying £1 880 for the goodwill. The first year's trading showed a profit of something like £300, but in the succeeding twelve months there was a heavy loss, which approached £4 000. That loss was largely due to heavy purchases of goods which could not be readily sold, and had since depreciated very seriously in price. The directors had never received any fees. The company also opened a London office which resulted in a loss of over £1 000, and was closed. Economies to the extent of at least £1 300 a year had been effected, and there were a number of profitable orders on hand.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Companies Winding-up Voluntarily.

ALFO ELECTRICAL ENGINEERING CO., LTD.—J. R. Dickin, 37, Moorfields, Liverpool, appointed liquidator. Meeting of creditors at 20, Castle Street, Liverpool, Monday, June 12, at 3 p.m. Particulars of claims to the liquidator by June 6.

MENAI BRIDGE ELECTRICITY SUPPLY CO., LTD.—W. Grey Pritchard, High Street, Menai Bridge, appointed liquidator. Meeting of creditors at the Council Chamber, Menai Bridge, Wednesday, June 7, at 2 p.m.

Bankruptcy Information.

CARTER, Thomas, 2, South Street, Dorchester, and at High Street, Swanage, electrical engineer. First meeting, June 8, 12 noon, Official Receiver's Office, City Chambers, Catherine Street, Salisbury. Public examination, June 23, 10.30 a.m., County Hall, Dorchester.

VELIKOID MANUFACTURING CO., Daw Bank Works, Stockport. Receiving order, May 18. Creditor's petition.

Notice of Dividend.

BECKETT, Samuel, Junior, 50, Deane Road, Bolton, electrician. Amount per £, 6¾d. First and final. Payable, June 6. Official Receiver's Offices, Byrom Street, Manchester.

Notice of Intended Dividend.

GOSS, Frederick Charles, 32, Windsor Road, St. Andrews Park, Bishopston, and 71, North Road, Bristol, electrical engineer, Last day for receiving proofs, June 13. Trustee, F. W. Darley. 26, Baldwin Street, Bristol.

Edinburgh Gazette.

DENHOLM, CRAIG AND CO., electrical engineers, 81, Townhead Street, Hamilton. Partnership dissolved as at April 29, 1922, by the retiral of Alexander Duncan. John Gilmour Denholm and Alexander Gray Craig will continue the business under the same firm name.

HARVEY, Thomas, mechanical and electrical engineer, 31, Arlington Street, Hillhead, Glasgow. A creditor's petition for sequestration has been presented.

Bankruptcy Proceedings.

BATE, Douglas Clavell, 16, John Dalton Street, Manchester, electrical manufacturer and supplier. The first meeting of creditors was held at Manchester. Statement of affairs showed liabilities of £1,959, assets estimated to realise £663, from which preferential claims of £79 had to be deducted, leaving net assets of £584, or a deficiency of £1,375. Debtor attributed his failure to marked fall in prices, his periodical ill-health for the past three years, and his total inability to attend his office since September, 1921. He was in the electrical business for over 40 years as an employee. About 14 years ago he came to Manchester and started on his own account at 40, Brazennose Street, removing to his present address in 1916. Until the armistice the business was fairly successful, but he had two bad periods, one after the armistice, which lasted about six months, and another which started in the spring of 1920 and still persisted. A full set of books of account had been kept. Debtor became aware of his position about the middle of March last. The creditors decided to appoint Mr. J. F. Warburton, 28, Queen Street, Manchester, as trustee. The following are creditors: A. and A. Electrical Co., London, £35; Benjamin Electrical Co., London, £70; Bi-Metals, Ltd., London, £10; Concordia Electric Wire Co., Ltd., New Sawley, £56; Central Electric Co., Manchester, £50; Eureka Conduits and Fittings Co., Walsall, £25; Edison Swan Electric Co., Ltd., Manchester, £46; Efandem Co., Ltd., Wolverhampton, £20; Greenwood and Batley, Ltd., Leeds, £300; Hackbridge Cable Co., Ltd., Hackbridge, £20; Hogan and Wardrop, London, £13; Hopkins, H. H., Manchester, £40; Moores, John, and Co., Manchester, £35; Premier Elec. Contracting Co., London, £16; Record Electric Co., Altrincham, £22; Simmonds Bros., Ltd., London, £160; Steel Tubes and Conduits Co., Keighley, £121; Velekoid Manufacturing Co., Stockport, £81; White, J. C., Manchester, £65.

HENDERSON, Charles Archibald, 63, Queen Victoria Street, E.C. The debtor, who carried on business as an insulating materials merchant, attended for his public examination last week before Mr. Registrar Francke. His statement of affairs disclosed liabilities £24 371 (£23 405 expected to rank), and estimated assets £18 359. The debtor was adjudged a bankrupt on May 22, aud it was now reported by the Official Receiver that his statement of affairs was only filed on May 23. Under the circumstances he asked for an adjournment until July 14. This application His Honour granted. Appended is a list of the principal creditors:—All's Well Paint Co., London, £24; Brooker and Jackson, Ltd., London, £30; Climax Stopper Co., Ltd., London, £234; Ebo Rubber Co., Ltd., London, £857; Fuller's United Electric Co., Ltd., Chadwell Heath, £522; Highlensite, Ltd., London, £57.

New Companies.

Hayward Turbine Engineering Co.

HAYWARD TURBINE ENGINEERING CO., LTD. (181 045). Private company. Reg. May 25. Capital, £100 in 1s. shares. Turbine, electric, irrigation, electrical and general engineers, etc. Subscribers: I. B. Blaiberg and S. Miles. Sec.: S. Miles. Reg. office: Liberty Works, Bollo Lane, Acton, W.3.

St. Helens Motor and Engineering Co.

ST. HELENS MOTOR AND ELECTRICAL ENGINEERING CO., LTD. (182,032). Private company. Reg. May 25. Capital, £600 in £1 shares. To carry on the business as indicated by the title. Permanent directors: H. Devany, E. Filmer, and F. Newton. Secretary: F. Newton. Reg. office: Canal Works, Church Street, St. Helens.

Naylor Benzon Engineering

NAYLOR BENZON ENGINEERING, LTD. (182 004). Private company. Reg. May 24. Capital, £20 000 in £1 shares. Manufacturers and installers of, and dealers in engines, boilers, gearing, machinery, plant and other goods, railway, tramway and road locomotives, etc. First directors: C. S. Ascherson, A. D. Tisdall, and A. C. Hay Solicitors: Lawrence, Webster, Messen and Nicholls, 14, Old Jewry Chambers, E.C.2.

London Magneto Repairing and Winding Co.

LONDON MAGNETO REPAIRING AND WINDING CO, LTD. (182 002). Private company. Reg. May 24. Capital, £3 000 in £1 shares. To take over the business carried on by S. T. Boon, at 78, Hampstead Road, N.W., as the "Magneto Repairing and Winding Co." Life directors: S. T. Boon and H. C. Eade. Solicitor: C. R. A. Edmonds, 61 and 62, Chancery Lane, W.C. Reg. office: 78, Hampstead Road, N.W.

Burke Electrical Manufacturing Co.

BURKE ELECTRICAL MANUFACTURING CO., LTD. (182 020). Private company. Reg. May 25. Capital, £500 in £1 shares. To adopt an agreement with S. Burke, and to carry on the business of electrical and general engineers, manufacturers and patentees of electrical machines and apparatus, etc. First directors: S. J. Burke, W. Dawson, H. W. Penney and H. A. Douglas. Reg. office: 6, Francis Street, Westminster.

Adams Silent Burglar Alarm Co.

ADAMS SILENT BURGLAR ALARM CO., LTD. (181 985). Private company. Reg. May 24. Capital, £4 000 in £1 shares. To adopt an agreement with S. G. Adams, A. B. Adams, G. E. Appleton and A. Adams for the acquisition of Patent No. 33 839 of 1920, for improvements in burglar and like alarm systems, etc. First directors: S. G. Adams, A. B. Adams, W. C. Sayers, G. E. Appleton, A. Adams, F. E. Sayers and O. E. H. Birchall. Reg. office: 58, Leander Road, Thornton Heath.

Wireless Appliances.

WIRELESS APPLIANCES, LTD. (181 984.) Private company. Reg. May 23. Capital £5 000 in 1s. shares. Electricians, manufacturers of generators, accumulators, suppliers and distributors of electricity for lighting, heating, telegraphic, telephonic and signalling communication, proprietors and managers of telegraph, telephone and signalling works, distributors of news, etc. Provisional directors, W. A. Heyland, W. G. Chapman. Secretary, C. H. Kieling. Reg. office: 132 and 134, Shaftesbury Avenue, W.1.

Universal Postal Frankers.

UNIVERSAL POSTAL FRANKERS, LTD. Private company. Reg. May 25. Nominal capital, £100 000 in £1 shares. To adopt an agreement with the Sterling Telephone and Electric Co., Ltd. (vendors and promoters), to acquire and turn to account certain patents and rights, and any inventions relating to machinery for franking letters, telegrams, cablegrams marconigrams, receipts and the like, etc. Subscribers: F. S. Gaylor and J. Findlay. Solicitors: Steadman, Van Praagh and Gaylor, 4, Old Burlington Street, W. File number is 182 037.

Arrangements for the Week.

WEDNESDAY, JUNE 7th.

INSTITUTION OF ELECTRICAL ENGINEERS.

6 *p.m.* At Savoy Place, Victoria Embankment, London, W.C.2. "The Performance of a Radio-Telegraphic Transmitter, with Special Reference to the New Installation at North Foreland," by Mr. N. Lea, B.Sc. "A Dynamic Model of Tuned Electrical Circuits," by Prof. C. F. Jenkin, C.B.E., M.A.

FRIDAY, JUNE 9th.

PHYSICAL SOCIETY OF LONDON.

3.30 *p.m.* Visit to the National Physical Laboratory, Teddington.

The unveiling and dedication of the WAR MEMORIAL in memory of the members of the INSTITUTION OF ELECTRICAL ENGINEERS who fell in the Great War will take place at the Institution building on Wednesday, June 28, at 4.30 p.m. The Memorial will be dedicated by the Rt. Rev. Bishop Ryle, Dean of Westminster, and unveiled by Air Chief Marshal Sir H. M. Trenchard, assisted by the president of the Institution, Mr. J. S. Highfield, and the senior vice-president, Dr. W. H. Eccles.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MEWBURN, ELLIS & CO., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

COMPLETE SPECIFICATIONS.

172 036 MARKS, E. C. R. (LANGGUTH AND HAAR). Electric heaters for heating liquids. (21/5/20.)
172 041 CREED AND CO., LTD., and LENAGHAN, T. Electro-magnetic relays. (3/6/20.)
146 336 CHAUVEAU, L. L. E. Automatic switch for distant control. (3/4/19.)
172 055 GLASER, W. H., and GLASER, LTD., W. H. Electric current regulating devices. (23/7/20.) (Cognate Application 23 650/20.)
172 069 GRILLETTE, L. Sparking plugs for internal combustion engines. (6/8/20.)
172 088 BISHOP, G. A., and CHADWICK, R. A. Electrically-driven motor wheels for automobiles and other road vehicles. (25/8/20.)
172 091 GELY, E. L. Insulating chain for electric transport lines. (25/8/20.)
152 690 FILIPPO, H., LELY, D., JUN., and NAAMLOOZE VENNOOTSCHAP PHILIPS' GLOEILAMPENFABRIEKEN. Electric discharge lamps. (27/8/19.)
165 760 WILSON WELDER AND METALS CO., INC. Electric arc welding systems. (26/6/20.)
172 102 SIMPLEX CONDUITS, LTD., and MCLOUGHLIN, H. F. Electric switches and enclosure boxes therefor. (30/8/20.)
172 104 FROST, R. J. Electric water-heater. (30/8/20.)
172 105 MARKS, E. C. R. (HORN, J. A. L.). Telegraphic receiving and transmitting apparatus. (30/8/20.)
172 112 WALL, T. F. Means for limiting change of speed in alternating current generators. (31/8/20.) (Cognate Application 13 971/21.)
172 122 MEDWAY, E. M., SMITH, E. C., and MEDWAY, A. S. Stopping or slowing of electric motors. (1/9/20.)
172 127 MACRORIE, A. K., AIREY, H. MORRIS-, and SHEARING, G. Valve transmitters and receivers for wireless telegraphy and telephony. (2/9/20.)
172 131 METROPOLITAN-VICKERS ELECTRICAL CO., LTD. (WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.). Automatic electric sub-station systems. (3/9/20.)
150 958 KREMENEZKY, J. (Firm of). Electrolytic rectifier cell. (14/3/18.)
172 153 ROYCE, F. H. Electrical turning-gear for starting internal combustion engines. (15/9/20.)
172 167 SOC. ANON. DES ANCIENS ETABLISSEMENTS HOTCHKISS ET CIE, and AINSWORTH, H. M. Starting and lighting systems for use on motor vehicles. (25/9/20.)
172 170 DAVIES, D. R., and METROPOLITAN-VICKERS ELECTRICAL CO., LTD. Electrical switch gear. (28/9/20.)
172 186 SIEMENS BROS. AND CO., LTD., and SIEMENS, A. Automatic and semi-automatic telephone instruments. (15/10/20.)
172 187 ERIKSSON, E. G., and JONASSON, K. G. Electric indicator boards and the like. (18/10/20.)
164 705 MEISSNER, O. Sparking plugs. (11/6/20.)
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157 721 BRITISH THOMSON HOUSTON CO., LTD. Braking systems for electrically driven vehicles. (25/3/18.)
172 246 SCHULZE, O. Magnetic control mechanism for liquid-raising apparatus. (17/2/21.)
160 459 DUTEIL, E. Electrolytic device for increasing the speed of ships. (16/3/20.)
161 955 ALLMANNA SVENSKA ELEKTRISKA AKTIEBOLAGET. Arrangement of neutral point resistances for electric high-tension transmission systems. (16/4/20.)
165 426 SOC. FRANCAISE RADIO-ELECTRIQUE. Electro-magnetic wave-receiving arrangements. (3/11/16.) (Divided Application on 146 204.)
172 267 HAILWOOD, E. A. Incandescent electric lamps. (25/8/20.) (Divided Application on 24 597/20.)

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13 588 C. O. OLSON. Wind-driven electric generators.
13 595 G. FORNACA. System of regulating voltage of electric generators.
13 601 V. E. RICHARDS. Primary cells.
13 602 V. E. RICHARDS. Apparatus for forming depolarizing element of primary cells
13 627 A. BUSHELL. Electric light fittings.
13 640 METROPOLITAN-VICKERS ELECTRICAL CO. Flexible couplings for shafts.
13 641 METROPOLITAN-VICKERS ELECTRICAL CO. Electric protective systems. (24/5/21 U.S.)
13 647 R. C. KAY.
13 649 IGRANIC ELECTRIC CO. (CUTLER-HAMMER MANUFACTURING CO.). Pressure regulating devices.
13 657 A. G. T. CUSINS. Reduction of disturbing effects of atmospherics in wireless signalling.
13 662 J. C. LINCOLN. Electric machines. (13/5/21 U.S.)
13 670 H. MACE. Electric engines.

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13 707 J. W. STEVENS. Electrically illuminated devices.
13 726 J. D. MORRISON. Electrodes for welding.
13 746 C. F. ELWELL, LTD., and B. E. G. MITTELL. Wireless telegraph transmitters, etc.
13 747 C. F. ELWELL, LTD., and B. E. G. MITTELL. Thermionic valves.
13 748 RADIO COMMUNICATION CO. and J. SCOTT-TAGGART. Continuous wave transmitters.
13 749 RADIO COMMUNICATION CO. and J. SCOTT-TAGGART. Thermionic valves, etc.
13 750 J. SCOTT-TAGGART. Radio communication, etc., signalling.
13 751 EFANDEM CO., J. EATON and A. H. WILLIAMS. Electric hand lanterns.
13 762 J. B. BOLITHO. Contacts for relays.
13 763 J. B. BOLITHO. Wireless and wired wireless telegraphy and telephony.
13 779 BRECKNELL, MUNRO AND ROGERS and H. J. ROGERS. Trolley poles.
13 794 E. J. CLARKE. Electrodes for electric welding.
13 795 METROPOLITAN VICKERS ELECTRICAL CO., A. STUBBS, and J. F. PERRY. Electric mining plant.
13 811 PHILIPS GLOEILAMPENFABR, E. OOSTERHUIS, and G. HOLT. Leading in conductors for vitreous material.

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13 902 R. S. CLAY. Transmitting pictures by telegraphy.
13 904 R. O. KING. Electric ovens, etc.
13 905 BRITISH L. M. ERICSSON MANUFACTURING CO. and W. M. CROWE. Telephone instruments.
13 908
13 912 M. A. PERSSON. Electric switch (2/6/21 Sweden.)
13 913 R. T. SMITH and R. C. BOOKLESS. Wireless systems and apparatus.
13 917 EVERSHED AND VIGNOLES, and G. B. ROLFE. Magneto electric generators, etc.
13 918 EVERSHED AND VIGNOLES, and G. B. ROLFE. Electric testing instruments.
13 925 B.T.H. CO. (G.E. CO.). Electric control systems.
13 926 B.T.H. CO., A. R. YOUNG, and E. G. PARROTT. Terminals or connections for electric conductors.
13 945 J. SCOTT-TAGGART. Radio communication, etc., signalling.
13 956 AUTOMATIC TELEPHONE MANUFACTURING CO., S. R. SMITH, and P. N. ROSEBY. Receivers for telephones, etc.
13 957 AUTOMATIC TELEPHONE MANUFACTURING CO., Telephone systems. (23/5/21 U.S.)

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13 967 W. J. BIRNIE. Locking device for electric lamps, etc.
14 004 AUTOMATIC TELEPHONE MANUFACTURING CO. Automatic switches. (23/5/21 U.S.)
14 009 BUREAU D'ORGANISATION ECONOMIQUE. Fan device for electric transformers, etc. (17/5/21 U.S.)
14 021 SIEMENS BROS. AND CO., H. A. E. EASON. Incandescent lamps.
14 022 SIEMENS BROS. AND CO., J. E. COLLYER, and E. A. PETITHORY. Selecting devices for telephone systems.
14 030 B.T.H. CO. Radio receiving systems. (18/5/21 U.S.)
14 038 H. A. GILL (VIGILANT AUTOMATIC FIRE ALARM CO.). Thermostat for electric fire alarm systems.
14 040 J. E. F. YOUNG. Synchronous recording and reproduction of sounds and moving pictures.
14 042 GENERAL ELECTRIC CO., LTD. Incandescent lamps. (19/5/21 Germany).
14 043 C. J. COLEMAN. Transmission of messages through cables having high electrostatic capacity.
14 049 E. G. F. SWANGREN. Electric ignition for oil fuel.
14 050 METROPOLITAN-VICKERS ELECTRIC CO. and H. FAWCETT. Operating gear for electric switches, etc.
14 052 SOC. DES ACCUMULATORS ELECTRIQUES ANC. ETAB. A. DININ. Batteries. (6/7/21 France.)
14 064 BRECKNELL, MUNRO AND ROGERS, and A. M. WILLIS. Insulators.
14 059 H. LEITMER. Accumulators, etc.
14 083 E. SCHATTNAR. Electric starting switches.
14 088 CLARKE, CHAPMAN AND CO., and R. C. HARRIS. Electric control gear.

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14 120 W. TRAVIS. Electric melting furnaces.
14 121 W. H. WILSON. Attachment of picture projecting apparatus to electric hand lamps, etc.
14 132 C. S. GOODE. Wireless aerials.
14 182 S. G. FROST. Thermionic valves, etc.
14 189 V.M.L. EXPERIMENTAL, LTD., F. L. J. JOHNSON, and O. D. LUCAS. Electric primers and vent sealing tubes.
14 190 F. ALDENDORFF. Electric relays.
14 193 B.T.H. CO. Signalling systems. (20/5/21 U.S.)
14 196 A. M. KEAYS and F. PATON-MOORE. Utilizing parts of gramophone, etc., for wireless telegraphy or telephony.
14 198 AUTOMATIC TELEPHONE MANUFACTURING CO. Telephone systems. (25/5/21 U.S.)
14 203 H. W. F. IRELAND and O. D. LUCAS. Electric horns.
14 204 G. ELLISON and H. BAMFORD. Jointing devices for electric cables, etc.
14 205 G. ELLISON and J. ANDERSON. Oil insulated electric switch gear.
14 210 BENJAMIN ELECTRIC, LTD. Electric outlet and fixture support. (20/5/20 U.S.)
14 211 BENJAMIN ELECTRIC, LTD. Electric outlet and fixture support. (23/6/21 U.S.)
14 212 BENJAMIN ELECTRIC, LTD. Electric outlet and fixture support. (22/8/21 U.S.)
14 219 ELECTRO-MECHANICAL BRAKE CO., E. M. TAUNTON, and G. N. CADBURY. Undertrucks for tramcars, etc.
14 224 GES. FUR DRAHTLOSE TELEGRAPHIE. Arrangements for multiplying frequency of alternating current. (30/5/21 Germany.)
14 225 GES. FUR DRAHTLOSE TELEGRAPHIE. Antenna systems. (27/5/21 Germany.)
14 226 GES. FUR DRAHTLOSE TELEGRAPHIE. Reception of wireless signals. (27/5/21 Germany.)

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14 234 H. E. FOARD. Accumulators, etc.
14 264 BRITANNIC ELECTRICAL CO. Diaphragm horns.
14 283 L. A. H. DAVIS. Apparatus for electrically heating water.
14 298 D. MACADIE. Electric measuring instruments.
14 299 B.T.H. CO. Variable current generators. (20/5/21 U.S.)
14 300 B.T.H. CO. and A. P. YOUNG. Sound producing devices.
14 321 G. D. BROOKS. Electric circuit fittings.
14 328 BARRITE, LTD., and F. FERNIE. Insulation of electric conductors.
14 330 A. S. BEWLEY. Telephones, phonographs, etc.

Prices of Metals, Chemicals, etc.

TUESDAY, MAY 30.

		Price.	Inc.	Dec.
Copper—				
Best Selected	per ton	£66 5 0	10s.	—
Electro Wirebars	,,	£71 0 0	£1	—
H.C. Wire, basis	per lb.	0s. 10 7/16d.	1/8d.	—
Sheet	,,	0s. 9 5/8d.	3/16d.	—
Phosphor Bronze Wire (Telephone)—				
Phosphor Bronze Wire, basis	per lb.	1s. 2 7/16d.	1/8d.	—
Brass 60/40—				
Rod, basis	,,	7d.	—	—
Sheet, basis	,,	9d.	1/4d.	—
Wire, basis	,,	10d.	1/4d.	—
Pig Iron—				
Cleveland Warrants	per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 S.W.G.	,,	£18 0 0	—	—
Lead Pig—				
English	,,	£26 0 0	—	—
Foreign or Colonial	,,	£25 0 0	2s. 0d.	—
Tin—				
Ingot	,,	£151 2 6	10s. 0d.	—
Wire, basis	per lb.	2s. 0 3/4d.	—	—
Aluminium Ingots	per ton	£100 0 0	—	—
Spelter	,,	£28 2 6	17s. 6d.	—
Mercury	per bottle	£12 10 0	—	—

Sulphur (Flowers)—Ton £10 15s. *Sodium Chlorate*—Per lb. 3 1/4d.
,, (Roll-Brimstone)—per ton £10 15s. *Sulphuric Acid* (Pyrites, 168°) per ton, £9.
Sodium Bichromate.—Per lb. 5 1/4d. *Copper Sulphate*.—Per ton £26 10s.
Boric Acid (Crystals). Per ton £60.
Rubber.—Para fine, 10d.; plantation 1st latex, 7 1/2d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Company, Ltd.

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CONTENTS.

Notes of the Week.

The Institution Summer Visit.

By judiciously mixing technology, Highland topography and social entertainment, and by enlisting the good offices of the Clerk of the Weather, the Institution of Electrical Engineers scored a distinct success for their visit to Scotland last week. Members saw something and heard a great deal more of the hydro-electric possibilities of the country, and are now in a position to form their own opinions upon the various schemes of water-power development that have been put forward. To see all these things for oneself is the first step to knowledge, and the Scottish Centre are to be thanked both for the opportunity they gave of so doing and their overflowing hospitality.

An Interesting Contrast.

The papers read during the meeting by Mr. R. B. Mitchell and Dr. Magnus Maclean respectively form an interesting contrast. The former, in describing the Dalmarnock station, showed what can be done with the modern steam station and made the prophecy that something better can be achieved. The key to economical working, he said, lies in the boiler house, where, with a steam pressure of 274 lb. and a temperature of 700° F., 6 5 lb. of water are evaporated per pound of coal consumed. Of the losses that occur, the most important are those in the flue gases, and opportunity should therefore be taken, where possible, to use these to pre-heat the air supply. Another indirect means of economy lies in a judicious expenditure on and the constant use of coal weighing equipment. At Dalmarnock, under normal working conditions, a boiler house efficiency of 74 per cent. is obtained, so that the use of these instruments is quite justified.

Flexibility in the Auxiliary Plant.

Mr. Mitchell also called attention to the need for flexibility in the auxiliary plant, a matter which has been carried even further at the new Nechells station of the Birmingham Corporation than it has at Dalmarnock, and to the need for constant and careful testing of the equipment. He gave a number of figures of cost, whence it appears that the total generating costs during April amounted to 0·26d. per unit and rather less for the whole year, the coal consumption being 10·65 lb. per unit generated. As the cost of coal is falling and other conditions will improve, there is no doubt that these figures will be reduced in future. Even so it is evident that Scotland is not lagging behind so far as generation by coal and steam is concerned.

The Hydro-Electric Problem.

Professor Magnus Maclean, however, was anxious that members of the Institution of Electrical Engineers should realise the amount of water power that there is available in Scotland for industrial purposes, and very eloquent he was. But the utilisation of this power is not purely an engineering question. The Highlands are practically depopulated, but if the water power present were developed there is no reason why commercial work should not be carried out under the best possible conditions and the national life thereby elevated, man-power restored, congestion in large centres relieved, and social conditions improved. It is a great dream which we do not wish to rudely shatter. The difficulty is, however, that the water power of the Highlands is not over large in amount and is widely scattered in smallish units. To develop it will require enormous capital expenditure, and to use it either on the spot or in the present industrial centres an expenditure equally enormous. While, therefore, we admire the enterprise of such undertakings as the Grampians Power Co.,

we feel this is a case where it will be well to hurry slowly; and for the present at least to leave development to such undertakings as the British Aluminium Co., whose processes are particularly adapted to the use of water power and to the harnessing of some of the smaller falls for supplying country houses and their adjacent villages. There is a great deal of profitable work to be done under the latter heading, and it certainly should not be neglected.

Sir Eric Geddes on Railway Progress.

THE lecture of the first Minister of Transport to the Junior Institution of Engineers, last week, though pleasantly reminiscent and retrospective in character, contained little that our readers are not already acquainted with. The address is mainly a defence of the Railways Act of 1921, and of Sir ERIC GEDDES' own policy. But although the schemes of amalgamation authorised by the Act must have effected great economies in administration costs and running expenses, so far traders and the travelling public do not appear to have gained much from the change. The wages bill of the railways has been reduced by over £25 000 000 a year, and other expenses have also decreased, but so far there have been only slight reductions in freight charges and passenger fares. In fact, it is only the railways that have gained any benefit from the legislation of which Sir ERIC seems so proud, and we are not sure that the Act, which practically confers a monopoly, is an unmixed blessing. Time alone will show. The market value of railway stocks and shares has risen more than Government securities and the best industrial shares, so that from this point of view the railway unification policy has been a success. But the charges are high enough to handicap trade and industry, and unless something more than the recent illusory concessions to the coal and iron trades are made there will be a public agitation which no Government or railway will be able to withstand.

Electrification and Motor Transport.

ON the important subject of electrification, Sir ERIC GEDDES had not much to say, though evidently he is a firm believer in electric traction and an advocate of the standardisation recommended by the Advisory Committee. He is also right to pronounce in favour of the railway against the road transport of goods. For passengers and for light parcels, the automobile is coming into favour in certain districts, especially in urban and industrial areas, and the electric vehicle can also fill a place in towns, but the railways have only themselves to thank for this competition. If they will persist in high fares, and if they refuse to take the obvious course of electrifying their suburban lines, they will lose more and more of their clients to the owners of motor lorries and charabancs, just as they did in earlier days to the electric tramway.

The Honours List.

WHILE the Honours List issued on the occasion of His Majesty's birthday last Saturday contains no more names of engineers and physicists than usual, it does at least contain two names which our readers will welcome with the heartiest congratulations. Mr. GEORGE SUTTON, the chairman and managing director of Henley's Telegraph works, receives a baronetcy, and Mr. ERNEST MONTAGUE HUGHMAN, honorary secretary of the Institution of Electrical Engineers in India, receives a knighthood. The connection with, and services, of both these gentlemen to the electrical industry are well known to readers of THE ELECTRICIAN. Sir GEORGE SUTTON represents all that is best and most enterprising on the manufacturing side, and by assisting in the foundation of the Cable Makers' Association has not only raised the standard of the products in which he is interested, but has paved the way for that closer co-operation between employers and employed which all but reactionaries desire. By his benevolence Mr. HUGHMAN has placed the industry in his debt in another, but no less certain, way. They are two representative men whom we are delighted to see recognised.

The Engineers' Dispute.

As we go to Press it seems likely that the dispute in the engineering industry is to come to an end. We cannot say that it has been settled, for no true settlement has been reached and the twin reasons that have forced the men to return to work are hopelessness and a lack of funds. But it is only fair to leaders of the A.E.U. to point out that they realised that this would be the outcome months ago, when they recommended that members should accept the terms they had negotiated with the employers. This recommendation was, however, rejected by the members as a whole. The leaders have now arranged once again to submit the proposals of the employers to the rank and file, and though it is unsafe to prophesy there seems every reason to suppose that this time they will be accepted, as they have been by all the other "forty-seven" unions except three. Even in these cases two are to re-ballot, so that the only sign of further prolonged cessation of work comes from the boilermakers. It may well be asked, what good has this dispute achieved? The answer is, none, except as affording yet another illustration of the need for the discovery of some better methods of dealing with such matters. That discovery must be made without delay, and in the meantime we hope that the long-promised trade revival will now really dawn.

Overhead Wires.

THE decision of a Divisional Court that poles and wires erected on a bank by the side of an ordinary public highway in Ipswich must be removed because their presence is a trespass on private property is disconcerting. But it is a good illustration of the difficulties undertakers have still to contend with in their efforts to extend the facilities for electricity supply. In some respects the judgment is unsatisfactory, and we hope that the Corporation will take the case to the Court of Appeal. Notwithstanding the alterations made by the Electric Lighting Act of 1909 and the Electricity (Supply) Act of 1919, the law relating to the use of overhead wires is still far from what it should be, and the obstructive tactics of some owners of land adjoining public highways are the cause, therefore, of much needless expense and delay.

The Law of Property.

IN the present case the road is on the outskirts of Ipswich, and, as ordinary underground mains would have been too expensive, the sanction of the Electricity Commissioners was sought and obtained for the erection of poles and overhead wires. Assuming that the reverend gentleman who sued the Corporation is correct in his contention that the bank is his property, no real damage could have been caused to him by the poles as he could not have used the greensward. It was a mere technical infringement of a purely abstract right, and we think, therefore, that an injunction is not the appropriate remedy,

for it may lead to some consumers being deprived of electricity supply. We should like to see a discretionary power vested in Judges which would enable them to fix a rental for the poles as in the case of telegraph and telephone poles of the Post Office. Electricity is no longer a luxury, but a public necessity, and somewhat similar legal principles should be applied to all important public services.

Alteration of Law Required.

In many districts it is not easy to say how far a public highway extends. Some good authorities assert that it stretches from fence to fence and includes the banks by the side. An ordinary highway is not confined to the metalled part or that portion kept in order for carriages and foot passengers, and consequently greensward or grassy banks at the side would usually be included. This was, apparently, the decision of the County Court Judge, but he has now been overruled, and the reverend plaintiff has been awarded 40s. for the four poles placed on the bank and 5s. for lopping a pine tree, together with an injunction restraining the Corporation from continuing the trespass. The law relating to the rights over the soil and subsoil of public highways is somewhat complicated, but with great deference we have our doubts about the legality of the present decision. We had hoped that sections 21 and 22 of the Electricity (Supply) Act would have smoothed the path of electricity undertakers and would have enabled a wider use being made of overhead methods of distribution. Apparently the change made was not so great as some hoped or anticipated, and it is clear that stronger powers will have to be conferred on the Electricity Commissioners in order to defeat obstructionist tactics and to enable supply authorities to extend with comparative freedom into rural areas.

Electrification Schemes.

We are glad to record that satisfactory progress is being made with the scheme for the conversion of the suburban lines of the South Eastern and Chatham Railways. Special meetings of the stock and share holders have been held and have approved of the application to the Ministry of Transport for an Order under the Railways (Electric Power) Act of 1903, to authorise the construction and equipment of a power station at Angerstein's Wharf, Charlton, and the laying of electric cables, etc., for the electrical operation of a number of the Kentish lines. We believe this is the first use made of the powers conferred by the 1903 Act, but we hope it will be the forerunner of many similar applications. At present the Electricity Commissioners are investigating the proposal to erect a generating station as well as the alternatives sources of power available, and we shall await their decision with interest. The actual work of construction will be carried out by a construction company which will grant leases to the railway companies of the generating station, rolling stock and equipment. The cost of construction will be raised by debentures or debenture stock of the construction company, to be redeemed by 1947 at the latest, but there is an option to redeem in 1927, 1932 or 1942 if the railway companies purchase the station, plant and equipment. The rent payable under the lease will provide (*inter alia*) the interest on the debentures or debenture stock of the construction company; the principal amount required to redeem the securities in June, 1947; a fixed dividend on the share capital of the construction company (not to exceed £10,000), and administration expenses of the construction company.

Underground Improvements.

The proposals of the Underground Electric Railways Company of London for the extension and improvement of some of the lines have also taken definite shape. The new Bill of the London Electric and City and South London Railway Companies seeks powers to enlarge the tunnel of the latter, to provide new rolling stock, and to extend the London Electric line from Golders Green to Edgware. The estimated cost is £6 000 000, and the Treasury has agreed to guarantee a loan of £5 000 000, repayable in 50 years. The London Electric and City and South London Companies will be empowered to borrow further sums of £2 250 000 and £1 250 000 respectively, and these borrowing powers may be exercised by mortgages or by the issue of Second Debenture stock carrying interest at a rate not exceeding 6 per cent. Interest may be paid out of capital during construction, the final date for which is August, 1926. The contracts for the various works have already been let, and a start will be made on them almost immediately. When completed the transport facilities of London will be greatly increased, and there will be readier means of access to South and North West London.

Secretaries of Societies and the Technical Press.

At a meeting of the Circle of Scientific, Technical and Trade Journalists, held in the Hall of the Institute of Journalists on May 30, a suggestive paper was read by Mr. Percy L. Marks on the duties of secretaries, especially those associated with scientific and technical bodies. Mr. Marks was doubtless right in assigning as two of the chief qualifications of a secretary, tact and a sense of humour. The latter enables him to be with equanimity the "slings and arrows of outrageous fortune" occasionally hurled at him by well-meaning but precipitate members of Council. In no field is the wisdom of a secretary more shown than in his dealings with the Press. One occasionally hears complaints from scientific bodies to the effect that their doings are insufficiently appreciated and imperfectly reported, or even ignored. The technical press as a whole is naturally anxious to give publicity to useful scientific knowledge, but space is limited and editors are human. The attention they can devote to a subject often depends more on the manner in which information is presented than its intrinsic merits. Secretaries who make a practice of issuing summaries of proceedings in which the salient points are clearly indicated, and selected with a view to their interest to the journal approached, will find their labour well repaid. Another point is that information should not be too long delayed. It is a great assistance to an editor to have the material in hand before the actual date of reading of a paper. For the rest we are glad to note that the Circle, whose work was naturally interrupted to some extent by the war, is resuming active operations and has appointed a small committee to review its programme for the future and prepare for the next session.

Postal Rates for Trade and Technical Publications.

We are also glad to observe that a resolution was passed at this meeting of the Circle dealing with the matter of postal rates—a subject to which we have several times drawn attention in the past. The moment is opportune for an agitation for decreased rates and we think it is generally admitted that in the past technical and scientific publications have not been generously treated, having regard to the fact that they play such an important role in the

dissemination of useful knowledge. It is also aggravating in the extreme to observe that foreign periodicals are delivered in England at a rate far below that charged to periodicals of precisely similar nature printed and published in this country. If the Circle can use its influence to get these anomalies removed it will deserve well of the public, as well as the Press. Governments have been driven by the force of public clamour to spend more on education. They seem to overlook the fact that in technical journals they have a most valuable educational medium, supported by private enterprise, that might well be encouraged by the slight concession involved in providing reasonable charges for postage.

Labour Representation on J.E.A.'s.

During the recent debate in the House of Commons on the Electricity Bill, Mr. Myers, a Labour member, again raised the question of Labour representation on Joint Electricity Authorities. There is no such provision in the Electricity Supply Act, 1919, or in any of the schemes at present drafted by the Electricity Commissioners. And there is no call for the representation of labour in the way suggested. As it is the fullest provision for dealing with all questions concerning labour is ensured by the Industrial Councils, bodies which are comprehensive in their scope both as to undertakings and employees. But if some other body were entitled to deal with questions of labour (and labour representation means nothing if this is not the object), then conflict would be sure to arise.

German Industrial Situation.

The Report on the Economic and Financial Conditions in Germany recently issued by the Department of Overseas Trade covers much ground and contains a mass of statistics and useful information. We have already published an abstract of the portions relating to the electrical industry, but we believe a review of the general industrial situation would be interesting, and so we propose to place before our readers some of the general conclusions to be deduced from the Report of Mr. J. W. Thelwall and Mr. C. J. Kavanagh. It must, however, be borne in mind that many of their figures are only approximations.

Country Fairly Prosperous.

The most striking fact seems to be that, notwithstanding the restrictions imposed during and since the war, and in spite of the reparations demands of the Allies and other difficulties, the country is in a fairly prosperous condition and there appears to be practically no unemployment. Further progress was made during the past year in the restoration of order in the country, and overseas trading relations were expanded in various directions. As the Germans are a highly trained, well-disciplined and hard-working people, this is only what might be expected, but in face of the great and continued depreciation of the mark, it is obvious that stable commercial intercourse cannot be established between Germany and other nations until the violent daily fluctuations of the rate of exchange cease. How this is to be brought about must be settled by bankers and business men, for apparently it is little use depending upon those peripatetic politicians who indulge in picnics in various parts of Europe.

Temporary Advantages of Depreciated Mark.

The fall in the mark is attributed (*a*) to the large issue of paper money (on December 31 last the total was 121 964 200 000 paper marks, compared with 5 500 000 000 marks in 1914); (*b*) to the necessity of purchasing large amounts of foreign currency beyond that which is secured in the ordinary way of trade; (*c*) to international gambling in marks; and (*d*) to the reparation demands of the Allies. No doubt there are other causes which have contributed to the depreciation, and it is highly expedient that all these should now be investigated in a rational, businesslike way, so that Germany may resume her place in the comity of nations, and so that this country and other industrial nations shall not suffer through the effects of the depressed mark. It is clear that Germany has been able to attract to herself during the past year a large part of the world's trade in manufactured goods owing to the low rate of the mark. Not only has she returned to her former overseas markets, but she has opened up new ones; she has largely reconstructed her mercantile marine by means of paper marks, and the ships can earn freights paid in gold; the low mark has saved her from the burden of unemployment, and it has enabled her manufacturers and exporters to re-establish foreign balances, because they were able to sell their goods and thus obtain foreign currency and supplies of raw materials.

Large Capital Issues.

During the past year the amount of capital issued by new and existing companies reached the large total of 25 907·36 milliard marks, against 8 803·77 milliard marks in 1920, so that apparently there was no shortage of capital for new enterprises or for the expansion of old businesses. A large portion of the increases in capital was required to meet the higher expenditure caused by the inflation, but it would seem that the country cannot have been unduly burdened with taxation when such a large sum was found for industrial and commercial undertakings. Incidentally, it may be noted that the electrical industry and gasworks, the metal and machine trades and foodstuffs absorbed the largest amounts of fresh capital.

Fuel Situation Improved.

The coal and fuel situation has greatly improved. The science of fuel improvement is being energetically pursued by research into the chemical components of coal and lignite, particularly for the extraction of oils, and by the utilisation of the utmost calorific value by new firing methods, especially for lignite. It is stated that the result will be a great reduction of Germany's dependence on coal and oil imports. Another important factor in the situation is the great development of electric power, first by the erection of generating stations on lignite mines where the coal is fed straight from the mine into the boilers, and secondly by the development of water power. The vast schemes for the erection of hydro-electric stations will probably take a decade to complete, but each year should see substantial progress and easier fuel conditions for the country. British engineers will watch this activity with sympathetic interest, for the results obtained may have valuable lessons for the supply industry of this country. At all events, it would appear as if some of the difficulties created by the war would be turned to the economic advantage rather than to the detriment of Germany, and the ultimate result will probably be greater industrial capacity and cheaper production.

Rhenish Electricity Tariffs.

One of the appendices to the Report contains an interesting table of tariffs for large power consumers of the Rheinisch-WestphalischeElektricitätswerke, which shows that manufacturers enjoy the great advantage of a very cheap supply. The basic price for low voltage supply ranges from 14 pfg. per kWh for 700 units or under per month to 8·5 pfg. for 8 000 units; the high tension supply tariff ranges from 11·5 pfg. per kWh for 1 000 units to 6 pfg. for 50 000 units a month, but rebates are granted on these rates ranging from 7½ per cent. for 750 to 1 000 working hours per year to 25 per cent. for 2 750 hours. The basic prices are varied according to the price of coal. For high tension supply the increase amounts to 0·3 pfg. per kWh per 10 tons for each increase in the price of 10 tons of coal over 160 marks per 10 tons, Nut Coal III or IV at Coal Syndicate price and delivered power house being taken as the basis. No rebates are allowed on these increases. It is clear that there are few parts of the world where such a cheap supply of electricity is available and this will no doubt assist German manufacturers in keeping down costs and in competing with other industrial countries in foreign markets.

The Position of Foreign Trade.

A large portion of the Report is devoted to an examination of Germany's imports and exports, though, owing to the incompleteness of the figures, and to the fact that values are given in paper marks, no reliable conclusions can be drawn. However, it is clear that substantial progress was made, though it is to be noted that an export of about 20·6 million metric tons in 1921 brought a smaller return than 19·8 million tons in 1920, when the mark was much higher. There was also an excess of exports over imports of 848 000 000 marks, but the total quantity of exports was only 27 per cent. of the figure for 1913. The value of British exports to Germany was £40 700 000 (against £51 100 000 in 1920), and the imports from Germany only £20 550 000 (against £30 300 000). The exchange is taken at 405·33 marks to the £ in 1921 and 215 marks in 1920. The quantities would have been a more reliable guide than the values, but it is stated that Great Britain furnished 13·8 per cent. of German imports in 1921, compared with 11·5 in 1913; and absorbed 8·3 per cent. of Germany's exports, against 16·2 per cent. in 1913.

Germany's Large Imports.

During the year Germany imported large quantities of cotton and copper from the United States, and her exports to America were only about one-fifth in value of her imports. In regard to Canada also the situation is somewhat similar, Canadian exports to Germany being more than twice the value of those of 1914, her imports from Germany being only about one-seventh of pre-war figures. On the other hand, Germany's trade with Italy, Holland, some of the Baltic and Balkan States, China, Japan and the Dutch East Indies is greater than in pre-war times, and there is a steady expansion in business with Sweden, India, Egypt, Spain, South America and elsewhere. Altogether we cannot help feeling admiration for the manner in which the Germans seem to have surmounted most of their difficulties. Energy, skill and experience have been expended in repairing their losses, and a large measure of success seems to have attended their efforts. Plant and factory equipment have been largely renewed out of reserve funds, thus placing them in a better position to compete in the world's markets.

Iron and Steel Trades.

Mr. C. J. KAVANAGH'S contribution on the iron and steel and allied trades makes interesting reading; but a good deal of what he states concerning Germany's losses of iron ore and coal through the Peace Treaty is now ancient history, and many of his figures can only be rough approximations. It appears that the Saar producers of iron and steel now find themselves unable to compete with the Rhineland producers owing to the payment of wages, coal and transport in French currency, and the Lorraine ore fields and blast furnaces are also suffering from acute depression for similar reasons. The German industry was helped by the inflation of the currency, the absence of large stocks of raw materials, cheap fuel, power and labour, and by internal reconstruction schemes. The coal strike in England also deflected many orders to Germany, and the result was that business was good and employment brisk, especially since the great depreciation of the mark set in. This general condition of affairs is not, however, healthy; and the plenitude of orders has enabled exporters to adopt the procedure of invoicing in foreign currency. The movement towards the consolidation of interests and the fusion of companies has continued, and the Report gives an interesting review of the most important groups, together with tables of prices, outputs and wages.

Labour and Wages.

Notwithstanding adverse conditions, the attitude of Labour towards production has so far been most exemplary, and to this must be attributed the steady progress made in the past year. The German workman seems to have a higher sense of discipline and is more easily controlled than other workers. The disputes which arose were readily settled; the extreme element seems to be smaller and to have less influence than in other countries, the result being that the output per man is now said to be almost equal to that attained before the war. During the first half of the year there was a gradual upward tendency in wages, owing to the increase in the cost of living, and the latest reports show that there has been a further sharp rise in the price of foodstuffs, with a rapid slump in the purchasing value of the mark. These factors will have a most important influence upon the future attitude of the workers; and as prices are likely to rise still further, Germany may not much longer enjoy that comparative industrial peace which has helped her during the year. Generally speaking, the working hours are longer than in this country; and as the result of the collapse of the strike of the South German metalworkers, ten hours a day are to be worked in future. There is a similar tendency in other trades, owing to the pressure of economic conditions, and this will undoubtedly react unfavourably upon the trade and commerce of other countries, but especially upon the export of goods.

As Germany is not yet in the League of Nations, there is no direct means of controlling the length of the working day in that country, but we venture to suggest to the leaders of Labour in this and other countries that it is most desirable to find means of eliminating the extreme competition of German workers who put in ten, twelve or more hours a day. The question of the length of the German working day and the stabilisation of the mark are two urgent problems upon which employers and workers in this country might profitably co-operate in finding solutions, for it is upon the right treatment of these that the future of both as well as the prosperity of the country depend.

Wireless Telegraphy in the Mercantile Marine.

By F. J. CHAMBERS. M.Inst. Radio E.

At the date of the Armistice the wireless arrangements in the British Merchant Service were abnormal in relation to what was requisite for ordinary commercial requirements. Under the Defence of the Realm Act, all vessels of any size, even coasting vessels, were called upon to carry installations, and sufficient operators to maintain a constant watch, day and night. There was actually only one company in a position to equip merchant steamers, and ship owners were obliged to make the best bargain possible under the circumstances. The standard arrangement was a contract for hire, maintenance, and the supply of operators, covering a term of ten years from the date of installation.

Meanwhile, the famous master patent, by virtue of which, assisted by Government Regulations, an effective monopoly had been achieved, had completed its term. Two new companies were registered for the supply of wireless apparatus, and a third company revived their wireless department, and re-entered the market.

A Monopoly Undesirable.

There was at this time a growing feeling amongst ship owners that a monopoly was not desirable, more especially in view of the fact that it was obligatory to carry the apparatus. It may be said that the first evidence of this was the decision taken by the Cunard Steamship Company to make trials of the other apparatus offered in order to ascertain what alternative service could be obtained. Two sister ships were selected, and the masts slightly heightened so as to represent the conditions obtaining in the average cargo steamer. A 1½ kW quenched spark set was installed on board one steamer, with a crystal receiver which could be used alone, or in conjunction with a three-valve "note amplifier." In the other vessel a 1½ kW, high-note frequency "rotary spark" transmitter was installed, with a single valve receiver which could be used in combination with a two-valve "note amplifier." Through the good offices of the Post Office authorities, arrangements were made by which the station at Valentia, on the south-west coast of Ireland, assisted in the trials. On account of these being carried out upon different occasions by the individual ships, night comparisons were considered misleading, and the actual tests were strictly confined to the periods between one hour after sunrise at the westerly station, and one hour before sunset at the easterly. Test messages were transmitted at frequent intervals as the vessels approached the point where communication was just possible. It was the best means of comparison which could be devised for vessels on their ordinary trade voyages.

Results of Official Tests.

The actual results are given in the following table :—

Main Sets	1½ kW quenched spark transmitter, crystal detector, 3-valve amplifier	1½ kW rotary spark transmitter, valve detector, 2-valve amplifier
Maximum range without amplifiers ..	358 nautical m. (on reduced power)	355 nautical m. (on full power)
Maximum range with full amplification..	553 nautical m.	584 nautical m.
Emergency Sets ..	Hammer break induction coil, quenched spark, crystal detector	Wilson induction coil, plain spark, valve detector
Maximum range with Valentia, no amplification	169 nautical m.	234½ nautical m.

The above distances were calculated as arcs of great circles. Night ranges would be approximately double the above figures.

Comparisons of the Apparatus.

It will be seen that the crystal receiver set gave as good results as the single valve arrangement. The superiority of the latter used in conjunction with a note amplifier was pronounced, and may be partly due to an advantage in applying the more prolonged impulses permitted by the grid leak method of rectification.

Measurements of the respective aerial currents with a specially calibrated Fleming high-frequency thermo-ammeter indicated a ratio of the order of 11 to 7, for equivalent d.c. input, in favour of the quenched spark set, both aerials being identical in height and form. The trials were therefore considered inconclusive as regards the relative transmitting ranges of the two stations. The obvious indication was that less "quenched spark" transmitting power could be installed for the same results ; accordingly, a ½ kW set was substituted for the 1½ kW transmitter, and the amplifier retained. Subsequent observations over a prolonged period showed that the substitution was quite justified. Similar experience of the same character was obtained on board s.s. "Kaiserin Auguste Victoria," fitted with a modern amplifier receiver, and a ½ kW quenched spark transmitter. This vessel, which handled heavy traffic, showed that she was able to hold her own with steamers employing higher powered transmitting apparatus, and similar receivers.

The Need for Amplifiers.

It therefore became apparent, very early, that "cargo boat" service with modern coast stations could be maintained, under practical conditions, with less costly apparatus, provided amplifiers were employed. But the case of large and fast Atlantic liners had to be specially considered. The volume of traffic to be handled is considerable ; the atmospheric conditions extremely bad at the time of year when traffic is heaviest ; and the jambing and congestion very serious matters. An important step towards improving this class of traffic was taken by the Marconi Company C.W. valve plant of 3 kW. was added to the installations on board the principal liners. This resulted in an immediate relief of traffic congestion. The daylight transmitting range was very considerably increased, and, by the adoption of a special wavelength, additional terminal coast stations could be operated independently of spark traffic.

Overcoming Atmospherics.

Atmospheric troubles proved much more severe on the longer wave adopted, and it soon became clear that, if a direct telegraph service in the true sense was desired, the only solution lay in using higher transmitting power.

Accordingly, the s.s. "Caronia" was equipped with a 10 kW "Elwell-Poulsen" arc, in addition to the usual 1½ kW spark set. As it was the first occasion when a large arc of the kind was called into service on board a British vessel, the first experience was valuable. Early trials indicated that there was room for improvement, more especially in connection with the means for providing the "atmosphere," and in eliminating the spacing wave. The objection to the latter was principally the jambing caused in oscillating the arc after a period of rest, which involved a certain amount of interference with other traffic. These troubles were surmounted by introducing a special form of alcohol vapouriser, which was kept operating by a current in a heating element during the intermittent periods when the arc was not required ; and by the adoption of a certain form of back shunt circuit which involved no breaking of the aerial continuity, and consequently an absence of keying troubles. After these improvements had been introduced it was found that the installation was capable of very superior service, and direct communication with the shore stations was assured under all conditions normal to the requirements of the passengers.

Introduction of Rival Systems.

The success attending the above trials encouraged ship owners generally to instal rival systems, and there is at the present time a large and increasing number of British steamers equipped with these.

Different Commercial Methods.

Until recently, it was practically the universal custom for shipowners to hire the apparatus and make arrangements for its maintenance, and for the supply of trained operators, with the Wireless Company. An alternative system, advocated more particularly by one company, is to sell the apparatus outright, and enter into arrangements for maintenance and for supplying operators who become, temporarily at any rate, the directly-employed servants of the shipping company. As to the relative merits of the respective systems, it is still a little early to judge. But an organisation set up by any company contracting for a large number of vessels, under either system, is a strong instrument against a newcomer. It is a comparatively long and costly business to build up a service for ship owners, and, unless well supported in the initial stages, a new concern has uphill work. For this, and other reasons, it is difficult to understand why British ship owners do not make arrangements to perform the maintenance and operating services for themselves. Their collective organisation abroad is enormous, and could easily be adapted to the requirements. The advantages gained would be that any suitable manufacturer would be encouraged to enter what would then be a really open market, and shipowners would then be able to do as they chose in wireless matters. In several foreign countries it has already been recognised that the first necessity is as the writer indicates, and it should be a comparatively easy matter to co-operate with foreign organisations which are proceeding along the same lines.

The Effect of a Strike.

Shortly after the Cunard trials a strike by wireless operators, resulting in an increase of wages, gave rise to negotiations between the shipowners and the wireless companies. These were protracted, but an arrangement was arrived at eventually by which the two principal parties accepted a new form of contract. Shipowners had the option of proceeding under their old arrangements, or signing the new form. In effect, the latter gave the shipowner the right to purchase his installation, at stated times, at a price which allowed for depreciation from the date of installation. After five years from the latter date the shipowner had power to terminate at six months' notice, provided he paid compensation at agreed rates for the second period of five years, making up the original ten-year term. Further details of the arrangements were published at the time. The arrangement is equitable as regards compensation, and throws the market open to competition without undue hardship to the original contractor. A competing company must, however, frame their proposals to be still more attractive, having regard to the fact that the shipowner must take the compensation scale into consideration. The onus of the arrangement falls very much upon the new contractor. In spite of this, there is a good deal of business done, though one would perhaps prefer to see this more fairly distributed in the interests of healthy competition.

Patents and Monopolies.

The present virtual monopoly has been legitimately built up during the enjoyment of the rights conferred. It has been further supported by the work of inventors in many countries. The two words patent and monopoly are synonymous, and invention is probably a greater force in the wireless than in any other branch of industry. So long as shipping, which is the main section of the industry, remains in the hands of any one organisation, there will be comparatively little return for capital invested in the development of wireless inventions, except from the smaller markets. The inventor, whether he be here or abroad, will therefore be practically compelled to make the best bargain possible with the representative of the controlling organisation in his own country. There lies the true secret of the monopoly, and until concerted, world-wide action is taken by the parties interested in the open market, conditions will remain very much as they are. On the other hand, if there were another epoch-making development of the same importance, say, as the thermionic valve, and every manufacturer were able to exploit the invention on fixed terms, the industry would receive an unparallelled stimulus. Were such an invention to come into the hands of a " ring," it would involve a great setback to others. Two important reasons for the revival of competition in this country have been the facts that the tuned coupled circuit patent has expired and the lapse of the de Forest basic valve patent. Had either of these two master patents merely changed hands, the industry as a whole would have been no better off. The remedy for monopoly is no monopoly : a free market.

An International Wireless League.

Experience of recent years shows the vital importance of consolidating wireless interests in the principal countries. It would appear to the writer that the needs of the industry call for an " International Wireless League " ; that is an organisation which could be supported by commercial concerns, patentees, physicists, engineers, and all parties who are interested in the maintenance of the open market, and the unfettered advancement of the art. Members of the League should undertake to carry out repairs at special rates, and generally assist through their organisations, visiting foreign vessels operated by other members. Should an operator fail, through sickness or other cause, to present himself for duty abroad, an appeal could be made to a local member or representative of the League, who would arrange to meet the situation, and avoid the risk of the steamer being held up by the authorities. With regard to patents, it would be necessary, individually, to accept a principle for the good of the industry as a whole. A suggestion is that members of the League should have the option of retaining their exclusive rights in the country where they are located but should undertake to grant licenses for the exploitation of their foreign patents to any member of the League, on terms fixed by disinterested arbitration. The local branch of the League in each country might undertake to bear the cost of obtaining and maintaining certain approved patents, which, with an administration charge, could be debited to the licensees. The functions of the League could be extended, and the scheme would tend to succeed if carried out in the spirit of mutual co-operation. Fortunately, the latter should be encouraged by the evidence on record showing that the small concern, struggling alone, has generally been ousted from the shipping business in the long run, or has fallen into the hands of the " ring " organisation.

Electricity Supply in Belgium.

The demand for electricity supply in BELGIUM continues to increase, and many schemes of extension and development are projected. The Societé de l'Electricité de l'Escant, which supplies in Antwerp, has made a ten years' agreement for the supply of light and power to the docks in the northern part of the city, and arrangements are being made for extending the supply cables along the Scheldt-Meuse canal to Turnhout. A 7 000 kW generating set was recently installed by the company, and a 10 000 kW unit is being erected. Out of 152 communes in the ANTWERP province, only 62 have an electricity service, but efforts are being made to devise a scheme to cover the entire province.

The Société des Centrales Electriques des Flandres, which supplies a number of communes, and has 13 600 consumers, is negotiating with the Provincial Government for the extension of its service to a number of villages in East Flanders, and with the State Government for the supply of 2 000 kW for the radio station at Ruysselede.

A committee of three engineers is examining the merits of two schemes for the supply of electricity throughout the province of LIMBOURG. A private company's proposals have been rejected, and it is probable that the Provincial Government will undertake the supply of electricity in bulk to the whole of the communes, and erect and maintain the high tension transmission lines, leaving the work of distribution to the local communes. Already about 40 miles of overhead transmission line have been erected, over 40 miles of line are being constructed, leaving about 110 miles to complete the scheme which will entail a total expenditure of nearly five million francs.

The Radio-Telephone Broadcasting Boom.

By Prof. G. W. O. HOWE, D.Sc.

The boom that is taking place at present in the reception of radio-telephonic messages and concerts cannot but interest, and, to some degree amuse, the radio engineer; to a much greater extent it should interest the advertising agent, the manufacturer of wireless equipment, and the student of psychology. The public is periodically swept by some novelty or by the resurrection of some old and well-known form of amusement. Within recent years we have had ping-pong, roller-skating, standard bread, rag-time music, and many others. In some cases the origin of the craze is difficult to trace, but for the most part they provide eloquent sermons on the text "Sweet are the uses of advertisement." In the present case our daily papers have responded well with a regular display of catchy headlines, intriguing descriptions of the delights which await the purchaser of a receiving set, and even photographs of celebrities listening to wireless concerts.

An Eastward Course.

As in so many similar cases, the boom appears to have travelled here from the United States. Owing partly to the eagerness with which any scientific novelty is taken up in the States, partly to the greater publicity given there to all such matters, but mainly, no doubt, to the almost entire absence of Governmental restriction, amateur wireless is much more widely practised there than here. It was apparently a simple matter for any college or school or even private person to fit up a transmitting station and "blaze away" to some distant receiving station. In this country, on the other hand, and in Europe generally, the authorities have kept a much firmer hand on the situation, and only gave transmitting licenses in exceptional cases. To judge from the recently issued report of the Radio-Telephonic Committee of the American Department of Commerce, it is proposed to control more rigorously the issue of licences and the allocation of wave-lengths in the United States. It is stated that about 19 000 transmitting licenses have been granted, and that about 16 000 of these are amateur.

The Original Amateur.

Even before the war there were scattered about this country a large number of amateurs who had aerials and receiving equipment and took the time signals and weather reports from Paris and Norddeich and whatever other signals they were fortunate enough to pick up. Generally speaking, these amateurs were interested in wireless telegraphy itself and not in the weather reports and other messages received. They were content to experiment with various coils and couplings and various types of detectors, and to increase the facility with which they could take down the Morse Code signals. Since the armistice, however, a great development has taken place; the thermionic tube, with its manifold applications, has opened up undreamed of possibilities. The amateur can now receive transoceanic signals with ease and make them audible to a large audience.

A New Sense.

The crowning factor, however, has been the greatly increased probability of picking up not only Morse signals, which are, after all, very impersonal and unsympathetic, especially when conveying a message in some unknown cipher, but also spoken messages and vocal and instrumental music. Even if one has no great interest in the wireless weather or market reports, and if the music, when received, may not be very much superior to that obtainable at any hour of the day or night from a good gramophone, it seems incredible that any thinking being can know that electromagnetic waves are sweeping continually through the room in which he is sitting, carrying music and speech of which he is absolutely unconscious, without wishing to provide himself with what is virtually a new sense, enabling him to understand and appreciate the messages being carried on these invisible and scarcely-to-be-credited waves. Many people will be moved by such feelings as these to purchase a receiving set.

An Increased Sense Range.

Our senses of sight and sound are operated by means of waves; the eye is, however, only sensitive to about one octave, the ratio of the wave-lengths of red and violet being roughly two to one; the ear has a much wider range, extending to ten octaves or more. The range of wave-lengths now actually employed in radio-telegraphy is greater still and, in view of the short wave tests recently described by Mr. Franklin, can be put at about fifteen octaves. Signals are passing us continually, a large number simultaneously, any one of which we may hear by suitable adjustment of this new sense, which can be purchased for a few pounds. So long as the signals when received were unintelligible sounds, one could well ignore them, but now that they may convey songs or instrumental music or news of any kind, one may be excused for showing some curiosity to "listen-in."

Progress in America.

In America it has been suggested to use radio-telephony for broadcasting market and weather reports from a number of centres to the farmers within a given radius. In Germany, where the energies which would otherwise have been employed in developing an Imperial Chain have been concentrated on an intensive development of the internal radio network, experiments have already been made with a view to distributing information of general interest from a central station to a number of receiving stations scattered throughout the country. So far as one can judge from announcements in Parliament and in the Press, the main functions of the broadcasting stations to be licensed by the Postmaster-General are to interest and amuse the public; that is, they are for pleasure rather than business. Mr. Kellaway suggested that it might be possible to enable constituents to listen to their member's eloquence in the House. We hardly know whether to sympathise with the member or with his constituents at this alarming prospect. We are pleased to see that the matter to be broadcasted is to be strictly controlled. We were rather afraid that financial considerations would entail the listener, in the interval between two musical items, in being urged in stentorian tones to try somebody's pills.

Four Categories of Service.

The American Committee divide broadcasting services into four categories, which, in the order of importance, are as follows:—Government, Public, Private and Toll. The first is that carried out by Government departments; the second that by public institutions, universities and licensed disseminators of information and educational service; the third is that by private companies licensed to send out news and entertainment; the toll service applies to those cases in which a charge is made for the use of the transmitting station.

Even the American Committee recommend the prohibition of direct advertising and the company doing the broadcasting are limited to a statement of the name of the company. A very interesting point is the recommendation that, in view of the public demand for broadcasting, wireless telephony be not used for point to point communication, where it can be effected by other means.

Good for the Electrical Industry.

One very satisfactory aspect of the boom is that at least one branch of the electrical industry is very fully occupied, and those firms who were far-seeing enough to anticipate—or should we say cultivate?—this feverish demand for receiving sets should be reaping their reward.

The wave-lengths between 350 and 425 metres are to be allocated to the broadcasting stations, but the actual wave-

lengths of the individual stations will have to be carefully chosen, so that a receiver which is equidistant from three or four transmitting stations will be able to hear one without interference from the others. This can be accomplished by giving adjacent stations wave-lengths at the opposite extremes of the range, whilst widely separated stations, such as London and Aberdeen, may have wave-lengths differing but little.

The American Committee recommend the allocation of 150 to 275 m. to amateurs, 100 to 150 m. and 285 to 485 m. for private and toll broadcasting, 275 to 285, 484 to 495, 700 to 850, 1 050 to 1 500 and 1 850 to 2 050 m. to Government and Public Services.

Radiation from Receiving Aerials.

A difficulty that will need serious consideration is that of the radiation from the receiving aerials due to the heterodyne method of reception; although weak, this may be sufficient to cause trouble in neighbouring receivers. We note that 440 m. has been allocated as an amateur transmitting wave-length. This may prove troublesome to a receiver listening to a concert on 425 m.

A useful suggestion has been made in a recent issue of the *Wireless World and Radio Review* that a distinction should be made between those who merely wish to buy a more or less standardised receiving apparatus for listening to the broadcasting service and nothing more, and those who wish to carry out experiments and modify their apparatus from day to day. The former cannot conceivably cause any interference, and it is not difficult to understand that such a person may conceivably wonder why he should have to pay ten shillings for a licence permitting him to sit in his own house and listen to the messages being conveyed, whether he wish it or not, through the ether around him.

It is interesting to note that this new development of radio-telephony depends for its success upon what was considered its greatest defect, viz., its lack of directiveness and secrecy. Broadcasting requires approximate uniformity of radiation in every direction and ease of reception.

We conclude with the words of the Postmaster-General, "the possibilities of this service are almost unlimited."

The High Frequency Resistance of Inductance Coils.

A Scientific Paper recently issued by the Bureau of Standards contains an interesting contribution by Mr. Gregory Breit on the high frequency resistance of inductance coils. At low frequencies there is little difficulty in discovering the resistance of a coil. But at high frequencies complexities are introduced by the skin effect and by the influence of capacity. The skin effect has in general only a minor influence, but the effect of capacity, as shown by the author, is of more moment. The capacity leads to a collection of charges and a non-uniform distribution of current in the coil. Hence a special definition of resistance is needed. The definition adopted by the author is such that I^2R is the power lost in the coil where I and R are measured at the point where the E.M.F. is applied. The correctness of the formulæ derived are borne out by experiments.

Another study by the same author relates to the field radiated by two horizontal coils such as have been used in an antenna for directing radio waves upwards and assisting an aeroplane to land at times when visibility is poor. It was believed that the waves would radiate in the form of an inverted cone above the antenna, and experiment has shown this to be broadly true. The nature of the field radiated has been calculated and the currents received by a coil aerial or open antenna determined. In particular the portions of space where the signal can be heard have been studied. It is of interest to note that the signal was a maximum at an angle of 30 degrees with the vertical, for a vertical receiving coil.

On the Earth Resistance of Antennæ.*

By A. MEISSNER.

For quite a long time one of the most important problems in wireless telegraphy has been the question as to how a transmitter for high powers should be constructed. In 1911 the position was one of complete uncertainty. In England L-antennæ 1 000 to 2 000 metres in length and 50 m. in height were being built, and to these fabulous directive properties were ascribed. The Telefunken Co., on the other hand, declared in the main for the umbrella antenna, while others, again, wished to use only earth antennæ.

Experiments on Antennæ Types.

In order to provide a basis for the design of the then projected high-power German colonial stations it was therefore decided by the Telefunken Co. to carry out a long series of experiments on antennæ. These were to comprise: Predetermination of their capacity, natural vibration period and damping; effect of insulation of the metal parts from the mast and its supports; and, finally, investigation of the radiation relations. The first experiments at Nauen were supplemented by a longer series between Nauen and Jena, and the guiding lines as to design thereby established, which since then have been generally applied in the calculation of antennæ, were in the main as follows:—

1. The relation, that the radiation resistance is proportional to h^2/l^2, is true for all types of antennæ (where h=height, λ=wave-length).

2. The shape of the antenna is, for equal medium heights, immaterial over a wide range; only an L antenna is less favourable owing to the large losses in the earth with this construction.

3. The directional effect of an L antenna is practically negligible when the horizontal extension exceeds 20 per cent.

The question of how the earth resistance could be reduced remained at that time unanswered.

Efficiency and Earth Resistance.

Now this very question became of burning importance, since the efficiency of the entire antenna installation depends mainly on the earth resistance, especially in large plants. So far as the generation of electric oscillations itself is concerned, efficiencies of 70 to 80 per cent. have been obtained during the last few years. On the other hand, the effectiveness of the antenna installation has deteriorated owing to the tendency to adopt longer and longer waves, for the purpose of diminishing the absorption and the liability to interference. For even if the highest practicable masts were used, a radiation resistance of 0·1 to 0·3 O only would be obtainable with wave-lengths of 12 000 to 20 000 m.; the earth resistance, on the other hand, with these long waves would be 1·5 to 5 O. This means an efficiency of the antenna installation of only 5 to 15 per cent. It is thus evident that the whole problem of the efficiency of antennæ having large horizontal expansion can be solved by reduction of the earth resistance.

There are several ways of attaining this result. One way is to increase the antenna capacity. This expedient, however, is of restricted application in that, even under the most favourable circumstances, the resistance cannot be brought down below 2 to 2·5 O; further, in the case of unsymmetrical antennæ, the resistance actually rises as the capacity is increased.

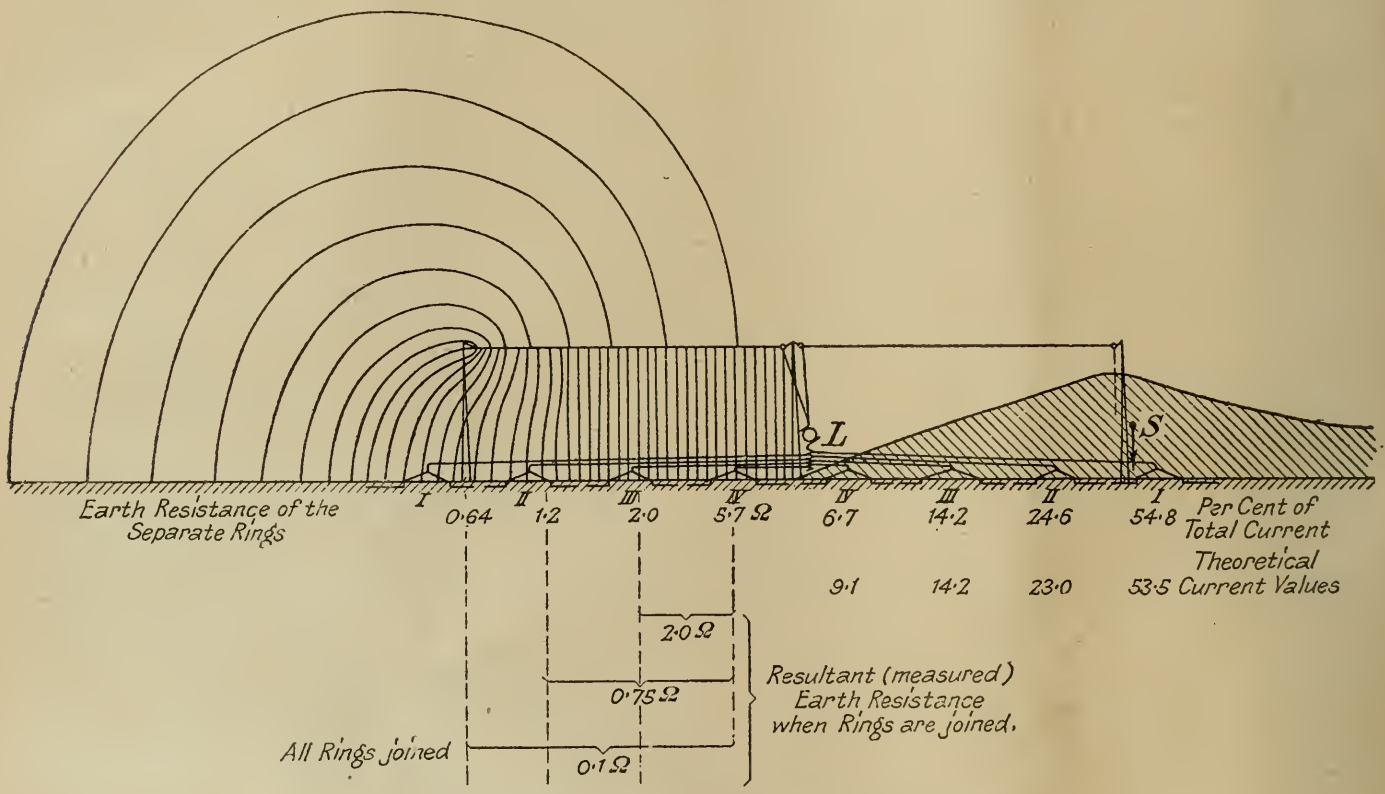
The Use of the Counterpoise.

Another way to reduce the earth resistance is to employ a counterpoise. At the Karlberg station a very large counterpoise system, utilising in its construction some 400 km. of 1 mm. copper wire, was used; in this case the earth resistance was less than 0·1 O, so that for the first time there was attained, in this way, the ideally low value desirable for a high-power station. This low value, however, is obtained at great cost, and if the same counterpoise system were to be employed at a modern really high-power station an area of 5 to 6 sq. km. would be required.

Owing to the prohibitive cost of the counterpoise construction the Telefunken Co. was forced to return to earthed installations. After long-continued experiments an arrangement was evolved by means of which similar low earth resistances can be obtained as with the large Rendahl counterpoise. The principle employed consists in taking the current

* Abstract of an article in the *Jahrbuch der Drahtlosen Telegraphie*.

from the earth's surface always at the spot, so far as possible, where the lines of force proceeding from the antenna enter the earth. In this way lengthy current paths and equalising currents in the earth are obviated—that is, the current from the transmitter is so distributed among the separate earthing places that each earth wire only receives just so much current as corresponds to the current generated by the antenna's lines of force (induced current) in the locality. If the whole surface of the ground cannot be covered with earthing conductors, the earth should preferably be placed where the greatest percentage of such induced current enters the ground. It is precisely this point which has hitherto been missed. Actually, in the case of a high-power antenna of radius 500 m. and height 200 m., the chief part of the antenna capacity, and hence the chief part of the antenna's lines of force entering the ground, lies outside the projected edges of the antenna, far from the centre of the antenna. If, therefore, the current at the mid point of the antenna is taken straight to earth, the whole of the current which enters the earth beyond the projection of the antenna



CURRENT DISTRIBUTION IN MODEL EARTHED ANTENNA.

(which means more than one-half of the whole antenna current) will have to traverse the whole length dimension of the antenna through the badly conducting earth.

Current Distribution.

The figure shows the current distribution in the case of a model actually constructed on scale of 1 : 20. The antenna was of pentagonal form with a radius of 25 m. The height was 10 m. above the ground, and the capacity 2 065 cm. Under the whole antenna and extending beyond the projection of the antenna, earths were arranged in four concentric rings, each being in the form of a star. In the first ring, counting from the outside, were 28 earthing stars ; in the second, 25 ; in the third, 15 ; and in the fourth, 5. From the first ring 18 conductors were taken to the centre ; from the second, 13 ; from the third, 8 ; and from the fourth, 2. The conductors were fastened to the central mast at about 3 m. above the ground. The earths were arranged in a ring, as mentioned, and by connecting them to the coil L—that is, by switching in more or less self-inductance in the earthing conductors—the current distribution in the separate rings could be altered at will. On so arranging the amount of self-inductance that the system had the smallest resistance, the total current was distributed over the separate rings in the proportions shown on the right-hand side of the figure. The outermost ring, it is seen, carries more than 50 per cent. of the total current. The theoretical current distribution calculated from the line-of-force diagram is indicated on the second line on the right-hand side of the figure.

Resistances of Various Arrangements.

On the left-hand side of the figure are given the measured earth resistances when the separate rings were used ; the second and third lines give the resistance when several rings are combined ; the fourth, the resistance when all the rings are connected together. It will be noticed that, when working with ring 4 only—that is, with one earth, which corresponds to, or is better than, the normal earthing arrangements hitherto used—a resistance of 5·7 Ω is obtained, a value such as is usually found for an earthed antenna of this size. When working with ring 1 only the resistance falls to 0·64 Ω. By joining all the rings a resistance of less than $\frac{1}{10}$ Ω is obtained. This resistance was measured for waves down to 400 m. in length ; above 1 200 m. it increases somewhat, and at 1 835 it reached <0·4 Ω. It can be seen from these measurements that the central portion of the antenna and earths is practically of no importance and could be omitted, were it not important for the purpose of conducting the current towards the outer edge.

It is intended to use the above-described earthing arrangement for the contemplated extension of the Nauen station. Since the antenna will in this case have a height of 190 to 200 m., the radiation resistance at a wave-length of 12 600 m. will be 0·3 to 0·33, and the coil and antenna wire resistance can be brought down to 0·3 Ω ; the total resistance of the antenna is hence 0·6 to 0·7 Ω. The efficiency of the new installation will then be approximately 50 per cent., as against 7.5 per cent. at the present time.

Metropolitan-Vickers' Edinburgh Showroom.

Splendid new showrooms have just been opened by METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., in Edinburgh. This is in pursuance of their plan to establish trade showrooms in the leading towns where contractors and the trade generally will find all facilities for inspecting the latest designs in domestic lighting, heating, and cooking apparatus, and of obtaining all information with regard to power installations. The showrooms are at 127, GEORGE STREET, and are therefore very central. "Cosmos" lamps and fires are attractively displayed, and a wide selection of electric kettles, jugs, hotplates, cookers, grillers, toasters, domestic irons, urns, etc., may also be seen. An extensive range of accessories is also exhibited, including the Cosmos new type connector, the "M-V" super switch plug, "Harcourt" electric fittings, &c.

Some Notes on Dalmarnock Power Station.*

By R. B. MITCHELL.

As a detailed description of the plant (see THE ELECTRICIAN, Vol. LXXXV, pp. 303, Sept. 10th, 1920) at Dalmarnock has already been published, it is advisable in this short address to deal only with some special features of the station and with some of the results which have been obtained from its working. This will be illustrated by extracts from the working figures for the whole station, test results of individual parts of the plant, and by notes on the equipment which has been provided for the oversight of the most important quantities.

Boiler Plant.

It is recognised that the boiler house provides the greatest scope for obtaining economies, and so far as the original lay-out of the station permits, everything possible has been done at Dalmarnock to help to attain high efficiency.

The following figures will indicate the results which are being obtained at present. These figures are abstracted from the working logs of No. 1 Boiler House; no attempt has been made to select a specially favourable example.

DATA AND HEAT BALANCE OF NO. 1 BOILER HOUSE.
(*4 to 7 Units in operation.*)

Average Boiler Pressure	274 lb. sq. in. gauge
Average Total Steam Temperature	700° F.
Average Temperature Feed Water, Economiser Inlet	141° F.
Average Temperature Feed Water, Economiser Outlet	274° F.
Average Temperature Flue Gases, Economiser Inlet	630° F.
Average Temperature Flue Gases, Economiser Outlet	400° F.
Average Percentage CO_2	10 per cent.
Calorific Value of Coal	10 800 B.Th.U.
Air Temperature	70° F.
Draught Over Fires (in. H_2O)	0·3 in.
Draught at Damper (in. H_2O)	1·5 in.
Draught at Fan (Ind.) (in. H_2O)	2·5 in.
Total Coal Consumed	953 580 lb.
	425·7 tons
Ashes	45·33 tons
Ashes per cent. of fuel consumed	10·65 per cent.
Total Water Evaporated	6 264 960 lb.
Condensate	6 024 000 lb.
Make up water	240 960 lb.
Make up water per cent. of total	3·85 per cent.
Lb. of Water evaporated per lb. of coal	6·5 lb. (actual)
Power consumption of auxiliaries as percentage of fuel consumed	1·68 per cent.

From the information on the above table, the following heat balance is obtained :—

HEAT BALANCE, NO. 1 BOILER HOUSE, DALMARNOCK.

	B.T.U.	Per cent.
To Calorific Value of Coal	10 800	
To Power Consumption of Boiler-house auxiliaries		100
B.T.U. Equivalent, per lb.	181	
Total	10 981	100
To Heat Transfer in Boiler	6 253	56·94
To Heat Transfer in Superheater	1 014	9·23
To Heat Transfer in Economiser	864	7·86
To Heat Transfer in Combined Plant	8 131	74·03
To Loss in Flue Gas	1 644	14·98
To Loss in Radiation	549	5·00
To Loss in Ashes, Moisture and Unaccounted for	657	5·99
Total	10 981	100·00

It is evident from an inspection of these figures that the chief source of loss is in the heat escaping in the flue gases. Provided that space is available and that a sufficiently large heat transfer apparatus can be built for a moderate capital outlay, there seems to be nothing to prevent the use of these hot flue gases for pre-heating the furnace air supply, and the gain will be represented in a more efficient heat balance, and in a saving of coal per kilowatt-hour.

Lay-out and Economy.

The lay-out of Nos. 1 and 2 boiler houses does not, unfortunately, lend itself to the installation of an apparatus of the foregoing description. In Nos. 3 and 4 boiler houses, which have yet to be built, its possibilities will not be lost sight of. The installation of automatic coal weighing machines has made it possible to obtain accurate figures of the coal consumed during each shift, without any delay. It is then a simple matter to balance this figure against the station output for the same shift. By plotting the results on a chart, a "Willans" line is obtained which is recognised as a standard to which the station engineers must aspire.

Benefit of Daily Results.

At Dalmarnock these results are plotted daily and the records have been of great benefit. This method of record-keeping would not have been possible had it not been for the weighing machines weighing the fuel as it is burned. In many modern stations it has not been thought necessary to instal these machines, but without them or some equivalent, no quick or accurate method of obtaining efficiency figures over short periods is available. Under modern boiler house conditions, where the closest supervision of the burning of fuel is imperative, the author is of the opinion that money expended on these appliances is well spent. The guaranteed combined efficiency of boiler, superheater, and economiser, is 80 per cent.

It will be noticed from the foregoing table that the boiler house efficiency attained under normal working conditions is about 74 per cent. It is expected that under better circumstances this figure will be considerably improved.

Auxiliary Services.

The method or methods adopted for driving the auxiliary plant and of using the heat energy rejected, is next in importance, if not equal, to the economics of the boiler house. At Dalmarnock, this problem has been tackled in various ways; in fact, it may seem that too many complications have been introduced. These auxiliary arrangements have been very severely criticised in an American magazine, but the diversity of auxiliary plant gives experience and data which could hardly be determined other than by trial.

All the rotary auxiliaries are electrically driven from :—

1. (*a*) Two house turbo-generators each of 500 kW capacity exhausting into open-type heaters through which the condensate is pumped;
   (*b*) Two house transformers taking power direct from the 20 000 V bus bars.
   (*c*) Nos. 3, 4, and 5 sets have auxiliary low-tension windings on the step-up transformers.
2. Nos. 2, 3, 4, and 5 turbines have steam led at low-pressure to heaters through which the condensate may be passed. Nos. 2 and 3 have surface heaters integral with the turbine and Nos. 4 and 5 external open type heaters.
3. The steam ejectors on Nos. 1 and 5 turbines exhaust into open-type heaters, and the steam driven boiler feed pumps exhaust direct into the hot well tanks. Electrically driven boiler feed pumps are also installed.

It is too early yet to state definitely which system, or combination of systems, is the most economical to use, but it will be agreed, that the operating engineers have ample means at their disposal for investigating the relative merits of the different combinations. It is certain that the integral heaters introduced in Nos. 2 and 3 sets add in a marked degree to the overall efficiency of the units, and there is much to be said also for the regular use of the house turbines.

The Ideal to be Aimed At.

The ideal to be aimed at, however, is to have sufficient flexibility in the use of exhaust steam to be able at any time to use just the exact quantity required and no more. In the past, where steam driven auxiliaries have been used without alternative, the amount of exhaust steam produced has been far in excess of requirements. This, of course, depends on the size of unit installed, and the comparatively low ratio of auxiliary power to main unit power is one of the advantages of large units over small ones.

It has been said by a critic and it will be agreed that "valuable lessons may be learned from the results observed in the operation of the Dalmarnock Station, particularly in the matter of heat balance control and the auxiliary drive. The very complexity of the design makes for exceptional flexibility in operation, and affords a rare opportunity to test out the different combinations under actual operating conditions."

All auxiliary motors are of the induction type and their reliability has been extremely satisfactory. The economic

* Abstract of a paper read before the Summer Meeting of the Institution of Electrical Engineers.

aspect is by no means so clear, and investigations are being carried out to see whether too great a price is not being paid for the obvious advantage of simplicity of A.C. motors.

Testing and Control.

Every effort has been made to measure as accurately as possible all important quantities, and for this purpose each circuit in the station has been treated separately. The quantity of coal going to the furnaces is measured accurately by automatic weighing machines, as already stated, and is, in addition, indicated approximately on each furnace. The total quantity of air for combustion is indicated, and the temperature of the outgoing air is measured accurately, so that these quantities give the chimney losses at any instant. The degree of combustion is measured by indicating CO_2 meters, one of which is placed on each furnace. The pressure of air at various points in the furnace circuit is measured by draught gauges.

For the steam circuit, the usual equipment of pressure and temperature indicators for the live and exhaust steam, together with steam flow meters, provides an indication of the boiler output, which is almost as reliable and accurate as the electrical equipment for the output of the generators. This equipment provides the staff with means for practically continuous oversight of the boiler performance.

Continuous Records.

The performance of the turbo-alternator sets is also under continuous observation, the steam consumption being measured by a Lea Recorder in the condensate circuit, while the output of the machine is measured by accurate watt-hour meters. It is interesting to note that no difficulty has been experienced in obtaining consistent results well within 0·1 per cent. at the electrical end, although of course, the question of the absolute accuracy of the results is much more doubtful.

For accurate tests on the turbines, two steel test tanks, each of 28 000 lb. capacity have been installed permanently close to the turbine room, so that very accurate measurement of the steam consumption of any set can be made when required.

The whole testing equipment has proved extremely convenient in practice. The general idea underlying the arrangement of all testing equipment has been to take the pressure, flow, and resistance, as in an ordinary electrical circuit. To illustrate the performance of the various units in the station, tabulated tests are given. These include boiler, turbine, and auxiliary plant tests.

It is interesting to note how the various instruments have gradually gained the confidence of the operators. The steam flow meter, which was looked on in the early stages as a toy, is now considered to be absolutely essential, and the temperature measurements are now quite as reliable and accurate as the pressure measurements.

Operation of Plant.

Owing to the prevailing depression and to the lock-out in the engineering trades which has been in force recently, the station output during the past few months has been much below what was expected. Dalmarnock has been carrying the whole load of the system and operating at a load factor of about 0·34 per cent.

On an output for the last month for which figures are available, the generating costs were as follows :—

DALMARNOCK POWER STATION GENERATION COSTS.

Comparison Costs for the Month of April, 1922.

	Pence per Unit Delivered.		
Operation :	Average for year.	Preceding month.	April.
Coal	0·1825	0·1707	0·1752
Coal Handling	0·0063	0·0065	0·0060
Ash Handling	0·0080	0·0084	0·0082
Water	0·0009	0·0008	0·0009
Oil and Stores	0·0037	0·0044	0·0040
Shift Wages and Salaries	0·0172	0·0169	0·0202
Maintenance and Repairs :			
Building Wages	0·0045	0·0046	0·0057
Material	0·0008	0·0007	0·0007
Engine Room—Wages	0·0070	0·0070	0·0082
Material	0·0040	0·0054	0·0061
Boiler Room—Wages	0·0113	0·0114	0·0132
Material	0·0044	0·0043	0·0056
On cost Charges	0·0078	0·0080	0·0095
Totals	0·2584	0·2491	0·2635
Totals (less Coal)	0·0759	0·0784	0·0883

Units :	
Generated	10 764 200
Delivered	10 233 203
Coal Consumed :	
Tons	9 056
Lb. per unit delivered	1·98
B.Th.U. per unit delivered	20 679
Ashes Removed :	
Tons	1 210
Percentage to coal	13·36
Make-up Water :	
Gallons per unit delivered	0·046
Number of Men Employed :	
Shift—Salaries	20
Wages	58
Time—Main and Reps.	131
Maximum Load at Station	42 200
Load Factor on Station :	
Units Delivered / Maximum Load × Hours	33·68

The cost of coal per ton in that month was taken at 16s. 6d. This figure is gradually becoming lower, and under better conditions of output and load factor, it is certain that the total cost figures will be very much improved.

BOILER TEST AT DALMARNOCK.

(Test on Single Unit.)

Normal Working Conditions.

Rate of Steaming	55 000 lb/hour
	Per cent.
Heat Transfer in Boiler	59·4
Heat Transfer in Superheater	10·6
Heat Transfer in Economiser	9·75
Heat Transfer in Combined Plant	79·75
Losses in Flue Gas	15·0
Losses by radiation	4·0
Combustible in Ash unaccounted for	1·25
	100·0
Average kW Induced Draught Fan Motor	85·5
Duration of test	4 hours on induced draught

Test results obtained on a turbo-alternator set corrected to standard conditions for the station.

Steam pressure, 250 lb. per sq. in.; temperature, 650° F.; vacuum 29·1 in.:

Load in kW.	Lb. Steam per kW-hour.
11 250	10·68
15 000	10·53
18 750	10·48

These figures were obtained without special preparations on the part of the turbine makers. The various measurements were made as accurately as possible both on the steam and on the electrical side.

Arrangements for Comparison.

In logging the station performance, an attempt has been made to get the results tabulated so that comparisons can be made readily with other plants, and at the same time give figures which the operating engineer can readily remember. In the boiler house the usual figure of lbs. water per lb. coal has been improved upon in accordance with modern practice, and this is now given as equivalent evaporation per 10 000 B.Th.U. The coal being sampled from the hoppers and tested every day, this figure becomes strictly comparable from day to day.

A summary sheet of the daily log is also compiled, the sheet being drawn out for seven days. This sheet (which is reproduced herewith) gives the daily performance compared with a standard, which represents the average results under good running conditions. The summary sheet is not for the compilation of costs : it is provided so that the operating staff may note any serious departures from the standard and take steps to rectify them.

As the all-important figure is lb. of coal per unit, the scheme suggested by Mr. R. H. Parsons some time ago in the *Electrical Review*, as referred to earlier in the paper, has been adopted. The total coal consumed, and units generated, are plotted out per shift for each month. The same is done for water. Then each month a base line is drawn on squared paper, which represents the coal per unit or water per unit, less the station losses, that is to say, if the coal line for the previous month is $C = 16\,600$ plus $1{\cdot}714\ K$, then the base line is at 16 000, and the performance of each shift is plotted against this line. If any shift shows a great departure from the base, an inspection of the summary sheet should help to find the cause of disparity.

GLASGOW CORPORATION ELECTRICITY DEPARTMENT.
DAILY RUNNING STATISTICS FOR WEEK ENDING

	Standards	4th Thursday.		5th Friday.		6th Saturday.		7th Sunday	8th Monday.		9th Tuesday.		10th Wednesday.	
Back Pressure, in. Hg.	0·9 in.	1·23	+0·33	1·36	+ 0·46	1·23	+ 0·33		1·51	+ 0·61	1·4	+ 0·5	1·39	+ 0·49
Theo.-Act. Vacuum, in. H.S. .. $\frac{W}{Tr}=\frac{11·7}{11·2}$	0·55 in.	0·42	−0·13	0·63	+ 0·08	0·57	+ 0·02		0·78	+ 0·23	0·65	+ 0·1	0·61	+ 0·06
Engine Room Steam Efficiency ..	1·04	1·18		1·20		1·34			1·31		1·36		1·31	
$\frac{3\,410\times 100}{(H-h)\times \text{lb. per unit}}$	24 per cent.	22·25	− 1·75	22·28	− 1·72	21·95	− 2·05		21·33	− 2·67	22·3	− 1·7	22·26	− 1·74
Stack Temperature, ° F.	400° F.	395	− 5	378	−22	382	−18		392	− 8	395	− 5	389	−11
Per cent. CO_2..	10·6 per cent.	12·7	+ 2·1	11·6	+ 1·0	11·1	+ 0·5		12·5	+ 1·9	11·8	+ 1·2	13·3	+ 2·7
Boiler Kennedy Factor .. .. $\frac{\text{Water Evaporated}}{50\,000\times \text{Hours}}$	90·11	79·24	−10·87	76·26	+13·85	76·34	−13·77		76·82	−13·29	78·48	−11·63	79·27	−10·84
Boiler House Efficiency	77·77	80·45	+ 2·68	76·39	− 1·38	76·98	− 0·79		73·26	− 4·51	74·3	− 3·47	76·79	− 0·98
Station Efficiency	17·15	17·93	+ 0·78	16·97	− 0·18	16·95	− 0·20		16·06	− 1·09	17·49	+ 0·34	17·15	
Calorific Value of Coal as Fired ..		10 114		10 656		10 587			10 257		10 814		10 515	

W=lb. Water per unit generated. Tr=Temperature rise circulating water. H=Total heat in steam. h=Hotwell temperature.

Test results under ordinary working conditions, showing the effect of running the set (*a*) from its own auxiliary turbo-alternator, and (*b*) from the works sub-station supply :—

No. Turbine.

Averages over One Hour's Run.

House Turbine Supplying Main Unit Auxiliaries.

Steam Pressure	274 lb. sq. in. G.
Steam Temperature	725° F.
Superheat	310° F.
Steam Pressure after first experiment ..	74 lb. sq. in. G.
Barometer	29·6 in. Hg.
Vacuum	28·6 in. Hg.
Theoretical Vacuum	28·673 in. Hg.
Vacuum referred to Barometer 30 in. Hg.	29·00 in. Hg.
Condensate Temperature	77° F.
Heater Discharge Temperature	130° F.
Circulating Water Temperature, Inlet ..	53° F.
Circulating Water Temperature, Outlet	65° F.
Temperature Rise of Circulating Water	12° F.
Circulating Water	26 100 galls./min.
Total Water per Lea Recorder	180 000 lb./hr.
kW-hours generated	16 900
Lb. Steam per kW-hour	10·65

HOUSE TURBINE.

Steam Pressure, 1st Governor Valve ..	219 lb. sq. in. G.
Steam Pressure, 2nd Governor Valve ..	25 lb. sq. in. G.
Steam Temperature	710° F.
Steam Pressure at Exhaust	16 lb. sq. in. absolute.
Steam to House Turbine	10 350 lb./hr. (calculated)
Average load	348 kW.

Heat Balance.

Input	14 127 750 B.T.U./hr.
Heat in Exhaust	12 420 000 B.T.U./hr.
Heat regained in Feed Heater	9 540 000 B.T.U./hr.
Loss in Heater	2 880 000 B.T.U./hr.
Heat Cost in Auxiliary Energy per kW-hour	13 100 B.T.U./kW-hr.
Total Heat Cost of Auxiliary Energy ..	4 560 000 B.T.U.

HEAT BALANCE—MULTIJECTORS AND FEED HEATER IN SERVICE—ELECTRICAL AUXILIARIES SUPPLIED FROM MAIN UNIT ENERGY.

Main Unit kW	17 000
Steam Consumption	11·00 lb./kW-hr.
Heat Cost of Main Unit Energy ..	14 972 B.T.U./kW-hr.
Power for Electrical Auxiliaries ..	210 kW.
Expenditure in B.Th.U. for Electrical Auxiliaries	3 134 670 B.T.U./hr.
Steam Consumption of Multijectors ..	5 904 lb./hr.
Equal to	8 017 632 B.T.U./hr.
Temperature Rise of Condensate ..	42° F. 42 B.T.U./lb.
Total Heat regained in Heater .. .. (Ejector Exhaust and Entrained Gases)	7 854 000 B.T.U./hr.
Heat Consumption of Ejectors ..	163 632 B.T.U./hr.
Total Expenditure in B.Th.U. for all Auxiliaries	3 298 302 B.T.U./hr.

The Manufacture of Ediswan Accumulators.

The EDISON SWAN ELECTRIC Co. have now been manufacturing accumulators at their Ponders End Works for over four years. The accumulators, which are of the pasted type, are manufactured according to formulæ which have proved successful during a period of over twenty years. The positive active material in the Ediswan accumulators consists of a specially evolved oxide, the physical characteristics of which give a high efficiency and long life. This is obtained without the aid of any inert substances, which not only reduce the volume of active material and consequently the capacity, but introduce matter which can be of a highly injurious nature.

The Ediswan accumulator department is self-contained, and is laid out for the carrying out of the work with a minimum of handling and transportation. The grid casting room is situated at one end of the building. Here the lead and alloys are melted in gas-heated furnaces, which are equipped with air-trunks for the exhausting of fumes, etc., from the shop. The grids are cast in moulds of special construction, so designed that the resulting grid will effectually and securely hold the paste under the most severe conditions of vibration. Above this shop is situated an acid-mixing tower from which the acid diluted to various specific gravities is conveyed to the different sections of the building by means of a system of lead pipes.

The Pasting Department.

Adjoining the casting shop is the pasting department in which are machines for the wet and dry mixing of the oxides. This process is partitioned off from the main pasting room. The machines, which are power driven, are of special construction for handling the necessary heavy quantities of lead that go to the making of the paste. After mixing, the paste is conveyed to the pasting benches, which are lead covered. Here it is applied to the grids in a manner which ensures intimate contact between the paste and grid. The plates are then subjected to a pressing process, and are then conveyed to the drying room, where they pass through a special drying process.

When the plates are thoroughly dry, they pass through to the forming room. Here there are a series of forming rows which are controlled from panels situated in an adjoining switch room. The formation process is of too complicated a nature to give in detail here, but every care is taken to ensure that the resulting plate is absolutely free from defects. On completion of this process, the plates are passed to another drying room, where they are thoroughly dried out and stored ready for assembly. The next process is the section casting and lead burning. Here the plates have the section bars either cast or burnt on according to the type of battery under construction. From this department the made up sections are passed to the assembling room, where separators are inserted, and the sections placed in their containers. A part of the assembling room is devoted to pitching in the sealed top type batteries.

The next section is the test room. Here there are four charging panels, each capable of dealing with accumulators up to 360 Ah capacity. The last stage is the packing for despatch. In the packing department, cells of all sizes and types are carefully packed for despatch to all parts of the world.

Chemical Treatment of Wood Separators.

Adjoining the main accumulator shop is an annexe in which wood separators are treated. These separators, which are made in the works, are here treated in a series of chemical baths for the removal of resin and other oily matter, which would have a detrimental effect upon the working of the battery. The raw material store also adjoins the main shop.

The Institution of Electrical Engineers.

A Successful Summer Meeting in Scotland.

The success of the summer meeting of the INSTITUTION OF ELECTRICAL ENGINEERS, which was held last week in Scotland —and there is no doubt it was an unqualified success—may be ascribed to two authorities—the committee of the Scottish Local Centre, and especially the chairman and honorary secretary, Mr. E. T. Goslin and Mr. J. Taylor; and the Weather Bureau, as represented by that much-maligned and misunderstood person the Clerk of the Weather. That to visit Scotland, and especially the Western Highlands, in early June is an adventure is well evidenced by the recommendation to those joining the expedition to take warm clothing and rain-protective devices. The Clerk of the Weather, however, saw fit to render these recommendations quite nugatory, and, except on the voyage from Fort William to Kinlochleven, the weather was dry and very warm. A party of nearly 400 took part; and though a large number of these were either local Scots or Scots once again visiting the land of their birth, there was a sufficient intermixture of Southrons to give a representative character to the whole. Many new friendships were made, a number of old friendships were renewed, many interesting places were visited, and, generally, the visit may be described as a liberal education, which we hope will be repeated in due course.

Monday, May 29.

Thanks to the courtesy of the London and North-Western Railway Company, the party from London travelled down in the comfort of a reserved restaurant car, a facility that was all the more appreciated as the weather was very hot. During the course of the day visitors from other parts of the country converged on Glasgow, and made preparations for the strenuous life of the next few days.

Glasgow and Kelvin.

Tuesday, May 30.

The first business this morning was an official welcome to the Institution by the Corporation of Glasgow. This took place in the Royal Technical College, when the LORD PROVOST (Dr. Paxton) said that it gave him great pleasure, on behalf of the Corporation and the citizens of Glasgow, to extend to the Institution a most cordial welcome. He referred to the Jubilee celebrations, and said it was fitting that in its Jubilee year the Institution should visit the city where Lord Kelvin had spent so many years of his long and useful life, and had carried out work which had made his name famous throughout the world.

The PRESIDENT (Mr. J. S. Highfield) in reply, thanked the Lord Provost for his welcome, and expressed the pleasure it gave the Institution to meet in the city associated with the labours of Watt and Kelvin.

Dalmarnock and Clyde Mills.

A paper on "The Dalmarnock Generating Station" was then read by Mr. R. B. Mitchell. He began by giving some details of the progress of electricity supply in Glasgow, the latest phase of which was the erection of the generating station at Dalmarnock, whose various features he detailed. (A full description of this station was given in THE ELECTRICIAN of Sept. 10th, 1920.) He also gave an interesting account of the working and test results obtained and replied to some criticisms which had been levelled at the station's design and performance. This portion of the paper is given in abstract on another page of this issue; but it is interesting to note here that the guaranteed combined efficiency of boiler, superheater and economiser is 80 per cent., and that under normal working conditions 74 per cent. is obtained, though it is hoped that this figure will be improved.

It will be remembered that the first section of the station is to have a capacity of 93 750 kW in five sets of 18 750 kW each; and that a feature of the station is the coal-handling and storage plant. Energy is transmitted from the station at 20,000 V by cables to various sub-stations, and an interconnection is also to be made with the system of the Clyde Valley Electrical Co.

After having heard all about the station those present (or some of them) followed Mr. Squeers' policy and went to see it. It was generally agreed that it came up to expectations.

Lunch at the City Chambers.

Subsequently the Institution was entertained to luncheon by the Corporation at that handsome building—the City Chambers.

Bailie SADLER, in proposing "The Institution of Electrical Engineers," paid a tribute to the fame and work of Kelvin and quoted Varley's well-known saying regarding the future of the Institution. Varley was a true prophet, for who could set bounds to the scope of electricity. Every advance in our knowledge of the structure of the universe—and enormous strides had been made since his day—increased the probability that electricity "embraces every operation in nature." As Varley foresaw, the specialist character of the original body was soon merged in a diversity of electrical interests. Its growth had been steady, and the Institution had fulfilled its rôle in the highest degree, in that it had provided continuously an arena wherein electrical problems of every description might be debated, new methods and ideas brought forward and discussed, and accounts of progress, both at home and abroad. placed before its members. Much of its work was pioneer work, the benefits of which the industry was now reaping.

Mr. J. S. HIGHFIELD, in acknowledging the toast, said they had to deal with far more than the application of electricity. It was being shown more and more clearly every day that the whole of the universe was made up of electricity, and they had the whole range not only of matter but of energy.

In the afternoon visits were paid to the Clydesmill generating station of the Clyde Valley Electrical Power Co., a description of which appeared in THE ELECTRICIAN, Vol. lxxxvi. p. 86, June 3rd, 1921, and to the Corporation reservoirs at Milngavie. At both places the visitors were entertained to tea.

Civic Receptions and Informal Meetings.

In the evening a civic reception was held at the City Chambers, the principal attractions being music, dancing and refreshments (these are not necessarily arranged in order of merit). The national dances of the Scots, as performed with vigour and enthusiasm by the natives, were a great attraction, and to the Southern members the more usual terpsichorean evolutions were good exercise. We think it is a tribute to the vitality of the Institution that past-presidents and members of Council were particularly active in this exercise. Surely we have nothing to fear in the future when the seniors of the profession are so youthful in both outlook and action.

It is only right that the veracious chronicler should add that many unofficial meetings took place in the lounges and smoking rooms of the various hotels, whereat the subjects discussed were not wholly technical. Considering the hour at which some of these meetings broke up they must have been interesting.

Kelvin's Lecture Room.

Wednesday, May 31.

On Wednesday morning the first business was a lecture by Prof. MAGNUS MACLEAN on "The Hydro-Electric Resources of the Scottish Highlands." Prof. Maclean is himself a Highlander and he is an enthusiast on his subject, a combination which makes for a successful lecture.

Principal Sir DONALD MACALISTER, in welcoming the Institution on behalf of the University, said he was happy to receive them in the room where Lord Kelvin had laid the foundations of electrical engineering. Minor alterations had taken place, but his spirit remained and no one would welcome more than he the great developments which had taken place in the science he had founded so well. Sir Donald mentioned that he himself had also had to do with the beginnings of electrical engineering. He had helped to correct Clerk Maxwell's "Electricity and Magnetism," and had overlooked a great many mistakes that subsequent editors had discovered.

The Hydro-Electric Resources of Scotland.

Prof. MACLEAN began by saying that one of the most far-reaching effects of the late war had been to bring the nation face to face with its own resources. For decades previously its chief concern had been the promotion of specialised industries in the large centres. Almost everything else was sacrificed to this national activity, and the lives of men were moulded to feed the fires and keep going in pitiless monotony the rattle of machinery, which was fast becoming an industrial Moloch. No doubt the age of coal and iron might have to be regarded as a necessary stage in the onward march or evolution of civilisation, but we had only to visualise the effects as we knew them to realise how far a large proportion of the working classes had been sidetracked by this industrialism.

The wonderful thing was that we had been so blind with regard to our real assets. We had erred in two ways. On the one hand, we had wasted most extravagantly many of our resources, and on the other hand we had almost entirely neglected others. In the midst of the Great War struggle we were forced by stern necessity to take stock of our resources, and our eyes were opened to new possibilities. Of the various national resources to which the attention of the Government and the people was now directed water power was dominant. Personally he was concerned with it not only as an industrial proposition, but as a means of elevating the national life, of restoring man-power, of relieving the congestion in the large centres, of resettling the people on the land, and of furnishing them with better houses, better food and clothing, and a more natural life in the country. In a word, he held that the proper use of water power in the Scottish Highlands would go far to solve some of our pressing problems and promote comfort and contentment among large sections of the population. The extent of the Highlands was 40 per cent. of Scotland, though only 7 per cent. of the population was within that area.

Prof. Maclean then described in detail the Lochaber and Grampian power schemes and said that we were now at a point of departure in our whole industrial system. The old order, black and barbaric in many features, was yielding place to new methods. We were in the midst of readjustments which heralded the dawn of a new era, and it was given to us to be pioneers in the process. For all practical purposes light, heat and power were coming more and more to be comprehended in the word " electricity," and as our coal resources were being depleted we must rely for its production in the future to a greater extent on oil and water-power and other at present undeveloped agencies.

A Babcock Afternoon.

In the afternoon members combined work and pleasure in a most ingenious fashion. At the invitation of Babcock and Willcox they joined the " Queen Alexandra," a steamer with a gallant war record, at the Broomielaw and steamed past the shipyards of the Clyde to Renfrew, whence they were conveyed by special train to the works of the company. Here they were divided into parties and conducted through part of what is the largest boilermaking concern in the world. At these works are manufactured mechanical stokers, water softeners, superheaters, coal and ash handling plants, steam and water piping, valves, structural steel work and cranes; in fact, everything for the steam side of a modern generating station, except the turbines. There is evidence enough of a thorough system of production, a splendid organisation and a general efficiency, and it was gratifying among the present industrial troubles to find so many men at work. The one drawback to the visit was the intense heat, which caused one eminent electrical engineer to enquire anxiously for the whereabout of the canteen, for, we hope, platonic reasons only.

The " Queen Alexandra " was required shortly after 4 o'clock, when tea and other liquid refreshments were in great demand as the good ship headed down the river. A most enjoyable evening was spent viewing the beauty spots of the Clyde and the famous Kyles of Bute. Much speculation arose as to the ownership of the many palatial residences on the banks, Sir Harry Lauder, as being the only Scot known to most Englishmen, being the favourite. We hear on the highest authority that most of them are hotels, another tribute to the canniness of the native. During the course of the evening dinner was served, a photograph taken, and two very short speeches of thanks and acknowledgment made by Mr. Highfield and Sir James Kemmal. The best testimonial to the success of the expedition was in the remark we overheard a member make " That if Babcock's boilers were as good as their hospitality he must really buy one." Unofficial meetings again continued until a late hour.

A Tour in the Highlands.

Thursday, June 1.

At an early hour the party set forth by special train for Queen Street Station, Glasgow, for Fort William. This journey is Scotland peptonised. First tunnels and Glaswegian suburbs. Then Clydebank, Dumbarton and shipbuilding. Then Helensburgh seaside resorts and yachting. Loch Lomond, Ard Lui, mountain and loch scenery. Then the Moor of Rannoch, Caledonia stern and wild, and once again the sea and hills at Fort William. The Institution saw all these under the most favourable conditions, the necessary technical leaven being introduced by an inspection at Tulloch of the headwaters of the Lochaber power scheme. At this point we became aware that we were in the Highlands. Pipers joined the party and their music and ceremony was a feature of the remainder of the visit.

Highland Hospitality.

Fort William was reached in the early afternoon in advance of the time table, rather to the consternation of the various hotel keepers on whom the members had been billeted. Highland hospitality is proverbial, but it is different from that to which we are accustomed in the South. One of its peculiarities is gregariousness. In other words, two beds in a room and a room-mate is the order. To those of us who have experienced worse things in the Army the prospect was one which could be viewed with equanimity, but some of the others gave the unfortunate hotel keepers a *mauvais quart d'heure*, until their desire for single blessedness had been satisfied in some way or other. Our best advice to the " Fort Williams " is that before the Institution visit them again they build a hotel with nothing but single bedrooms.

We congratulate the local hospital on their piratical instincts in arranging a dance, sweepstakes and other money-getting enterprises on the day the Institution visited their town. The results must have been most gratifying.

Kinlochleven.

Friday, June 2.

The day's work began with a sail down Loch Linnhe, past Ben Nevis, and up Loch Leven, past Glencoe to the works of the British Aluminium Co. at Kinlochleven. These works have already been fully described in THE ELECTRICIAN, and are substantially the same as at that date, except that two extra generating sets have been added. The continuous load is about 20 000 kW. A feature of the place is the model village, which is a garden city among mountain scenery. There is a general air of well being which the activities of the company do not belie. It was suggested that an International Climbing Contest might take place up to the dam, but we did not hear of any entries.

After being entertained to lunch by the British Aluminium Co., the party set sail for Oban, where the meeting officially came to an end. Most of those taking part spent the week-end in profound sleep, having thoroughly exhausted and enjoyed themselves.

Reviews.

Factory Administration and Cost Accounts. By EDWARD T. ELBOURNE. (London: Longmans, Green & Co.) Pp. xx+811. 45s. net.

The war period provided new experiences in many directions, and not the least of these was the new experience obtained in the various branches of industrial administration. Mr. Elbourne published a book on industrial administration, entitled " Factory Administration and Accounts," in March, 1914. The present volume is of a more comprehensive character than the earlier volume, and aims at a more specific purpose, so justifying the change in title to " Factory Administration and Cost Accounts."

The volume is divided into two main divisions, the first of which relates to Works Management and includes three subdivisions referring respectively to Production Control, Labour Administration, and Material Control. The second division relates to Works Accounting and includes the two subdivisions of Administrative Records and Cost Accounts. The book is prefaced with a chapter on General Administration, and concludes with a chapter on Works Routine, the latter containing a large number of specimen forms used in industrial administration. Production Control deals with manufacturing processes, production, estimating, and rate-fixing, the provision and maintenance of tools and plant, concluding with an important section on the functions of foremanship and inspection. The section on Labour Administration records in considerable detail the more important features of industrial relations, trade union agreements, and working conditions, together with systems of wage payment, the selection and training of workers, and works regulations. Material Control includes information relating to purchasing and stores organisation, and to the warehousing and the despatch of goods. The section of the book relating to Works Accounting sets out in logical sequence the important aspects of administrative records, including employment and production statistics, and stock accounting. The section on Cost Accounts comprehensively analyses the underlying principles of a system of cost accountancy.

In view of the importance in modern industry of the suitable training of apprentices and all grades of industrial workers,

and also the growing importance of industrial research, it is unfortunate that the author makes scant reference to the first subject, and practically no reference at all to the latter subject.

At first sight it would appear as though the present volume fails to include an important chapter of the author's first volume, relating to the general problem of industrial works design, and contains such information as the choice of site, and general arrangement of both buildings design and process organisation. Much of this, we find, however, is contained in a sub-section of the Works Management division of the book relating to buildings and plant, and marks a distinct advance on the matter included under this heading in the earlier volume.

An important adjunct to the text is the system of cross references that has been developed, so that when the reader has once found a particular subject through the index, he is readily referred by the marginal page references to other pages bearing on the same subject. Another important and useful detail feature of the book is the glossary appendix giving definitions of the more important terms used throughout the text.

The most obvious use of the book is as a volume of reference for industrial administrators, works managers, and persons in like positions, but the volume should refer to a much wider field than this. It provides for the student of industrial administration a most up-to-date and valuable text book, and affords the ever-increasing number of students of the human problem in industry an opportunity of becoming familiar with the more important aspects of industrial organisation.

It is important to indicate that the book is by no means academic. The author has had wide industrial experience, and during the war period practised as a works manager of a large national factory. Throughout the book discussions relate to modern methods, and enumerate details of procedure in addition to the broad underlying principles.

While no one book can exhaustively deal with the whole field covered by the subject of industrial administration, the present volume constitutes a very commendable attempt to outline the more important aspects of industrial administration. It is reasonable to expect that further volumes dealing in greater detail with the special phases of industrial organisation will be required.

A. P. M. Fleming.

The Electric Furnace. By J. N. Pring, M.B.E., D.Sc. (London: Longmans, Green & Co.). Pp. xii+485. 32s. net.

Electro-metallurgy has during the last few years developed so rapidly along so many different lines that it is a very difficult matter to cover the subject adequately in one book, and even more difficult for any one man to be able to keep his information on all the different branches up to date. Dr. Pring's book deals with a great many subjects, and he has accumulated information of great interest from a number of sources, but in many cases the information is now out of date. For instance, he publishes on p. 391 a table showing the permissible current density on different sized electrodes, which for 16 in. diameter electrodes is given as 10·7 A per sq. in. He also refers several times to the necessity of using several electrodes clamped together in steel furnaces, owing to the impossibility of obtaining satisfactory large electrodes. These statements were perfectly correct ten years ago, but fortunately the time has passed when one of the chief qualifications of an electric melter was the ability to remove large pieces of broken electrode from the furnace rapidly.

A considerable part of the chapter on electrode holders might also have been written in 1910, and in a number of other cases references are made to papers written between 1909 and 1913. Electro-metallurgy has advanced so rapidly in the last few years that most of these papers now only possess a historical interest. The information on graphitising electrodes is necessarily not very detailed, as it is to a large extent a secret process. The particulars given do not represent modern practice, and the output of 3 to 3½ tons for 1 000 H.P. units in a run of 20 to 24 hours is unduly optimistic.

We think that sufficient credit has not been given to Great Britain for the great expansion of her electro-metallurgical industries during the war. In the chapter on ferro-alloys, while numerous Continental and American works are mentioned by name, there is no reference to the fact that by 1918 a firm in Newcastle was employing over 15 000 kW in the manufacture of ferro-chrome, ferro-tungsten and ferro-molybdenum, which was sufficient to supply the whole of the very large British requirements of ferro-chrome and a considerable proportion of the ferro-tungsten consumed. Moreover, the erection of one British graphitising factory and four amorphous electrode factories, with a capacity of about 13 000 tons a year, is ignored.

The application of the electric furnace to the brass industry has been dealt with very briefly. Only four pages are given to this branch of electro-metallurgy, and the Ajax-Wyatt induction furnace, which is more widely used in American than any other type, is not even mentioned.

Several other interesting subjects have either been discussed very shortly or completely ignored. Among those which might have received more recognition are the whole subject of automatic regulation, the various types of electrode economiser, the possibilities of the new Söderberg continuous electrode process, and above all, the extent to which the war development in all electro-metallurgical branches in likely to be permanent. Information on these points would surely be of more interest than a highly theoretical consideration of the most suitable size of electrodes, which entirely ignores the relative cost of the amorphous and graphite products, the size most suitable from the metallurgical standpoint, the standard sizes available from different works and the fragility of the smaller sizes of graphite electrode.

In spite of these criticisms, we consider that the book is a valuable addition to the technical library of all who are interested in electro-metallurgy. The illustrations and plates are excellent, and a useful bibliography is included as an appendix.

W. S. Gifford.

Notes and Examples on the Theory of Heat and Heat Engines. By John Case, M.A. (Cambridge: W. Heffer & Sons, Ltd.) Second Edition. Pp. 138. Price 7s. 6d. net.

In the reviewer's student days, Prof. John Perry (of whom grateful memories) used to tell us that we were too much "spoon-fed"; then out of his kindness he used to do his best to extend the process. We cannot help feeling that this delightful little book is another step in the same direction.

We know what the present-day students will say in reply to this. We know they will point out that they are expected to learn more and still more, that so much data has been accumulated in science, and now it is proposed that they should take courses in law and economics. Probably in no distant future enthusiasts will require them to take a course in eugenics as well. However this may be, here is a little book in which is collected together all the important formulae relating to the first and second Laws of Thermodynamics, together with clearly worked out examples which will be of great help to the student who has to memorize such matters for examination purposes. It will also be of great use to many older engineers who only occasionally wish to dip into such matters.

There is very little to criticize. It seems rather a pity that the author should take the symbol I instead of the universal symbol H. It seems also a pity that he should base on Smith and Warren's Tables when Callendar's Tables now hold a practically unchallenged position. We do not feel very sympathetic towards his handling of the question of internal energy of steam. Most of the problems which he gives for this quantity can be more simply treated by dealing with the total heat. We rather pity the poor student who has to do many examples on the simple logarithmic formula for entropy based on the conception of a constant average specific heat for superheated steam. Why also should he have to do such a lot of work on reciprocating engines?

If his course at Cambridge is to be of any real help to him when he comes to deal with questions of steam in actual practice, he could not be more helped than by giving him Callendar's Tables and telling him what they mean, and how to use them. There must come a day when this sheer memory work as indicated by the science tripos questions must break down, and the division between college and the drawing office tend to disappear. In the meantime, however, we have no hesitation in recommending this book to our student friends.

W. M. Selvey.

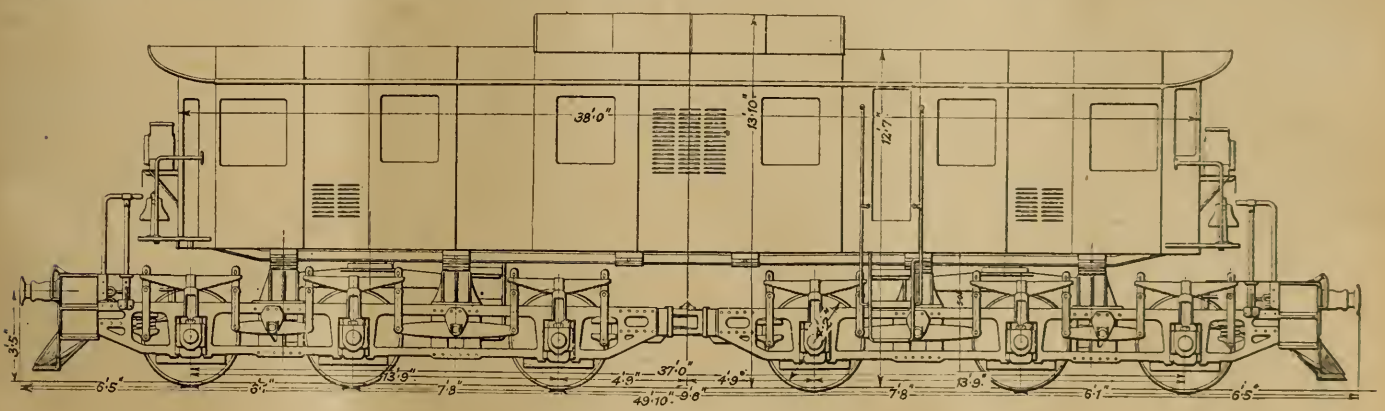
Electric Locomotives for Chilean Railways.

Work on the electric locomotives, which are being built for the Chilean State Railways, is rapidly progressing. The cabs for the first eight of the fifteen road freight locomotives have been delivered by the Baldwin Locomotive Works to the Westinghouse Electric Company for the installation of the equipment. There will also be seven shunting locomotives. The cab of the road locomotive is of the box type, carried on two articulated trucks, each having three driving axles with direct geared motors. The total weight is 226 000 lb. The locomotive will operate at 3 000 V d.c., and will be able to develop 3 200 H.P. for short periods. With natural ventilation the locomotive will deliver for one hour a tractive effort of 27 950 lb. at 22·6 miles per hour, but the continuous capacity with forced ventilation is 20 880 lb. at 24·8 miles per hour. The maximum speed is 40 miles per hour. The general dimensions and estimated weights of the locomotive are as follows :—

Dimensions and Weights.

Track gauge, 5 ft. 6 in. ; length over buffers, 49 ft. 10 in. ; length over cab, 38 ft. ; total wheel base, 37 ft. ; rigid wheel base, 13 ft. 9 in. ; height, top of rail to cab roof, 12 ft. 7 in. ; width over cab sheets, 10 ft. ; height of coupler, 41 in. ; wheel diameter, 42 in. ; weight of electrical equipment, 86 000 lb., and weight per driving axle, 37 670 lb.

The locomotives will operate over the 116-mile route between Santiago and Valparaiso, and the 28-mile branch between Las Vegas and Los Andes. The heaviest grade is 2·25 per cent. for 12 miles from Llai Llai to La Cumbre ; the maximum curvature is 11 deg. The present main line freight trains average 550 short tons, and are operated by a single steam locomotive, except on the heavy



Outline of Freight Locomotive.

12-mile grade southbound, and on a northbound grade of 6·8 miles. On these two sections a steam helper is used to maintain speeds of from 10 to 14 miles per hour. One electric locomotive will haul 770 short tons in either direction between Valparaiso and Santiago without assistance, except on the Tabon grade. On level track the speed with such a load will be 35 miles an hour. The average running speed on the Tabon grade will be 24 miles per hour. The time saved by the elimination of delay to take fuel and water and by the higher running speed will shorten the time of a trip from four to five hours in each direction.

Equipment of Locomotives.

These locomotives are equipped with Continental spring buffers and M.C.B. couplers, arranged to take attachments for chain couplers temporarily. The two six-wheel trucks are connected at the inner ends by a Mallet hinge. The bar-type cast steel side frames are outside the wheels and are connected by cast steel bumpers and cross-ties. The semi-elliptic driving springs over the journal boxes on each side are connected by equal beams, and the ends of each set of three driving springs are attached to the side frames through coil springs. The 38 ft. box type cab, including an engineman's compartment in each end and a central equipment compartment, is carried on centre pins over the midpoint of each rigid wheel base. One centre pin is restrained both longitudinally and laterally, and the other in the lateral direction only, permitting free longitudinal movement of the cab relative to one truck. The locomotives are equipped with air brakes interlocked with the regenerative brake, so that the latter may be supplemented by service application of the train brakes, if desired, without applying the air brake to the locomotive driving wheels. Current is collected by spring-raised, air-lowered pantagraphs, which are controlled by compressed air and are mechanically locked in the lowered position.

Control and Motor Equipment.

Individual switches, mounted in banks, establish the main circuit connections. Each switch is a complete unit and may be removed without disturbing adjacent switches. Compressed air, controlled by electro-magnetic valves, is used to operate the switches. For certain circuits, where no current is broken, and for low voltages, there are cam switches, which are also operated by compressed air. The cam group comprises a number of switches mounted on a single shaft, connected through a rack and pinion to a double acting air piston. Each axle is driven by a motor wound for 1 500 V and insulated to operate two in series on 3 000 V. The nominal rating of the motor is 280 H.P. at 155 A and 1 500 V. Field control is secured by two separate field windings on the main poles. The motors are geared directly to the axles with a ratio of 3·94 to 1. The gear is of the flexible type.

A motor-generator set provides low voltage power to compressors, blowers, control equipment and lights. The 3 000 V motor is a bi-polar double-commutator machine, and the continuous rating in the generator is 35 kW at 92 V. A master controller is located of each engineman's compartment to provide double end operation, the same master controller being used for both motoring and regenerative braking. This controller provides 50 control notches in acceleration, so that tractive effort variations are small, thereby permitting a smooth handling of the trains. The control provides speed combinations by varying the grouping of the motors to give one-third, two-thirds, and full speed. Field control gives three additional speeds. Transition from one motor combination to another is made by the shunting method. For regenerative braking, the main motor armatures are arranged for the same combinations as when motoring, and the motor fields are separately excited by the motor-generator set. The range of speed in regenerative braking will be from 8 to 30 miles per hour.

Shunting Locomotives.

The shunting locomotives will be the last ones to be built. The cab is of the steeple type and is carried on two swivel trucks. On each truck are mounted two motors driving direct through standard helical gears. The estimated weight is 136 000 lb. The control is arranged for double end operation. The nominal rating of the locomotive is 560 H.P. With 3 000 V, and natural ventilation, the tractive effort for one hour is 19 600 lb. at 10·6 miles per hour, and the continuous capacity is 11 400 lb. at 12·7 miles per hour. With 25 per cent. nominal adhesion the starting tractive effort is 34 000 lb. The maximum speed is 35 miles per hour. For short periods the equipment is capable of developing 1 000 H.P. In view of an expected increase in traffic the locomotives will be able to handle trains of 1 200 short tons in yards with level tracks. The trucks are of the rigid bolster equalised type with rolled steel frames located outside the wheels. A centre pin is located approximately midway along each rigid wheel base. The central cab has an engineman's stand at each end, and control apparatus centrally located and suitably protected. Buffers, couplers, air brake and control equipment are similar to those on the main locomotives, and the pantagraph is also of the same type. The four motors of the series type are wound for 1 500 V, and are insulated for operation two in series at 3 000 V. The motor has a one-hour rating of 140 H.P. at 75 A and 1 500 V. The motor-generator set, to supply power for the compressor motor, lights and control circuits, has a two part frame, each part containing two bearings in which runs a common shaft carrying two armatures, one a 1 500 V motor (insulated for 3 000 V) and the other a low voltage generator. With 3 000 V applied to the motors, the generators will deliver 22·5 kW at 92 V. The main resistance, connected ahead of all motors, is designed with ample capacity for frequent, heavy accelerations, and for a reasonable amount of emergency operation with one pair of motors cut out.

The troubles of would-be "broadcasters" already begin to manifest themselves. A Rhyl hotel licensee inquired last week at the local police court if it would be necessary to have a music licence if he put in a wireless set to intercept "musical messages." The Magistrates' Clerk stated that if there was music there must be a licence, whereupon the applicant replied that he could not say that wireless was music. It was noise.

Ultimately, the Magistrates advised applicant to wait and see what happened when he had his set ready, when he could renew the application.

Railway Companies' Power Supplies.

The inquiry by the Electricity Commissioners (Sir John Snell and Sir Harry Haward) into the proposals of (1) the S.E. & C. Railways and the Managing Committee of the two companies, and (2) the West Kent Electric Co. in regard to the erection and equipment of electric power stations and the provision of electrical energy for working certain of the S.E. and C. lines, was adjourned from the 1st inst. until Wednesday.

Advantages of Angerstein's Wharf Site.

Mr. C. P. Sparks said he had examined the Angerstein's Wharf scheme. Without extensions of the present wharf into the Thames, seaborne coal could be unloaded there from steamers carrying 1 500 to 2 000 tons, and an alternative source of fuel was available by means of the existing railway connection. By extending the jetty 50 ft. an extra 7 ft. of water would be obtained, and large steamers could be anchored alongside. The contour of the foreshore was favourable for drawing condensing water from the river. The proposal was to supply, in the first stage, 43 000 kW to Lewisham, to Redhill (18½ miles from Lewisham) 5 400 kW, to Tonbridge (24 miles from Lewisham) 3 700 kW, and to Rochester Bridge (25 miles from Angerstein Wharf) 4 600 kW, or a total demand, approximately, of 57 000 kW. Stage 1A comprised the electrification of 94 route miles, a demand of 29 000 kW, annual units required 90 000 000, and operating load factor 25 per cent.; stage 1B comprised 241 route miles, 57 000 kW, 222 000 000 units, and load factor 44½. In stage 2 it was estimated that a similar quantity would be supplied to a future member of the Southern group, raising the kilowatts to 114 000, annual units to 444 000 000 and load factor to 44·4. At stage 1A there would be four turbo-generators of 15 000 kW rating each (two being reserve), and boilers to steam 30 000 kW continuously, with reserve for maintenance purposes. At stage 1B there would be six turbo-generators (2 being reserve), and boilers to steam 60 000 kW continuously. The station might eventually be equipped with 10 generators of 15 000 kW each, of which two would be reserve, and boiler power to steam 120 000 kW continuously, plus reserve. Main distribution would be 25 ~, 33 000 V, three phase. The estimated cost of power was 0·475d. per unit for the 90 million units, 0·345d. for the 222 million, and 0·305d. for the 444 million. The estimates were based on coal at 15s. per ton, and with calorific value 11 000 B.Th.U. per lb., and the estimate of coal per unit was 1·82 lb. Taking the load curve of the power supply, the load factor was estimated at 35 per cent., as there would be considerable time when the plant would not be fully utilised.

Equipment of Station.

Cross-examined by Mr. Tyldesley Jones, witness said the South Western Railway had a 40 per cent. load factor on their suburban railway. They had 25 000 kW, and he thought they had a reasonable amount of spare plant. He was speaking of a load factor taken over half an hour. He had taken the load factor under the present scheme as 35 per cent. on average demand for half an hour with a maximum demand of 29 000 kW and an output of 90 million units per annum. In the first stage there would be 50 per cent. spare of generators only—two generators. He agreed that the larger the generators were the greater would be the saving in capital cost and in operation. The value of the site at Angerstein's Wharf had not been debited to cost of generation. As the company had other land to which the engineering materials now on the site could be removed there would be no cost. His figures for turbo-generators and step-up transformers were based on £4 10s. per kW, to-day's price. It was proposed to have ten boilers (7 working and 3 reserve), each with a capacity of 50 000 lb. of steam per hour. He had in view a pressure of 300 lb. to 350 lb. per sq. in. In stage 1 the whole of the energy would be transmitted to Lewisham. The cables would be 33 000 V, 0·25 sq. in. and three core. Each of the cables would cost £4 650 per mile, together with the control pilots and telephone cables. This cost was based on present day quotations. In stage 1B there would be transmission to Redhill, Rochester Bridge and Tonbridge. The cost might then be different. The centre of gravity of the load would not be altered to any large extent. Probably all the feeders to Redhill and Tonbridge would pass through Lewisham. At the end of stage 1B, Lewisham would require 43 300 kW, Redhill 5 400 kW, Tonbridge 3 700 kW, and Rochester 4 600 kW. Regarding size only, he did not know of any station of that size which had 17 per cent. efficiency, but he did not know of any station similarly equipped. He had allowed 1 per cent. for maintenance, and 7 per cent. allowed for interest and depreciation.

Mr. Herbert Jones, electrical engineer to the L. and S.W. Railway Company, said his company's power station at Wimbledon had been working seven years, had an output of 45 million units a year. It was desirable that the S.E. and C. Railways should adopt 25 ~. It was an advantage to use rotary converters.

System to be Adopted.

Mr. Alfred Raworth, electrical engineer to the S.E. and C. Railway Companies and the Managing Committee, said his companies had had negotiations with the West Kent Company and the London Electric Supply Corporation, and had been unable to get any definite offers from them with regard to a supply of energy. He prepared the scheme of electrification now under consideration. He advocated the use of 25 ~, because 50 ~ rotary converters were not reliable, and motor generators would give lower efficiency.

Cross-examined by the Hon. Evan Charteris (for the West Kent Company), witness said the electrification had not been debited with anything for the site to be occupied by the station. Uniformity of system of collection was more important than periodicity, but they should try to get uniformity in both. A frequency of 50 was better than 25 for purposes other than traction. The systems of collection on the South Western and on the Brighton lines were different, and it was proposed to adopt a third on the S.E. and C. system. The report of the Committee on Electrification of Railways permitted such a system when it could be shown to be financially justified.

Replying to Mr. Kennedy (for London Electricity Joint Committee): The transmission to Lewisham would probably be at 33 000 V. The highest total figure estimated for cost of energy at Angerstein's Wharf was 0·75d., or 0·9d. at Lewisham. He could not say whether there would be any advantage in generating at Angerstein's Wharf compared with Deptford. He would not hesitate to recommend a railway company to take a supply from an outside source if there were any advantage in taking it, and he did not think a railway company must necessarily retain sole control of its generating station.

Uniformity of System Desirable.

Replying to Sir John Snell, witness said he had had conversations with Sir Philip Dawson some considerable time ago in regard to supply of energy to the S.E. and C. system. By or before August of next year the Brighton, the S.E. and C., and the South Western Railways would become one system. It would be a great advantage if the supplies for the railways were obtained from a common source. It should bring about a reduction in cost. Combining railway and other loads should have the same effect. They carried the negotiations as far as they could, but got no definite offer. His original recommendation was to obtain, if possible, a supply from outside if satisfactory conditions could be obtained.

Mr. Sydney Hitchcock (rating surveyor to the S.E. and C.R. Companies and the Managing Committee) said on the basis of a station with 60 000 kW of generating plant he estimated the ratable value at £16 000, at 15s. in the £, or £12 000 a year for rates. Those figures were increased by 50 per cent. for 90 000 kW. On a 150 000 kW station the ratable value would be £40 000 at 15s. in the £, or £30 000 per year. He had checked these figures by the actual figures for the S.W. Company's Wimbledon generating station. At Belvedere (in Erith) rates for the year to March 31 last were 29s., and there was also a sewerage rate (7d. last year and 3d. this year). This year the poundage was 27s., but in Greenwich the rate this year was 17s. 2d.

On the resumption of the proceedings, Mr. Tyldesley Jones opened the case for the West Kent Electric Company, and the inquiry was continued yesterday (Thursday).

Legal Intelligence.

Trading With Infants.

At the Shoreditch County Court, last week, Thos. Cook and Co., Ltd., sued J. Rurka, trading as the British Commercial Trading Co., of 61, Chancery Lane, W.C. It appeared that defendant ordered goods to the amount of £21 12s. 4d., before December 7, 1921, and these were admittedly delivered on dates from December 9 to 21. When payment was demanded, defendant said he was only 21 years of age on December 7, so that he was not of age when the contract was made, and was not liable.

On Friday, Judge Cluer said he had allowed the matter to stand over to see if he could make defendant act honestly. It was clear defendant was an infant when he made the contract, and the Statute clearly said that all contracts made by an infant were void. There would have to be judgment for defendant and costs.

Mr. Robinson (for plaintiffs): The matter now gets into the police court, as we have information as to what he has done with the goods.

Judge Cluer: I am very pleased indeed to hear it, and it will be good news to a number of infants who are trading in this district.

Altering an Electric Meter.

Last week the Colchester Bench fined William Godfrey £5 for altering the index of an electricity meter at the Sea Horse Hotel, and the wife of the proprietor was also fined £5 for counselling and procuring the commission of the offence.

Transferring a Telephone.

At the Mayor's and City of London Court last week the Postmaster-General sued the Seat Indicator and Advertising Syndicate, of Chiswick, for £5 13s. 4d. for arrears of telephone rental.

For the defence, Mr. Wm. Hammerton said he had carried on the business of the Seat Indicator Syndicate. A man named Moody had taken over his business and agreed to pay the Postmaster-General's charges. He, therefore, brought Moody in as a third party.

Judge Jackson pointed out that that did not exempt the defendant from liability, as the Postmaster-General had not made the agreement with Moody. Judgment must be given for plaintiff against the Seat Indicator, and Hammerton would have an indemnity over against Moody, with costs.

Busy Europe: Politics and Business.

By Sir ERNEST BENN.

The very natural prominence which has been given to political questions, and the frequency with which international conferences are held, and international crises developed and settled, are natural outcomes of the War and the Treaty of Peace, but these things are giving to us and the world in general a dangerously false impression of fundamental conditions in Europe, and are doing much to retard that resumption of normal trade and commerce upon which all so much rely. A close study of the full report of the Genoa Conference leaves one with the impression that Europe is a pitiful mass of dejected peoples all vying with one another to explain how unbearable are their burdens, and how bad is their plight. There is, of course, a certain amount of truth in all this, but it is of the greatest importance that most of these questions should be got into better perspective.

For instance, there is often a very marked difference between the position of a nation and the position of the individuals who compose that nation. A national balance sheet may be a very discouraging document, while the balance sheets of the individuals who make up the same nation may be in the most flourishing condition. If, therefore, a nation is bankrupt, it does not necessarily mean that the nationals are undesirable customers, or that they may not themselves be wealthy persons, capable of transacting very desirable business.

Undue Prominence of Political Problems.

Many of the questions which loom so large in the newspapers and occupy so much time in public discussion, and sound so important when discussed in broad principle, are of no more interest or moment to the persons inhabiting the countries concerned than is the question of Proportional Representation to the average English citizen. Yet because these political matters are so much before the public, they are allowed to cloud our vision, and give an impression in commercial circles, in England certainly, that Europe is not in a fit position to trade, and that the markets of Europe are for the time being not worth consideration. There are, of course, many people who know better, but our trading figures disclose all too clearly how widely these false impressions are held.

To take a few examples: the city of Vienna brings to the mind of the average Englishman, famine, rickety children, absence of food, poverty, and general wretchedness and starvation. That is the effect upon the mentality of the public of all the efforts which have been made to alleviate the distress which did undoubtedly exist in certain parts of Vienna a couple of years ago. Vienna to-day is by no means happy, but no more is London or Manchester. And Vienna is full of ordinary, active, business mortals, getting along with the ordinary work of life in a more or less ordinary way, and desirous and indeed anxious to develop commercial relations with the rest of the world. The same sort of misunderstanding, arising from the undue prominence of political problems, is seen in connection with Germany. Or, speak of Hungary, and the English mind turns at once to Bela Kun, to whites and reds, to revolutions and counter-revolutions, to massacres and pogroms, and other political incidents, traces of which it is very difficult for the ordinary commercial visitor to find when he travels in this delightful land. There is no doubt at all that things are not what they were in Hungary, or what they will be again, but there is equally no doubt that business is waiting to be done in Hungary and that conditions are quite good enough for the business man who will take the trouble to study them.

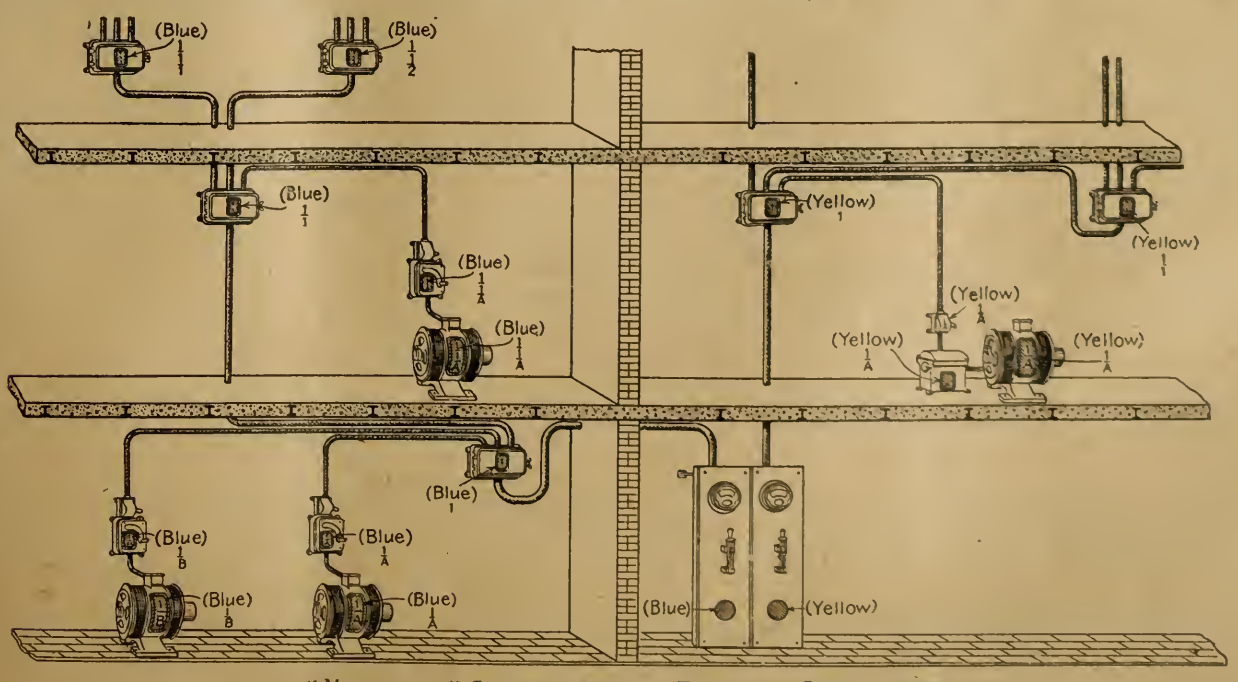
Russia is supposed to be closed to normal business and for practical purposes that is undoubtedly so, but nevertheless, it is significant to notice that the Russian rouble is quoted on the Berlin money market. On May 22, seven and a half million roubles could be purchased in Berlin for a sovereign. It is surely not to be presumed that people buy seven and a half million roubles for the fun of looking at them, and it is hard to imagine any use to which these roubles can be put except for the purchase of Russian goods; further, it is difficult to see how these same roubles got into Berlin except in return for German goods delivered in Russia.

Trading Difficulties Exaggerated.

There are other ways in which our knowledge of the Continent of Europe is by no means as complete and accurate as it should be. In political discussions a very great deal is made of the inconveniences which arise from passport arrangements. Within the last few months I have crossed and re-crossed all the frontiers of Central Europe, and I can state without the least hesitation that there is no frontier in the world that I know, except New York, which has half the terrors, half the inconveniences, or half the indignities that are put upon one in endeavouring to enter an English port. The currency difficulties are quoted far too commonly as an excuse for the absence of business. A fluctuating currency is a great inconvenience. It would be absurd to belittle the seriousness of the position of some of the European countries in this matter, but a fluctuating currency is, nevertheless, not a bar to business, if the business man is willing to take a little extra trouble. Many firms are adopting the very simple expedient of doing business both ways; one well-known manufacturer is selling his goods freely in a country with a very uncertain currency, he having taken the precaution to provide himself with two or three buying agencies, thus enabling him to buy and sell and balance his books, and be completely independent of any fluctuation in the rate of exchange. The politics of Europe are important, but it is equally important that we should not allow impressions gained in the political field to warp our views on commercial matters, or to mislead us into a totally erroneous impression of commercial possibilities.

"Manifoldia" System of Supervision.

In referring to the Industrial and Efficiency Exhibition at Birmingham, in our last issue, brief mention was made of the MANIFOLDIA (REGD.) SYSTEM for ensuring the perfected supervision and record keeping of electrical installations. The system, which was exhibited on the stand of Manifoldia, Ltd., of West Bromwich, has been designed by Mr. A. H. Human, and its interest and value lie in the labelling provided by which the distinguishing number of each individual item of plant in an electrical installation gives also its geographical position in relation to the rest of the installation. Thus is ensured the systematic and periodical examination, cleaning and routine overhaul of the installation. All repairs and alterations of items of plant are recorded and brought automatically to the notice of the manager, and so the system affords, it is claimed, an insurance against delay in restarting a plant after a shut down. Another advantage secured is that the system allows the manager or engineer to keep before him essential data which will enable him to appreciate immediately how much his plant is costing him in repairs, maintenance and energy, and the extent to which these items of cost vary from time to time.



"MANIFOLDIA" SYSTEM APPLIED TO ELECTRICAL INSTALLATIONS.

D

Electricity Supply.

The Electricity Commissioners will hold their second local inquiry at Birmingham on the 29th inst. into the scheme for the reorganisation of electricity supply in the South West Midlands Electricity District and in order to determine finally the area of the district.

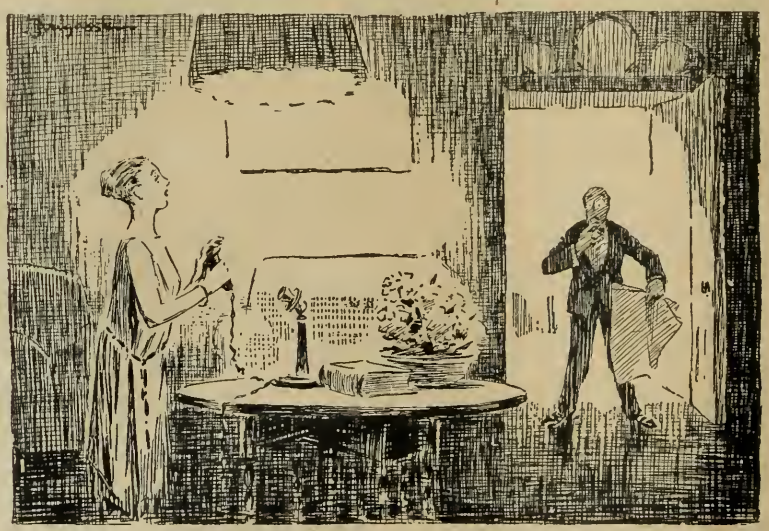
One of the Cardiff papers remarks that, if the Barry Council decides to go in for an electric supply scheme, it should see that it is in a position to supply electric fittings on a hire purchase system, as the absence of this power on the part of Cardiff Corporation has retarded the extension of electricity supply in that city.

The Minister of Transport proposes to confirm the Folkestone Electricity (Extension) Special Order, 1922, authorising the Folkestone Electricity Supply Company, Ltd., to supply electricity in Cheriton Urban and Elham Rural Districts. Any objections must be sent by June 26 to the Secretary, the Ministry of Transport.

Lancaster Electricity Committee have passed a resolution to the effect that no undertaking of an authorised undertaker should be shut down unless a supply of electricity could be obtained from some other source at a lower cost to the undertaking than the authorised undertaker could generate it, and every such authorised undertaking should be free to develop so long as it is able to generate at a cost not greater than it can obtain a supply from some other source.

The Electricity Commissioners will hold an inquiry on June 13 into the Order of Liverpool Corporation to extend their area of supply to Bootle, Waterloo, Seaforth, Litherland, and Great Crosby. The inquiry is necessary solely because objections to the Bootle transfer have been lodged by a section of the consumers and ratepayers of that borough. Instead of the £7 500 subsidy, the objectors ask for £12 500, or in the alternative one-ninth of any profits above £67 500 on which the £7 500 to be paid by Liverpool to Bootle annually is based. It is also contended that the compensation for loss of office should not be limited to the Bootle borough electrical engineer, but given to the rest of the works staff.

A Little Learning is a Dangerous Thing.



"I say, Harold, those ghastly people, the Dudd-Robinsons, have asked us to one of their filthy dinners on Tuesday. Tell me what excuse to make while I keep my hand over the telephone."

Reproduced by kind permission of the proprietors of "Punch."

New Schemes and Mains Extensions.

Kendal Town Council has decided to expend £11 655 on new plant and cables in connection with the electricity undertaking.

Folkestone Electric Supply Co. have been granted an Order to supply electricity to Cheriton, Saltwood, Newington and Hawkinge.

Newcastleton electric supply scheme has now been completed. The power station is said to be the smallest in the British Isles. The installation has cost £600.

Croydon Town Council has applied for a loan of £14 700 for steam raising plant at the electricity works. The original estimate of the cost of the plant was £23 000.

Denbigh Town Council have appointed the firm of Sloan and Lloyd Barnes, consulting electrical engineers of Liverpool, to prepare a scheme for supplying electricity to the Vale of Clwyd area.

It has been decided to light the streets of Welwyn Garden City by electricity. A contract is to be entered into with the local supply company and steps are being taken to obtain the necessary loan from the Electricity Commissioners to cover the cost of installation.

Elgin Town Council have agreed to the terms put forward by Mr. Williams, manager of Edmundson's Electricity Corporation, with regard to supplying the burgh with electricity. A committee has been appointed to carry out the various details, and work is to be started as early as possible.

The new sub-station at Stockton Heath which was opened last month receives its supply from the Warrington Power Station by means of duplicate e.h.t. cables which run underneath the Manchester Ship Canal. The generation and transmission pressure is 6 600 V. 3-phase, 50 periods, but at the sub-station the pressure is reduced by transformers to 440 V. for power and 250 V. single phase for lighting, domestic power and heating purposes. The h.t. switchgear consists of ironclad truck panels made up in single units, and designed to facilitate extension. A switch panel is provided for coupling up to the Latchford sub-station now in course of erection. From this sub-station the transmission cable will be continued to meet the cable running down Knutsford Road, which crosses the Manchester Ship Canal by the railway bridge near Latchford Locks, and if any accident should occur to the duplicate cables through the canal subways, a supply will be available through the Knutsford Road cable. The cables were laid by the Warrington Electricity Department's staff. The h.t. switchgear was erected and the l.t. switchgear was designed and erected by the Department.

Alteration of Charges.

Eccles Town Council has reduced the advance of 100 per cent. on the standard rates of charges for electricity by 25 per cent. with a discount of 5 per cent. for prompt payment.

The charges for electricity at Stoke Newington have been reduced as follows:—Lighting, 7d. to 6½d. per unit; heating, 2½d. to 2d.; power, 5d. to 4½d. on the first 1 000 units consumed.

Preston Town Council has reduced the charges for electricity for lighting by allowing 10 per cent. discount for payment in three weeks. For power the discount will be increased from 5 to 15 per cent.

Maidenhead Electricity undertaking for the past year showed an increase of 61 306 units over 1920. It has been decided to reduce the flat rate to 9½d. in the borough, and make a reduction of 5 per cent. on other rental meter charges for lighting and power.

The Kent Electric Power Co. has decided to reduce, as from July 1, the price of electricity for lighting and power at Rochester and Chatham to 10d. per unit for the first 400 units per quarter, and to 7½d. above 400 units. Power charges are to be reduced from 4d. to 3½d.

Demand Attachment for Watthour Meter.

For smaller power installations, which cannot use the more expensive graphic demand meter, or where the indicating type of demand meter is satisfactory, a demand attachment for use with a standard type OA polyphase watthour meter is being manufactured by the Westinghouse Electric and Manufacturing Company. The attachment is a watthour meter register, which combines the regulator watthour meter register with the scale and pointers of an indicating demand meter. By replacing the register and cover of a standard polyphase OA watthour meter with this attachment and a special cover, the meter is converted into an indicating block-interval demand meter, which will indicate the maximum kilowatt demand and the integrated kilowatt hours.

The demand attachment has two pointers, one white and the other black. The white pointer advances the maximum demand black pointer to any maximum demand position on the demand scale, where it is held by friction while the white one returns to zero at the end of each time interval. By watching the movement of the white pointer, which shows an integrated and not an instantaneous demand, the duration of the demand interval can be checked as well as the demand at the time of reading the meter. After the gears driving the white pointer have been disengaged from the gear train of the watthour meter, the pointer is returned by gravity to zero. The time at which the gears are disengaged, and therefore the time interval of the attachment, is determined by an induction motor, which, although small, gives several times the torque necessary to release the white pointer. The motor has practically a constant speed over a voltage range varying from 90 to 110 per cent. of the rated voltage. The demand scale, which is 3¼ ins. long, is marked directly in kilowatts demand, but the watthour dials are used with the register constant of 10 or multiples of 10.

Personal and Appointments.

Mr. A. A. Campbell Swinton has joined the board of W. T. Henley's Telegraph Works Co.

Lord Ashfield has been appointed hon. president, and Sir Sam Fay, president, of the Institute of Transport for the year 1922-23.

Mr. John Jackson, of Halberton, near Tiverton, has been appointed electrical engineer at the Royal Devon and Exeter Hospital, Exeter.

Major T. F. Purves, assistant engineer-in-chief to the Post Office, has been appointed engineer-in-chief in succession to Sir William Noble, whose retirement we announced last week.

Mr. Gerald Bellhouse has been appointed Chief Inspector of Factories in succession to Mr. R. E. Graves, whose death we announced in our issue of May 26th. Mr. Bellhouse has been Deputy-Chief Inspector since 1917.

The marriage took place at the Parish Church, Queenborough, Kent, on May 27, of Mr. Roger Hodgson, chief electrical engineer, R.N., of Newcastle-on-Tyne, and Miss May Crowe, youngest daughter of Mr. Crowe, of Eastchurch, Sheppey.

Mr. A. J. Abraham, of Aberdare, has been appointed electrical engineer and tramway manager for Bexley Urban Council at a salary of £500 per annum. Mr. Abraham is at present chief engineer and general manager of electricity and tramways of the Aberdare Urban District Council, a post which he has held for the past twelve years.

Sir William Noble, who, as we announced in our issue last week, has just retired from the position of engineer-in-chief to the Post Office, has accepted a seat on the board of the General Electric Co. We understand that Sir William proposes to devote his attention mainly to the development of the telephone and wireless sections of the Company.

The marriage took place at St. Mary's Church, Leigh Woods, Bristol, on June 1, of Mr. H. F. Trewman, Prof. of Electrical Engineering at the Artillery College, Woolwich, and Miss V. C. B. Morse, only daughter of Mr. and Mrs. R. W. Morse, of "Alpenfels," Leigh Woods, Bristol. The presents included a pair of silver vases from the electrical engineering branch of the Artillery College, Woolwich.

Mr. H. H. Burness has been appointed Lecturer in Civil Engineering at the University College of Swansea. While serving an apprenticeship of five years with Messrs. G. Anderson, he gained First-class Honours at Dundee Technical College, then went to St. Andrew's University, where he graduated in civil engineering. Afterwards he acted as assistant to the construction staff of the Dundee Electricity Department under Mr. H. Richardson. For the last twelve months Mr. Burness has been acting as assistant lecturer in Victoria University, Manchester, under Prof. A. H. Gibson.

Among the King's Birthday Honours we notice the following:— *Peer:* The Right Hon. Sir Archibald Williamson, Bart., M.P., Financial and Parliamentary Secretary to the War Office, 1919-21. Sir Archibald Williamson has taken a noteworthy part in Parliamentary affairs, having acted as chairman of various committees, including those on Telegraph Organisation and on Electric Power Supply. *Baronet:* George Sutton, M.I.E.E., chairman and managing director of W. T. Henley's Telegraph Works Company, a founder and past chairman of the Cable Makers' Association. *Knights:* Edwin Airey, Governing Director of William Airey and Son, engineers and contractors. Ernest Montague Hughman, late partner in Pyne, Hughman and Co., engineers and shipbuilders. Member of Council of Institution of Engineers, India, and Hon. Secretary Indian Council English Institution of Electrical Engineers; William Walker, C.B.E., recently retired from the post of Director of Health and Safety in the Mines Department of the Board of Trade. *Knight Bachelor:* Thomas Ranken Lyle, D.Sc., F.R.S., chairman of the Electricity Commissioners of the State of Victoria.

Business Items, etc.

Messrs. Hill and Provo have started business as electrical engineers, at 36, St. Michael's Street, Oxford.

Mr. W. J. May has been appointed sales manager and secretary of Pope's Electric Lamp Co., Elasta House, 5, Arthur Street, W.C.2.

The office of the British Empire Chamber of Commerce in the U.S.A. is now situated at Cunard Buildings, 25, Broadway, New York.

The North-Eastern District Office of Ferguson, Pailin, Ltd., has been removed to 90, Pilgrim Street, Newcastle-on-Tyne. Telephone No.: Central 5574. Telegraphic address: "Tension" Newcastle-on-Tyne.

On the 6th inst. the Electric Construction Company moved to new offices at Ingersoll House, 9, Kingsway, London, W.C.2. Their telephone numbers are Gerrard 8833 and 4606, and the telegraphic address "Concordance, Estrand, London."

The Jeary Electrical Co. have taken larger premises in Glasgoe, and their address in future will be 95, Waterloo Street. (Telephone: Central 5239.) Mr. John Grogan, the Scottish manager, will be pleased to give his personal attention to all inquiries.

Mr. A. T. West and Mr. J. S. Williams have resigned their positions with Pope's Electric Lamp Co., and have joined the "Z" Electric Lamp and Supplies Co. Mr. West will represent the company in the Southern and Eastern Counties, and Mr. Williams has been appointed Northern manager at the company's new branch at 10, Hockenhall Alley, Dale Street, Liverpool.

Realising the importance of extensive advertising, the Benjamin Electric, Ltd., is launching an intensive publicity campaign. Broadly, the scheme consists of an attractive series of full-page and half-page advertisements in the motor press. The advertisements are designed to create the demand on the retailer, and in addition, the company are sending to the whole of the motor trade throughout the country a series of four special folders at regular intervals containing actual reproductions of the advertisements to appear in the ensuing weeks so as to enable the recipient to visualize what they are doing in order to create the demand on him. They are also preparing a series of small leaflets, attractively printed, describing the various accessories, for distribution to consumers, and are prepared to supply quantities of these overprinted with the retailer's name and address.

A new and important company for the production of high-class wireless instruments of entirely new design has recently been formed under the name of Radio Instruments, Ltd. Mr. J. Joseph, who has recently resigned his position as general manager for Mr. H. W. Sullivan, and who has been associated with the design and manufacture of wireless instruments for the past 23 years, has been appointed managing director, as from June 1. In addition, the company has secured as director of research and chief designer the services of Mr. W. A. Appleton, late Admiralty technical research officer at H.M. Signal School, Portsmouth. The works, offices, and showrooms are situated at 12A, Hyde Street, New Oxford Street, W.C.1, within a few yards of the British Museum Station, and their central position renders them readily accessible from all parts of London. A special department will deal with laboratory standards and radio measuring instruments, and the company will be pleased to receive enquiries and advise on any special problems in connection with high frequency and radio work.

Electric Traction.

The Mile End Road extension of the South Shields Corporation Tramways and the new light railway to Cleadon Park were opened to the public last week.

London County Council have sanctioned a loan of £6 077 to Islington Borough Council for the purchase of four 2½ ton electric lorries and one 4 ton petrol vehicle.

West Hartlepool Tramways Committee recommend the Town Council to introduce trackless trolley trams on the Foggy Furze route. It is estimated that the running expenses of these trams will be about a third cheaper than that of the present system, and that the initial expenditure will be about one-half.

After full consideration Southport Tramways Committee has come to the conclusion that owing to the high cost of running omnibuses there are no districts in Southport where it would pay to run them as feeders to the trams. They are also unanimous in the opinion that it would not be advisable to substitute buses for trams.

The Ministry of Transport having refused the application of Burnley Tramways Committee for a suspension of payment to the sinking fund for tramway constructional works for a period of five years, in order to utilise the money for relaying certain tracks, the committee have applied for sanction to borrow £46 950 to carry out the work.

At Edinburgh Council meeting last week a motion by Mr. Whitson disapproving the Council's decision of May 4 to electrify the Hanover Street–Mound tramway route was carried by a large majority. It was stated that it would cost £80 000 to electrify this route, and that by electrifying 300 yards of the Chambers Street track people travelling by car from the North Side to the Infirmary might be taken by Broughton Street, Leith Street, the Bridges, and Chambers Street, and so the £80 000 proposed to be spent on the Hanover Street-Mound route would be saved.

The question of the electrification of some of the steam railroads in Quebec and Ontario was recently discussed in the Dominion Parliament. A member asserted that the railway in the St. Maurice Valley could be worked very much better and cheaper by electricity than by steam, and as the Canadian Pacific Co. proposed to convert the line from Montreal to Quebec the urban lines around Montreal should have been electrified. In reply, the Minister of Railways said his Department was keenly alive to the situation, and as soon as financial conditions warranted a heavy expenditure the matter would be dealt with.

Foreign Notes.

The German Syndicate of Manufacturers of High Tension Insulators have decided to increase prices as from June 1 by about 40 per cent.

Lucerne and Goldau electric railway, on the Saint Gothard line, was opened last week. The first train ran from Goldau to Lucerne in 32 minutes, with three stops.

Mr. C. G. Schluderberg, of the Westinghouse Electric and Manufacturing Co., has been elected president of the American Electro-Chemical Society for the ensuing year.

Progress is being made with the electrification of the first section of the Central Brazil Railway (about 53 miles), and orders have been let in the United States for the supply of 22 electric locomotives and 150 motor coaches.

Two large electric locomotives have been built by the Ganz Danubian Works of Budapest, and will shortly be tested on a strip of line which has been electrified with a view to the ultimate electrification of the Hungarian State Railways.

Fire Risk Rules for Radio Equipment have been drafted and are under consideration by a committee of the National Board of Fire Underwriters. In the meantime copies of a tentative code have been circulated by the Department of Commerce.

Los Angeles Municipal Council recently acquired for $12 044 370 the distributing networks of the Southern California Edison Company which are within the municipal boundaries. The Council has undertaken to take all bulk supply needed from the company and not to compete with the company outside the municipal area.

An electric light company was recently organised by the merchants in Tehtsing, Chekiang. The Ling Hu Tung Li Electric Light Co., of Huchow, Chekiang, has been granted a license by the Ministry of Agriculture and Commerce. The Pao Sing Electric Co., in Hupeh, has been registered by the Ministry of Agriculture and Commerce.

For the year ended March 31 last the sales of the Westinghouse Electric and Manufacturing Co. amounted to nearly $100 000 000, a higher figure than in any previous year, except in 1919–21. The net profit was $6 260 180, and after taking into account miscellaneous receipts and paying bond interest, etc., the amount available for dividends was $5 837 389. The orders booked since January were higher than in 1921 and there has also been a keen demand for radio-telephone receiving apparatus.

The possibility of electrifying two or more divisions of the National Railways of Mexico is being investigated. As oil fuel must be hauled from Tampico, it is thought that electric traction would be more economical than steam upon the mountain divisions, especially as there is an abundance of hydro-electric power available. The Guanajuato Electric Light and Power and the Northern Power Companies are in a position to supply electricity if required, but it is thought an independent plant or plants may be erected.

Important changes have recently taken place in the directorate of the General Electric Co., of America. Mr. C. A. Coffin has retired from the chairmanship and is succeeded by Mr. O. D. Young, and Mr. Gerard Swope becomes president in place of Mr. E. W. Rice, jun., who will devote his whole attention to the scientific and engineering phases of the company's business. Other changes and promotions have also taken place. Mr. Coffin remains a director, and the office of hon. chairman has been created for Mr. Rice.

In order to stimulate interest in hydro-electric development in Brazil it has been decided to hold a hydro-electric congress in connection with the forthcoming Centennial Exhibition at Rio de Janeiro. The potential wealth of the country in undeveloped water power has not yet been fully investigated, but it is known that its resources are large and the approximate capacity of several falls has been calculated. It is expected that the Congress will lead to more organised efforts to utilise water power for industrial purposes and for traction.

Mr. J. E. Aldred, a New York banker, is reported to have acquired a controlling interest in certain Italian Hydro-electric Companies which supply electricity in Milan, Venice and Turin. Between $25 000 000 and $50 000 000 will ultimately be invested in these enterprises, and Mr. Aldred's engineers are at present in Italy preparing reports on the undertakings. The financial arrangements will, it is stated, be worked out in New York and London. Mr. Aldred is president of the Shawinigan Water and Power Co., and chairman of the Pennsylvania Water and Power Co. and of the Consolidated Gas, Electric Light and Power Co. of Baltimore.

The Paris Orleans Railway has recently placed an important order for electric equipment, including 80 freight locomotives and 80 heavy high-speed passenger motor cars for the section of the main line between Paris and Vierzon, a distance of about 125 miles. This section is being electrified on the direct current, 1 500 V system, and most of the equipment will be supplied by French electrical manufacturers, including the Compagnie Française Thomson-Houston, but it is expected that some American material will be used. The order for the electric locomotives, which will weigh 250 000 lb. each, and be capable of running at speeds of 80 and 85 miles an hour, has not yet been given out, but it is expected that the company will do so at an early date, and also let additional tenders for equipment, as about 2 000 miles of line are to be electrified.

Exhibition Notes.

The British Industries Fair (Birmingham) is to be held from February 19 to March 2 next year.

The sum of £60 000 has now been guaranteed by Manchester for the British Empire Exhibition, which will be held next year. This is the largest amount guaranteed by any city outside London.

At a meeting of the guarantors in connection with the proposed Welsh National Exhibition to be held in Cardiff, it was decided, in view of the industrial conditions obtaining at present, to postpone further discussion on the matter until May, 1923, by when, it is hoped, the time will be more favourable.

It has been decided to hold the Shipping, Engineering, and Machinery Exhibition at Olympia in September next year. Dr. H. S. Hele-Shaw, president of the Institution of Mechanical Engineers, has been elected chairman of the Hon. Committee of experts, with Captain H. Riall Sankey, vice-chairman.

In view of recent announcements of a projected voyage round the world by the steamship *Orontes*, renamed *British Trade*, the directors of British Trade Ship, Ltd., announce that this ship has no connection whatever with British Trade Ship, Ltd., whose proposal is to build a special ship for the purpose of an exhibition and send her round the world in 1924.

The International Technical Exhibition of Engineering will be held at Liége from June 11 to July 14, under the organisation of the Association des Ingenieurs de l'Ecole de Liége. At the last exhibition, organised by the Association in 1905, there were nearly 1 200 exhibitors, representing more than 30 nations. The exhibits will include machines and machinery equipment, instruments, models, books, plans, diagrams, and all documents relating to engineering.

An International Metal Industries Exhibition is to be held at Ghent from June to October next year, under the patronage of H.M. the King of the Belgians and with the co-operation of the Belgian Government, and the Province and City of Ghent. It is intended, the Department of Overseas Trade states, to form a British section, the official representative for which in the United Kingdom is Mons. C. J. A. Lobo, Shirley House, 10, Throgmorton Avenue, London, E.C.2. The exhibits, covering every branch of the metallurgical industry, will be divided into 13 main groups and 46 classes, all confined to articles with a metallic construction of not less than 50 per cent. German exhibits, however, will not be admitted. The main groups include:—General mechanical apparatus; metallurgy and mines; machine tools; electricity; decoration and hygiene of the home (five classes—lighting, heating, ventilation, sanitation, ironmongery, etc.); transport.

Wireless Notes.

Remarkable records were made in cabling the result of the Derby last week. The Eastern Telegraph Company received the names of the three winning horses at 3.24½ p.m. at their offices in Moorgate, London, and telegrams recording this result were delivered in Bombay at the local equivalent of 3.26 p.m. (London time); in Sydney at 3.27 p.m., in Durban at 3.26 p.m., and in Calcutta at 3.30 p.m. Owing to the immense interest created by the race all over the world, special arrangements were made to clear the lines. The Imperial Cable also achieved a remarkable record. The result of the race was telephoned to the Central Telegraph Office, and was immediately transferred to the Imperial Cable. The message arrived in Sydney at 3.30 p.m. English summer time, which is equivalent to 12.30 a.m. Australian time, or six minutes after the time of despatch from London. The previous record in the time of transmission by the Imperial Cable between the Central Telegraph Office and Australia was eleven minutes, on the occasion of the 1921 Derby.

The wireless message sent out at the instance of the Chief Constables' Association on Friday last from Marconi House, London, respecting the apprehension of an imaginary criminal, was clearly heard by a representative of The Electrician who was "listening-in" at the workshop of Mr. G. Castagnoli, at Braintree, Essex. The message was also picked up by a "detective" provided with a portable receiving set for the purpose of the experiment between Chelmsford and Braintree. The wording of the despatch was as follows:—"Wanted at Chesterfield on a charge of obtaining food and money value 5s. by false pretences from William Stiggles, with intent to defraud, on May 21, 1922, Frank Beecroft, alias Bennett and Merchant; ship's cook; no fixed abode; age 32, height 5 ft. 4½ in.; brown hair, inclined to be curly, hazel eyes, mole under right eye. Warrant issued. Information to Chief Constable, Chesterfield." Three of the most important words, namely, the surname and alias of the fugitive, were not rendered quite so clearly as they might have been, and it would appear to be advisable to repeat each name letter-by-letter.

A military telephone between Tsingkiang and Chunghing has been installed by the Kiangsu military authority with the approval of the Ministry of Communication.

The Rutenberg Concession.

In the House of Commons on the 31st ult., Mr. A. T. DAVIES asked the Secretary of State for the Colonies by what authority the High Commissioner for Palestine granted a concession for important public works to Mr. Rutenberg; what efforts or inquiries were made by the High Commissioner to discover British engineers who could command the capital necessary to carry through the work in contemplation; what were the names of the capitalists in the United States who were finding the necessary capital for Mr. Rutenberg; and whether the High Commissioner was empowered to grant concessions to foreigners without consultation with his Majesty's Government.

In reply to the first and second parts of the question, Mr. CHURCHILL referred his questioner to the statement made in reply to a question by the member for Twickenham on November 7 last. Mr. Rutenberg had not yet received the concession referred to, but an agreement was concluded with him in September, 1921, under which, provided he succeeded in forming a limited liability company with adequate capital within two years from that date, the concession would be granted to the company on application. The agreement was concluded under the authority of H.M. Government. No such company had yet been formed, and he was consequently unable to give any information as to the source from which the capital was to be provided.

With regard to the last part of the question, the High Commissioner was not empowered under present conditions to grant concessions of any kind without the prior approval of H.M. Government.

German Scientific Instruments.

At last week's sitting of the Committee appointed under the Safeguarding of Industries Act to inquire into the complaint by British manufacturers of optical and other scientific instruments of alleged unfair German competition, the case for the importers of German goods was heard.

Mr. Inskip, K.C., M.P., on behalf of seven agency firms, said that every effort was made to keep German trade in the hands of authorised agents who were not permitted to sell articles below certain prices. Though illegitimate trade was being done from Germany, the genuine agents were not putting goods on the market in competition with British goods at unfair prices. Scientific study was an international affair, and people were prepared to purchase microscopes regardless of expense. He urged that it was not German, but American and French competition that affected British manufacturers.

PROF. W. A. BONE said that scientific workers were impeded and retarded by the duty on foreign instruments. Their work demanded the very finest apparatus that could be procured, and in many cases such could only be purchased from abroad. An increased price of instruments would be a hardship to students. Already drawing and experimental equipment had increased in price in some cases by several hundred per cent. The consensus of opinion was decidedly that microscopic lenses made abroad were slightly better than those made at home.

Agents for German instruments said that their trade had greatly fallen off since the imposition of the duty of 33⅓ per cent.

The Committee adjourned until June 19.

Institution Notes.

The annual conversazione of the INSTITUTION OF CIVIL ENGINEERS will be held at the Institution Building in Great George Street on Tuesday, June 27.

The 27th ANNUAL CONVENTION of the INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION will be held at Wolverhampton from Tuesday, June 20, to Friday, June 23. In our Arrangements for the Week we give the complete programme of the proceedings.

The BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION has just issued, in its quarterly Bulletin, a Union List of Periodicals of interest for reference on industrial metallurgy. The service provided by fourteen libraries in London, Birmingham and Manchester is clearly indicated so far as concerns the 118 periodicals which have been selected, and the next edition will include additional libraries and periodicals which experience with the present list suggests as desirable.

The POWELL DUFFRYN COAL COMPANY, which is engaged in large colliery developments in South Wales, have made great progress towards the complete electrification of their pits. The main power station is at Bargoed, and an extension to this has just been completed by Heenan and Froude. The capacity of the turbo generators is 18 000 kW, and another set is to be installed of 12 000 kW capacity. In the Aberdare Valley there is another main power station having a capacity of nearly 30 000 kW. From these main stations the power is transmitted to the several pits and sinkings by means of overhead cables supported on steel latticed transmission poles.

Miscellaneous.

On the 31st ult. the ROYAL ASSENT was read to the following new Acts of Parliament: Ayr Burgh (Tramways), etc., Confirmation Act, Metropolitan Railway Act and Yorkshire Electric Power Act.

While placing a belt round some shafting at the electrical porcelain works of Gaskell & Grocott, Longport, last Friday, JOHN COOPER was caught by the belt, and his left arm was torn off from the shoulder and his chest badly crushed. He is reported to be in a critical condition.

An order was made on May 27 for the RESTORATION OF PATENT No. 1453, of 1915, granted to George Saint for "Mercury globule electrical contact maker for releasing mine winding signal indicators, actuating indicators of the stopping, starting and reductions of speed of machinery and the like."

An application has been made for an EXTENSION OF THE PERIODS OF PATENTS Nos. 21290 and 23271 of 1906 granted to Joseph Johnson and John Tetley. Notices of opposition must be lodged at Mr. Justice Sargant's chambers, 317, Royal Courts of Justice, Strand, London, W.C., seven days before July 7, when an application will be made to the Court concerning the matter.

The NATIONAL ASSOCIATION OF SUPERVISING ELECTRICIANS will hold a smoking concert at the St. Bride's Institute, Ludgate Circus, London, E.C., on Tuesday, June 13th, at 7.30 p.m. At this gathering, which will bring the 1921-2 Session to a close, Major T. Vincent Smith will resign his office on the ground of ill-health and will hand over his duties to his successor, Mr. W. E. Highfield, who has accepted the office of president.

At the annual conference of the ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS, held in London last week, a resolution urging that the time had arrived when the position of technical education should be reviewed, and asking for the appointment of a committee of inquiry to investigate the whole field of technical education, was moved by PROFESSOR G. KNOX, of South Wales and Monmouth School of Mines. The motion was carried, also another resolution "viewing with alarm the reduction in the number and value of scholarships available for higher education."

The Board of Trade state that they have received a complaint by the British Electrical and Allied Manufacturers' Association that vulcanised fibre manufactured in the U.S.A. is being sold in the United Kingdom at prices below the cost of production as defined by the Safeguarding of Industries Act, 1921, and that in consequence employment in the vulcanized fibre industry in the United Kingdom was likely to be seriously affected. They have therefore appointed a committee to inquire into the case. The first sitting for the taking of evidence will be at 11 a.m. on Tuesday, June 20, at 5, Old Palace Yard, Westminster, London, S.W.1.

An example of BROAD TENDERING BY BRITISH CONTRACTORS who compete for orders in India is given in the "Times Trade Supplement." The Corporation of Calcutta requires eight electric lorries for conservancy service. The tenders for 5-ton lorries, based on exchange at 1s. 4d. per rupee and subject to exchange variation, were as follows:—Heatly and Gresham (Clayton lorries), Rs.19 863 each, or total for eight, Rs.1 58 904; Jessop and Company (Orwell lorries), Rs.24 524 each, or total for eight, Rs.1 96 272; The Associated British Engineers (Garrett lorries), Rs.30 500 each, or total for eight, Rs.2 44 000; Walford and Company (electromobile lorries), Rs.32 330 each, or total for eight Rs.2 58 640. The tender of Heatly and Gresham was recommended for acceptance, subject to the inspection of the lorries in England by the chief engineer and his approval.

The total number of applications for patents during 1921 was 35 132, which, although 1 540 less than the number for 1920, is substantially more than in any pre-war year. The complete specifications filed numbered 19 159, or 2 637 less than in 1920, the decrease being due to the expiry, on January 10, of the extensions of time granted by the Treaty of Peace with Germany and the Berne Agreement for the filing of applications under the Convention. The number of applications to register designs was 13,387, against 13 669 in 1920, and the number of designs registered was 12 313, as compared with 13 071. There were 11 959 applications for the registration of trade marks as compared with 14 064 in the previous year. Trade marks registered numbered 7 518, an increase of 396 over 1921.

Damages for Tramcar Passenger.

At Hamilton Sheriff Court last week Sheriff Shennan awarded Mrs. E. Wilson £50 damages for injuries sustained while travelling in a tramcar of the Lanarkshire Tramway Co. Plaintiff sued the company and the Hamilton Central Co-operative Society, because the injuries were alleged to be due to a collision between the tramcar and a motor lorry belonging to the Co-operative Society.

The Sheriff Substitute found that plaintiff received a shock to her nervous system from the collision incapacitating her at first wholly and then partially for several months; that the tramcar was being driven carefully and at a moderate speed and the driver was blameless; but that the accident was caused through the fault of the driver of the motor lorry in trying to cross in front of the tramcar when it was within a short distance of the lorry.

Companies' Meetings, Reports, etc.

Oriental Telephone and Electric Company.

In the course of his speech at the annual meeting last week of the ORIENTAL TELEPHONE AND ELECTRIC COMPANY, Sir H. Babington Smith (chairman of the company), who presided, said that the important question of the Indian licences had at last been settled. The negotiations began more than two years ago. The terms, briefly, were that the Government undertook not to exercise their option of purchasing under the existing licence before 1943. If the option were exercised then, the purchase would be on the terms defined in the original licences—that was, on plant value without any payment for goodwill. Conditions were laid down for securing efficiency in the plant and its operation (including the obligation to provide automatic or central battery plant in all exchanges over 200 subscribers). The maximum rate chargeable for an exchange connection within four miles of the exchange had been raised from Rs. 250 to Rs. 350 per annum per subscriber, subject to certain conditions as to periodical revision of the rates, such revision to be on the basis of a standard dividend of 12½ per cent. on the paid-up capital. The rate charged in the past had not, till recently, exceeded Rs. 200. The agreements applying these conditions to the Bombay and Bengal Companies had already been signed. Those relating to the company's branches at Madras and Rangoon were practically settled, and would be signed in the near future. Steps had been taken for organising the Bombay and Bengal undertakings on a new basis, suited to the new conditions, and for raising the capital required for new developments. It was probable that it might be found advisable to form separate Indian companies to take over the systems at Madras and Rangoon.

Mr. Parker Ness had, at the request of the board, made another journey to the East. He left this country last October, and had visited Bombay, Calcutta, Madras, Rangoon, Singapore and Hongkong. Mr. W. W. Cook, the company's consulting engineer, had also gone to India, Singapore and Hongkong for the purpose of advising on numerous questions which had arisen. Mr. Cook was recently appointed by the House of Commons Committee on Telephones to be its technical adviser. He was giving particular attention to the question of the use of automatic exchanges in tropical climates and would advise also on questions of rates and organisation generally as well as on the valuation of the company's plant. The new exchange at Singapore, which had been brought into use in June, 1920, had proved very satisfactory, and the efficiency of the service given was now generally recognised. The Singapore licence extended at present to 1934, and the company had for some time past been in communication with the Singapore Government with a view to a prolongation. Similar questions had arisen at Hongkong, and they had just heard from Mr. Parker Ness that an agreement had been arrived at for an extension of the Hongkong licence to 1955; for a revision of the rates; and for the formation of a local company, the Oriental Telephone Company receiving payment for its property in debentures and shares of the new company. The liquidation of the Egyptian company had at last been completed, and the final distribution of £15 638 had been made by the liquidator.

Shanghai Electric Construction.

Addressing the shareholders at the annual meeting of the SHANGHAI ELECTRIC CONSTRUCTION Co. last week, Sir Alfred Dent, who presided, said that, although the accounts did not show the largest sterling profit in the history of the company, they might be regarded as satisfactory, inasmuch as the operating profit, reckoned on the usual basis of 2s. to the dollar, was larger than ever before. After providing for all expenses there was a disposable balance of £122 361. The loss by depreciation of subsidiary coinage amounted during the year to £93 731, which was rather more than the company's operating profit. Negotiations with the municipal council for extension of the system under railless traction and for additional track facilities were well advanced, and the indications were that a first instalment of extensions would shortly be proceeded with. The traffic pressure was very great, and it was realised that the congestion in the streets could best be relieved by the extensions of the system which were contemplated and by the proposed doublings of the track and improved terminal facilities. The new routes to be developed had at length been agreed upon with the municipal council, but unfortunately they had not reached an agreement on all the terms and conditions. The company were recently approached by the Singapore Electric Tramways Company, and negotiations had been opened with a view to their making arrangements for administering the Singapore system.

Mr. Donald McColl, the company's general manager, said the fact that the volume of traffic had increased from 11¾ millions of passengers in 1909 to 120 millions in 1921, with only a mile and a third of additional route, and was increasing further, so that they were carrying 7 000 000 passengers per mile of route per annum, was evidence of the congestion and of the urgency of extensions. If all the proposed extensions could be introduced to-morrow they would only partly meet existing needs.

An abstract of the accounts was given in our issue of May 19.

Dublin and Lucan Electric Railway.

Mr. J. W. Hill (chairman) presided at the 72nd annual meeting of the DUBLIN AND LUCAN ELECTRIC RAILWAY COMPANY. The report showed that, after providing for debenture interest, and transferring £1 023 from the amount received under the Railways (Settlement of Claims) Act, 1921, there was available £1 339, out of which was recommended the payment of a preference dividend of 5 per cent. for the half-year, absorbing £475 (leaving the cumulative preference dividend six years in arrears). The sum of £864 is carried forward. The chairman said that the British Government had entered into an agreement to pay £3 000 000 in settlement of all claims by the Irish railways, and, out of a sum paid on account, this company had received £2 728. One-sixth of the total sum available would be allocated to the smaller companies to divide amongst themselves. This company, with other smaller companies, was having its interests protected by representation at the Railway Commission, and everything possible would be done to further the interests of the undertaking and the shareholders. The receipts were considerably lower than in 1920, and it was only by transferring a considerable amount from the Government sum referred to that they were able to pay the dividend recommended. Last year, owing to curfew regulations, strikes, coal supplies, etc., the mileage was further reduced, and the number of passengers carried was reduced from 502 719 in 1920 to 387 194 in 1921. With regard to wages, while there had been some reduction, the sum payable was out of all proportion to the revenue of the company, but the directors had no responsibility for it, the huge increases granted during the war being decreed by the British Government.

Electric Construction Co.

The net profit of the ELECTRIC CONSTRUCTION Co. for the year ended March 31 last, after providing £6 131 for debenture interest and £10 000 for depreciation, amounted to £82 685, plus £53 498 brought forward, less provision for excess profits duty for year 1921 (final period), £30 000, making a total of £106 182 10s. Interim dividends paid on November 30, 1921, on the preference and ordinary shares amounted to £11 197, leaving a balance of £94 985, which the directors recommend be appropriated as follows: Final dividend at the rate of 7 per cent. on the preference shares (£2 197); final dividend at the rate of 9 per cent. on the ordinary shares, making a dividend of 7½ per cent. for the year (£13 500); bonus of 2½ per cent. on the ordinary shares, all under deduction of income tax (£7 500); transfer to general reserve fund, which will then amount to £140 000 (£19 715); transfer to dividend equalisation fund (£30 000); leaving £22 073 to be carried forward.

The BRAZILIAN TRACTION, LIGHT AND POWER Co. announce a dividend of 1½ per cent. on the cumulative preference shares to holders of record on the 15th inst.

YORKSHIRE (WEST RIDING) ELECTRIC TRAMWAYS COMPANY announce a dividend of 3 per cent. on the Preference shares for the half-year ending the 30th inst.

A dividend of 1¾ per cent. has been declared by the PENNSYLVANIA WATER AND POWER COMPANY for the quarter ending June 30 to holders of record on June 16.

THE CONSOLIDATED GAS, ELECTRIC LIGHT AND POWER COMPANY OF BALTIMORE has declared its regular quarterly dividend of $2 per share on the series "A" preferred and common stock.

The directors of BRUNNER, MOND AND CO., recommend a dividend on the ordinary shares of 11 per cent. per annum, making with the interim dividend, 8 per cent. for the year, subject to deduction of income tax.

The annual accounts of PERNAMBUCO TRAMWAYS AND POWER Co. show, after providing for debenture interest and transferring £10 230 to capital reserve, and £1 500 to amortisation fund, a surplus of £1 108, which it is proposed to carry forward.

The net profit of J. STONE AND CO. for 1921, after making the necessary allowances for depreciation, etc., was £176 152, making with £52 633 brought in £228 785. The directors recommend placing £25 000 to reserve, paying a dividend of 7½ per cent. per annum on the ordinary shares, and carrying forward £128 755.

The directors of the WESTERN TELEGRAPH COMPANY have declared the third quarterly interim dividend of 5s. per share, free of income tax, for the year ending June 30, 1922, payable to shareholders registered on June 9, being at the rate of 10 per cent. per annum. The transfer books of the company will be closed from June 9 to 16, inclusive.

The profits of the INTERNATIONAL AUTOMATIC TELEPHONE Co. for 1921 were £11 799, plus £634 brought in, making £12 433. Of this directors' fees and dividend on preference shares absorbed £11 790, leaving £643 to be carried forward. A dividend on the preference shares for 1921 has already been paid to the extent of 6 per cent., leaving 1 per cent. to be paid on July 1.

The net revenue for 1921 of the MERTHYR ELECTRIC TRACTION AND LIGHTING COMPANY amounted to £21 074. After deducting administration and general expenses, debenture and other interest, and placing £5 000 to renewals account, there remains £5 002 plus £1 429 brought forward, making £6 431. The directors propose to place £1 200 to reserve, and to pay a dividend of 6 per cent. on the ordinary shares (same as previous year), carrying forward £1 331.

The report of the AUTOMATIC TELEPHONE MANUFACTURING Co. for 1921 shows profit of £28 578, plus £6 861 brought in. After providing for directors' fees (£2 560), debenture interest (£9 567), depreciation on patents, etc. (£3 000), dividend on preference shares

(£12 000), £4 313 remains to be carried forward. Owing to the heavy cost of financing orders due to the high Bank rate and the writing down of stock values, the directors are unable to pay any ordinary dividend.

The accounts of the BRISBANE ELECTRIC TRAMWAYS INVESTMENT COMPANY for 1921 show dividends for the year on shares held by the company £99 933, plus sundry receipts £4 381 and £42 837 brought in, making £147 151. After deducting general charges in London (including corporation profits tax) and expenditure in Brisbane, the net balance was £132 487. After paying debenture interest and preference dividend, the directors recommend a balance dividend of 4s. per share, free of tax, making 8 per cent. for the year, carrying forward, subject to corporation tax, £46 162.

The report for 1921 of the LEWES AND DISTRICT ELECTRIC SUPPLY COMPANY states that the total capital expenditure amounted to £35 919, compared with shares and debenture stock issued to the amount of £32 070. Surplus on working showed a balance of £4 575. After adding interest (£50) and deducting administration and general expenses and remaining items charged against revenue, including debenture interest and provision for £1 750 for renewals, totalling £4 170, there remained £455, making with £1 119 brought in £1 574, which the directors recommend be carried forward.

The net revenue of the DELHI ELECTRIC TRAMWAYS AND LIGHTING COMPANY for 1921 was £22 669. In place of a substantial profit on exchange earned during 1920 there was a small loss under that head during 1921. Profit, after charging general expenditure in London and Delhi and debenture interest, was £18 253, plus £982 brought in, making £19 235, less depreciation of plant and equipment £6 000, renewals reserve, £1 500, reserve for taxation £1 000, leaving £10 735. Dividends of 8 per cent. per annum upon the preferred and participating shares, and 1s. 6¼d. per share upon the ordinary shares are proposed, leaving £530 to be carried forward.

New Companies.

H. Haydon and Co.

H. HAYDON AND CO., LTD. (182 123.)—Private company. Reg. May 29. Capital, £1 500 in £1 shares. Electric light and general electrical engineers, etc. First directors: H. H. Haydon (managing director) and R. Dunn. Secretary: R. Dunn. Registered office: 3, Welford Road, Leicester.

Sunray Ltd.

SUNRAY, LTD. (182 199.)—Private company. Reg. May 31. Capital, £2 000 in £1 shares. Manufacturers of and dealers in electric cables, wires, lines, lamps, and all kinds of electrical plant and accessories, etc. First directors:—J. A. Hartley and C. S. Wallbridge. Reg. office: 196, Greengate, Salford, Manchester.

Breward Sales Co.

BREWARD SALES CO., LTD. (182 055.)—Private company. Reg. May 26th. Capital, £10 000 in £1 shares. Manufacturers, designers and importers of and dealers in electrical plant, house-lighting sets, accumulators, batteries, dynamos, and electric fittings of all kinds, etc. Subscribers: W. A. Anderson and L. R. Shaw. Registered office: St. Margaret's House, 57–59, Victoria Street, S.W.1.

L. McMichael, Ltd.

L. MCMICHAEL, LTD. (182 184.)—Private company. Reg. May 31. Capital, £10 000 in £1 shares. Wireless engineers and contractors, dealers in electrical, magnetic, galvanic and other apparatus, etc. Permanent directors:—Hubert Leslie McMichael, Reni H. Klein, and Armand G. Bloch. Secretary: Leslie McMichael. Reg. office: Providence Place, West End Lane, Kilburn, N.W.

Radiola Wireless Telephone Parts Co.

RADIOLA WIRELESS TELEPHONE PARTS CO., LTD. (182 102.)—Private company. Reg. May 27. Capital, £8 000 in £1 shares. Manufacturers, importers and exporters of and dealers in wireless telephones and telephonic and telegraphic apparatus, parts and accessories, etc. First directors: W. Mansfield and J. F. Little. Secretary: W. Mansfield. Registered office: 17, Brunswick Street, Liverpool.

H. D. Butler and Co.

H. D. BUTLER AND CO., LTD. (182 157.)—Private company. Reg. May 30. Capital, £2 500 in £1 shares. To acquire the business of a wireless engineer and electrical instrument maker and agent carried on by H. D. Butler at 222, Great Dover Street, W., as "H. D. Butler and Co." First directors:—H. D. Butler (permanent managing director) and G. A. Huxley. Reg. office: 15, Queen Street, Cheapside, E.C.2.

South Eastern and Chatham Construction and Power Co.

THE SOUTH EASTERN AND CHATHAM CONSTRUCTION AND POWER CO., LTD. Reg. May 29. Nominal capital, £10 000 in £10 shares. To adopt an agreement with the S.E. Railway Co., the L.C. and D. Railway Co., and the S.E. and C. Railway Companies Managing Committee, and to carry on the business of engineers, contractors for the electrification of railways, tramways or similar works, constructors of generating and transforming stations, suppliers of electricity or other energy, etc. First directors: H. C. Orme Bonsor, Brigadier-General Hon. Everard Baring, Viscount Chilston, Sir William Hart Dyke, Charles Sheath, Sir Alfred Waldron Smithers, P. Crosland Tempest. Solicitors: H. N. Groves, 9 and 10, Railway Approach, London Bridge, S.E. File number 182 131.

Arrangements for the Week.

TUESDAY, JUNE 20th.

INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

9.0 *a.m. to* 9.45 *a.m.* Assembly at Grand Theatre, Lichfield Street, Wolverhampton.

10 *a.m.* At the Grand Theatre, Wolverhampton Opening of the Convention. Welcome by the Mayor; Presidential address by Mr. S. T. Allen, chief engineer and general manager of the Wolverhampton Electricity Supply Department; paper on "The Extension of the Uses of Electricity for Domestic Purposes," by Lieut.-Col. W. A. Vignoles, borough electrical engineer, Grimsby.

1 *p.m.* Luncheon at the Royal Artillery Headquarters, West Park, Newhampton Road, Wolvernampton.

2.30 *p.m.* Visit to Apley Terrace on the River Severn.

8.30 *p.m.* Reception by the Mayoress at the Art Gallery, Lichfield Street, Wolverhampton.

WEDNESDAY, JUNE 21st.

9 *a.m.* Members residing in Birmingham assemble outside the Queen's Hotel (New Street Station), where the conveyances for Stoke-on-Trent will be in readiness; members residing in Wolverhampton assemble at St. Peter's Steps.

11 *a.m.* In the Assembly Room, Town Hall, Stoke-on-Trent. Paper: "The Administration and Control of Electricity Departments," by Mr. E. Calvert, chief electrical engineer, Finchley. (A visit to Pottery Works will be arranged for any of the ladies or others who do not attend the reading of the paper. Conveyances will be in attendance at 11.15 a.m.)

1 *p.m.* Luncheon to members, delegates, and visitors, by the Stoke-on-Trent Electricity Committee, in the King's Hall, Town Hall.

2.15 *p.m.* Visit to: (1) Central Power Station; or (2) Main Electricity Sub-Stations of the Stoke-on-Trent Corporation; (3) Pottery Works*; or (4) Trentham Gardens direct.

4 *p.m.* Assemble at Trentham Gardens, where facilities for tennis and boating are available.

5.30 *p.m.* Conveyances will leave the Gardens for Wolverhampton and Birmingham.

* The following firms have arranged to conduct parties of members through their works:—Pottery Works—Cauldon Potteries, W. T. Copeland and Sons, Doulton and Co., Ltd., Mintons, Ltd., Josiah Wedgwood and Sons, Ltd.; Engineering Works—The Boving Engineering Works, Cowlishaw, Walker and Co. (1920), Ltd., Kerr Stuart and Co., The North Staffordshire Railway, The Potteries Electric Traction Co.

THURSDAY, JUNE 22nd.

9 *a.m.* Members residing in Wolverhampton should assemble at St. Peter's Steps, where the conveyances for the General Electric Company's Works, Witton, Birmingham, will be in readiness.

9.40 *a.m.* Members residing in Birmingham should assemble outside the Queen's Hotel (New Street Station).

10 *a.m.* In the Main Hall, Magnet Club, Witton. Paper: "Sub-Station Equipment, including Automatic Control," by Mr. R. A. Chattock, city electrical engineer, Birmingham.

11.30 *a.m.* Tour round the various branches of the Witton Works.

(The General Electric Co. have placed their club house, with recreation rooms and grounds, at the disposal of members. An exhibition of domestic and other electrical labour-saving appliances will also be held during the visit).

1.30 *p.m.* Luncheon at the Magnet Club.

2.30 *p.m. prompt.* Visit to Nechells Power Station of the Birmingham Corporation.

3.45 *p.m.* Conveyances will leave Nechells Power Station for the Botanical Gardens, where members will be received and entertained by the Rt. Hon. the Lord Mayor of Birmingham.

5.30 *p.m. prompt.* Leave Garden Party.

7.45 *p.m. for* 8 *p.m.* Annual dinner (evening dress), in the Royal Field Artillery Headquarters, West Park, Newhampton Road, Wolverhampton.

FRIDAY, JUNE 23rd.

9.30 *a.m.* Meeting of the Council in the Grand Theatre, Wolverhampton.

10.30 *a.m.* Annual general meeting in the Grand Theatre, Wolverhampton.

Afternoon. Visit to Wolverhampton Corporation Electricity Generating Station, Commercial Road, when the President (Mr. S. T. Allen) will personally welcome members.

TUESDAY, JUNE 13th.

THE RONTGEN SOCIETY.

8.15 *p.m.* At the Institution of Electrical Engineers, Victoria Embankment, London, W.C.2. Annual general meeting.

Tenders Invited and Accepted.

UNITED KINGDOM.

TYNEMOUTH CORPORATION, June 26.—One a.c. booster. Specifications from the Borough Electrical Engineer.

CADBURY AND FRY JOINT BUYING DEPARTMENT.—Electric cables, fittings and accessories. Specifications from ENM, Cadbury Bros., Bournville.

EDINBURGH CORPORATION. June 20.—Thirty tramcar-top covers. Specification from the Tramways Manager, 2, St. James's Square, Edinburgh.

EDINBURGH CORPORATION, June 12.—Underground insulated cables for twelve months. Specifications from Engineer, Electricity Dept., Dewar Place, Edinburgh.

CHURCH OF OUR LADY OF THE ROSARY, NENAGH. June 17.—Wiring and fitting. Specifications, etc., from Messrs. MacEntee, Lavelle and Gregory, 22, Nassau Street, Dublin.

CLYDE NAVIGATION TRUSTEES. June 12.—Electrical stores, rubber, iron and steel ironmongery, etc., for three, six or twelve months. Specifications from the Superintendent of Stores, 1, Graving Dock, Govan.

PORTSMOUTH TRAMWAYS COMMITTEE. JUNE 13.—Supplies for six or twelve months, from July 1, including insulating materials, overhead line materials. Particulars from the Engineer, Mr. V. J. Lironi, Engineer's Office, Vivash Road, Fratton, Portsmouth.

REIGATE TOWN COUNCIL. JUNE 27.—(1) Diesel engines and single phase alternators; (2) two steel tanks, 20 ft. diameter, for oil storage; (3) 12-ton overhead traveller driven by single phase electric motors; (4) alteration in position of existing cast-iron water tank. Particulars from Mr. C. H. Wordingham, 7, Victoria Street, Westminster, S.W., and 11, Mosley Street, Manchester.

AUSTRALIA.

VICTORIAN STATE RAILWAYS. June 28.—2 687 tons 80 lb. rails, 2 200 tons 100 lb. rails, 224 tons fishplates. Specifications from John Coates and Co., Victoria House, Melbourne Place, Strand. London, W.C.2.

JOHANNESBURG CORPORATION have been recommended to accept the tender of Bruce Peebles and Co. for one 2 000 kW Bruce Peebles-La Cour converter, £10 750.

ABERDEEN Town Council have accepted the tender of the Steel Construction Company, of Glasgow, for the steel work for the first section of the new boiler-house at the electricity works, Ferryhill, Aberdeen, at a sum of £8 113.

GLASGOW CORPORATION has been recommended to accept the following tenders: Carron Co., McDowall, Steven and Co., and R. Taylor and Co., c.i. boxes, section pillars, etc.; Stewarts and Lloyds and Scottish Tube Co., tubes and fittings; Enfield Ediswan Cable Works, Callender's Cable and Construction Co., W. T. Glover and Co., and Craigpark Cable Co., cables; Edison Swan Electric Co., Chamberlain and Hookham, and Ferranti, Ltd., d.c. meters; Beacon Carbons, Ltd., carbons; Edison Swan Electric Co. and Metropolitan-Vickers Electrical Co., a.c. meters; Metropolitan-Vickers Electrical Co., reconstructing car magnetic brake equipments and adding skid-proof attachments; Steele, Turner and Wright, T. Lane and Sons, Alexander and Co., General Electric Co., Simplex Conduits, Ltd., Malcolm and Allan, Wm. Brown and Co., and Alston, Scott and Co., electric fittings and accessories; D. King and Sons, Carron Co., M. McCulloch, J. Allen, Senr., and Son, and Philip and Bruce, lamp pillars.

Electric Ovens for Paint Drying.

The issue of the "Electrical World" for May 27 records a case of economy in the use of electric ovens for drying paint by the Schleuter Manufacturing Company, of St. Louis. An operating economy was obtained in drying paint on light metalware of 12 lb. to 60 lb. per kWh, the extent of the saving depending on the bulkiness of the material handled, and the time of day. Three electric ovens, which are used for drying coloured paints at temperatures varying from 160° to 270° F., were installed in place of large gas and low pressure steam ovens because of their speed, cleanliness and even heat, and the improvement in production has been so satisfactory that the Company proposes to use electric heat for a number of other purposes. The existing ovens are of the standard box or kiln design, with large double doors at one end. The loading is done by hand and the ovens are heated by standard air heaters, placed in the lower side walls. The largest oven has a capacity of 36 kW and operates at a baking range of 270° to 450° F, and four inches of heat insulating material, covering all sides, has been built into it. The two other ovens are of 27 kW and are used for light colour work, at from 150° to 180° F.

A cutting from the "Eastern Province Herald," of Port Elizabeth South Africa, which gives the award of contracts in connection with the Municipal electricity supply in respect of sections a, b, c (part 1), d, and e, may be seen by interested United Kingdom firms on application to the Department of Overseas Trade (Room 49).

Books Received.

"Elektro-Auskunftei." By Georg Heber. (Leipsig: Paul Schulze.) Pp. 754. 10s. net.

"The Year Book of Wireless Telegraphy and Telephony, 1922." (London: Wireless Press.) Pp. lxxxix.+1 477.

"Electric Power Systems." By William T. Taylor. (London: Sir Isaac Pitman & Sons.) Pp. xii.+107. 2s. 6d. net.

"High Voltage Power Transformers." By William T. Taylor. (London: Sir Isaac Pitman & Sons.) Pp. x.+117. 2s. 6d. net.

"Modern Practice in Heat Engines." By Telford Petrie, M.Sc. (London: Longmans, Green & Co.) xi.+264. Price 15s. net.

"Practical Profit Sharing." Reprinted from "The Manchester Guardian Commercial," with Introduction by Seebohm Rowntree. (Manchester: Manchester Guardian, Ltd.) Pp. 67. 1s.

Marconi International Directory.*

The first annual edition of the MARCONI INTERNATIONAL DIRECTORY, BUYERS' AND EXPORTERS' GUIDE, just published, marks a new era in directory publishing and will be welcomed by business men everywhere. The volume embodies many new features and is arranged throughout for quick reference to any item. The Alphabetical Section, which gives the full titles, description of business, full postal and cable addresses, of the leading business houses of the world, is arranged in one complete series instead of providing separate lists for each country or state. Similarly, the Buyers' and Exporters' Guide shows under each trade heading the principal firms in each country engaged in that particular trade, and at one opening one is able to select firms in any part of the world. The time-saving advantages afforded by this arrangement are obvious. Another special feature is the indexes to the Buyers' and Exporters' Guide, which have been translated into five different languages. Not the least important section, however, is the Cable Address Register, by which the sender of a cablegram can be identified when an unfamiliar signature has been used.

We learn from the "Electrical World" that business in ELECTRICAL SUPPLIES in the UNITED STATES is steadily improving, as the result of organised sales campaigns. The orders received are much higher than those of 1913 and 1914 and employment in electrical manufacturing is increasing. The electric light and power companies, the largest market for electrical plant and goods, are ordering large quantities of generating plant, transformers and line material, and at least $400 000 000 will be expended during the current year. This will, in due course, involve the increased use of wires and cables, meters, lamps and other supplies. The general industrial situation is also improving and there is a better demand for motors and switchgear, while the electrification of railroad lines and terminals also promises to bring much work to electrical manufacturers.

* "Marconi International Directory of Cable Addresses, Buyers' and Exporters' Guide, 1922." London: The Marconi International Code Co. 25s. Pp. 1 134.

Prices of Metals, Chemicals, etc.

		Price.	TUESDAY, JUNE 6. Inc.	Dec.
Copper—				
Best Selected	per ton	£67 10 0	£1 5s.	—
Electro Wirebars	,,	£71 10 0	10s.	—
H.C. Wire, basis	per lb.	0s. 10½d.	1/16d.	—
Sheet	,,	0s. 10⅝d.	¼d.	—
Phosphor Bronze Wire (Telephone)—				
Phosphor Bronze Wire, basis	per lb.	1s. 2½d.	1/16d.	—
Brass 60/40—				
Rod, basis	,,	7d.	—	—
Sheet, basis	,,	9d.	—	—
Wire, basis	,,	10d.	—	—
Pig Iron—				
Cleveland Warrants	per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 S.W.G.	,,	£18 0 0	—	—
Lead Pig—				
English	,,	£26 0 0	—	—
Foreign or Colonial	,,	£24 17 6	—	2s. 6d.
Tin—				
Ingot	,,	£154 2 6	£3 0s. 0d.	—
Wire, basis	per lb.	2s. 1½d.	½d.	—
Aluminium Ingots	per ton	£100 0 0	—	—
Spelter	,,	£28 3 9	1s. 3d.	—
Mercury	per bottle	£12 10 0	—	—

Sulphur (Flowers)—Ton £10 15s. *Sodium Chlorate*—Per lb. 3½d.
,, (Roll-Brimstone)—per ton £10 15s. *Sulphuric Acid* (Pyrites, 168°) per ton, £9.
Sodium Bichromate.—Per lb. 5½d. *Copper Sulphate*.—Per ton £26 10s.
Boric Acid (Crystals). Per ton £60.
Rubber.—Para fine, 10d.; plantation 1st latex, 7⅞d.–7⅝d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

COMMERCIAL INTELLIGENCE.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

BOULT AND CO., Slater Street, Liverpool, electric engineers. £23 4s. 2d. April 6.

HAINE, William Ernest, and BLISSETT, Henry Cornelius (trading as STAMFORD BRIDGE ELECTRICAL AND MECHANICAL ENGINEERING CO.), 495, Fulham Road, S.W. £13 10s. 2d. April 5.

MACAULEY, R. A., 48, Ashton New Road, Beswick, electrician. £30 1s. 2d. April 5.

MESSENGER, Mr. G. V., 26, Edna Street, S.W.11, electrical engineer. £29 12s. 6d. March 29.

Bill of Sale.

[The undermentioned information is from the Official Registry. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice has been entered on the Register.]

WILLIAMS, Frederick, The Retreat, County Oak, Crawley, electrical apparatus manufacturer. May 30. £300

RECEIVERSHIPS.

S. GILLITT AND CO., LTD.—A. Dees, of 25, James Street, Newcastle-on-Tyne, ceased to act as receiver and manager on April 29, 1922.

YORKSHIRE INCANDESCENT ELECTRIC LAMP CO., LTD.—J. A. Couper, of Stoney Lea, Ilkley, was appointed receiver on May 24, 1922, under powers contained in second mortgage debentures, dated October 1, 1914.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

CALCUTTA ELECTRIC SUPPLY CORPORATION, LTD.—Registered May 25, supplemental Trust Deed dated May 22, 1922, securing £202 500 debentures with a premium of 2 per cent., present issue £90 000; charged on property as charged by Trust Deed registered November 30, 1920. *£500 000. May 26, 1921.

YORKSHIRE INCANDESCENT ELECTRIC LAMP CO., LTD., Leeds.—Registered May 25, £1 400 and £200 1st debentures part of £6 000: general charge. *£11 400. June 21, 1920.

Satisfaction.

WATSON, MARSH AND CO. (HAMPSTEAD) LTD., manufacturers of electrical apparatus.—Satisfaction registered May 26, all moneys, etc., registered April 21, 1922.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Bankruptcy Information.

COATON, Thomas Green, 16, Humberstone Road, Leicester, under the style of T. G. COATON AND CO., electrical engineer. Receiving order, May 29. Debtor's petition.

GRIEVE, Gideon George, MANGES, Archibald Arthur, co-partnership under the style of THE UP-TO-DATE ELECTRICAL AND MECHANICAL ENGINEERS, 14, West Bute Street, late 236, Bute Street, Cardiff, electrical and mechanical engineers. Receiving order, May 31, Debtor's petition.

Partnerships Dissolved.

DAVIES, Frederick Howell, and ROWE, Edward George, under the style of DAVIES AND ROWE, 119, Dunraven Street. Tonypandy, co. Glamorgan, electrical contractors, by mutual consent, and the business will be continued by E. G. Rowe.

DEARDS, Robert, and CUSDEN, George Augustus, under the style of the ELECTRO METAL CLEANING CO., 86B, South End, Croydon, by mutual consent, as from May 20, 1922. Debts received and paid by R. Deards, who will continue the business.

MARSDEN, Herbert John, and HUTCHINSON, Edward Thomas, electrical, etc., engineers, De Montfort Street, Leicester, under the style of H. J. MARSDEN AND CO., by mutual consent as from March 25, 1922. Debts received and paid by H. J. Marsden.

RODDA, William Duncan, and NEUREUTER, Joseph, electrical factors, 37A, Fountain Street, Manchester, under the style of W. D. RODDA AND CO., by mutual consent, as from May 15, 1922.

Bankruptcy Proceedings.

FRANCIS, William, 4, Prospect Place, Cheam, Surrey, electrical engineer. The first meeting of the creditors was held last week. The statement of affairs showed liabilities £711, net assets estimated to realise £9, deficiency £702. Debtor attributed his failure to losses on contracts and high interest paid to moneylenders. Prior to August, 1915, debtor was employed as an electrician. In August, 1916, he started business as an electrician at his present address, without capital. The business steadily increased until early in 1920, when he made a loss on a sub-contract and was sued by a creditor for £36. He had had recourse to moneylenders. A full set of books had not been kept. Debtor became aware of his position in April, 1920. The case being a summary one, was left in the hands of the Official Receiver as trustee of the estate. The following are creditors:—Southern Electric Co., London, £17; B.E. Co., London, £10; General Cable Manufacturing Co., Leatherhead, £40; Times Electric Co., London, £21.

HILL, George, NOBLE, George, and COWLEY, Edgar, trading as GEORGE HILL AND CO., 22, Chantry Lane, Great Grimsby, electrical engineers. The statement of affairs shows liabilities of £426, and a deficiency of £217. The business was commenced by G. E. Hill and G. Noble in January, 1919, with a joint capital of £200, provided in equal shares. In November, 1920, E. Cowley joined them, bringing in a borrowed capital of £150. Debtors estimated their turnover in 1919 at £1 000, in 1920 at £2 000, and in 1921 at £1 400. No balance sheets had been prepared. They became aware of their position about a year ago. At their public examination last week debtors attributed their failure to losses on contracts, insufficient capital and loss on stock owing to fall in prices.

PRINS, Nathan, late Forest Road, Dalston, N.E.—This debtor, who dealt in electrical accessories, attended at the London Bankruptcy Court recently for public examination on a statement of affairs showing a liability of £143 and assets £7. In reply to the Official Receiver he said that he was a Dutch subject who came to this country in 1912. Before the middle of 1919 he was in employment, latterly with a firm of dealers in electrical appliances, but then began business on his own account as a dealer in electrical accessories. He had no capital, and traded at 74, Forest Road, Dalston, until the date of the receiving order. He had not kept any books of account. Debtor attributed his failure to bad trade and to depreciation of his stock. The examination was concluded.

Catalogues, Price Lists, &c.

We have received from J. C. White a copy of the new addition of the J.C.W. WIRING SYSTEM.

THE "KALEECO" WIRING SYSTEM is the subject of a new illustrated booklet issued by Callender's Cable and Construction Co.

No. 9 of the "TRANSFORMER ABSTRACTS," published by Johnson and Phillips, deals with current distribution with inter-connected star static balancers.

The PORTER PATENT SAFETY SEALS, LTD., of 7 and 9, Belfast Road, Stoke Newington, N.16, have just published, in English, French and Spanish, a new catalogue of their seals for electricity meters, cables, etc.

The ELECTRICAL ALLOY CO. have sent us a copy of their latest publication relating to resistance wires and ribbons used for electric heating purposes. The publication contains a useful set of charts for determining the current carrying capacity of ribbon and strip.

The ENGLISH ELECTRIC COMPANY have recently issued several new publications. Nos. 330, 331 and 332 deal with E.E. cylindrical balanced valves, relief valves, and bucket attachments for impulse wheels; No. 357 with the E.E. camshaft control for electric locomotives; and No. 359 contains an illustrated account of Blackburn (East) Power Station, reprinted from the January number of the E.E. Journal.

We have received an advance copy of a new SECTION (X.5) of the G.E.C. complete CATALOGUE. This list deals with d.c. and a.c. motor starters, and includes full particulars and prices of d.c. face-plate starters of the open, semi-enclosed, totally enclosed cover and totally enclosed types, plain a.c. starters, oil immersed rotor starters, auto-transformer starters and star-delta starters. Complete ranges of starting panels, including switches with fuses, both pedestal-mounted and with angle iron framework, are also given and fully dimensioned line drawings for all types are provided.

Reference Index to Recent Wireless Publications.

We continue below our series of references to recently published articles dealing with wireless telegraphic and wireless telephonic communication.

R.200. RADIO MEASUREMENTS AND STANDARDISATION.

J. M. A Simple Generator of High Frequency Current for Measurement Purposes (*Electrician*, 88, pp. 436-438, April 14th, 1922).
Describes the Elwell 100 W arc with examples of laboratory measurements that can be made with it. Full circuit details are given. R.200.

F. Trautwein. New applications of thermionic valves to high frequency measurements (*Elektrotechnische Zeitschrift*, 42, p. 1 249, November 3rd, 1921).
Abstract of paper read at Physics Congress at Jena. Methods are described whereby two valves with the coils of a differential galvanometer in their anode circuits can be employed to determine the phase difference of two alternating voltages or the scalar product of two alternating currents. R.200.

J. Marsten. Inductance, capacity and resistance of coils (*Wireless Age*, 8, pp. 33-35, September, 1921). R. 200.

M. Chatel. Armagnat's method for the measurement of the wavelength of sustained oscillations (*L'Onde Electrique*, 1, pp. 96-100, February, 1922.)
Gives the theory of a null method of wavelength measurement. R.210.

J. R. Weeks. The Dielectric Constant of Mica (*Physical Review*, 19, pp. 272-273, March, 1922).
Variations from one grade to another of mica found to be due to air films. When carefully split to eliminate air films, and using mercury electrodes, no differences were found between different grades. R.220.

S. Rschewkin and **B. Wuedensky.** The measurement of capacity and high resistances by means of the vacuum-tube generator of intermittent oscillations (*Physikalische Zeitschrift*, 23, pp. 150-153, April 1st, 1922).
The valve oscillator with grid condenser and leak adjusted to periodically interrupt the production of oscillations is applied to measure the value of the capacity and resistance inserted in the grid circuit. R.220/230.

M. Bedeau. The Measurement of the Dielectric Constant of Gases and Vapours by means of sustained waves (*Comptes Rendus*, 174, pp. 380-381, February 6th, 1922). R.220.

R. Ettenreich. Capacity measurements on Antenna Models (*Elektrotechnische Zeitschrift*, 42, p. 1 289, November 10th, 1921).
Abstract of paper describing measurements on small models and a comparison of the two results with those obtained from the formulæ of Austin and Howe. R.220.

R. Whiddington. A Laboratory Valve Method for determining the Specific Inductive Capacities of Liquids (*Proceedings of the Cambridge Philosophical Society*, 20, pp. 445-446, November 10th, 1921).
The method employs alternating electromotive forces of low frequency generated by a thermionic valve. R.220.

L. T. Jones and **H. G. Tasker.** A Braun Tube, Undamped Wave Precision Method of Determining Dielectric Constants of Gases (*Physical Review*, 18, pp. 330-331, October, 1921).
Abstract of paper read before the American Physical Society describing a method of carrying out such measurements in which the small changes of frequencies are observed by a Braun cathode ray tube. R.220.

D. N. Mallik. On the Mutual Induction between two Circular Currents (*Philosophical Magazine*, 43, pp. 604-606, March, 1922).
A mathematical article. R.230.

A. Esau. The inductance of a solenoid of rectangular section (*Jahrbuch Zeitschrift für drahtlose Telegraphie*, 18, pp. 453-457, December, 1921).
A criticism of a formula published by Nirva in the Journal of the Electrical Society of Japan, 1919. The formula gives good results when the ratio of length of coil to length of side of square does not exceed 0·05, and the pitch is not more than six times the diameter of the wire. R. 230.

L. V. King. On some New Formulæ for the Numerical Calculation of the Mutual Induction of Coaxial Circles (*Proceedings of the Royal Society*, 100A, pp. 60-66, October 4th, 1921).
A mathematical paper divided into four sections, entitled respectively (1) note on the direct numerical calculation of elliptic integrals; (2) the scale of arithmetico-geometrical means; (3) application to mutual inductance formulæ for coaxial circles and (4) numerical illustrations. R.230.

J. Wallot. Inductance and Capacity of Single layer coils (*Archir für Elektrotechnik*, 10, pp. 233-256, November, 1921).
An investigation of the experimental results obtained by K. Schäfer which are compared with those of Drude, Gothe, Lenz and others. He comes to the same conclusion that the self-capacity of a coil depends very little on the size of wire and pitch, but mainly on the overall dimensions of the coil. R.230.

J. J. Dowling and **Miss K. M. Preston.** On the Resistance of Electrolytes at High Frequencies (*Philosophical Magazine*, 43, pp. 537-545, March, 1922).
The method employed is similar in nature to that employed in Dowling's ultra-micrometer using three-electrode valves. R.240.

P. O. Pedersen. A Method for the Measurement of R.F. Resistances (*Wireless World and Radio Review*, 10, pp. 135-139, April 29th, 1922).
The method described is based on the use of a quadrant electrometer in conjunction with a special vacuum mercury make-and-break key. R.240.

G. Breit. High-frequency Resistance of Inductance Coils (*Scientific Papers of the Bureau of Standards*, No. 430, Vol. 17; *Journal of the Franklin Institute*, 193, pp. 544-545, April, 1922—Abstract). R.240.

L. Frank. High Frequency Resistance (*Radio News*, 3, p. 932, April-May, 1922). R.240.

J. Erskine-Murray and **B. Williams.** The Determination of the Decrement of a Distant Station by means of a Coil Aerial (*Journal of the Institution of Electrical Engineers*, 60, 3p. 347-351, March, 1922).
A frame aerial at 45° to the bearing of the station is used to obtain a current equal to $1/\sqrt{2}$ of the current in the main receiving coil, for the direct determination of decrement. R.240.

G. L. Addenbroke. The Electrostatic Wattmeter (*Electrician*, 88, pp. 466-469 April 21st, 1922). R.240.

R. R. Ramsey. A simplified method of correcting for the decrement of a Decremeter (*Physical Review*, 19, p. 274, March, 1922). R.240.

N. Grösser. The Damping of two Oscillatory Circuits with Capacity Coupling and a Small Decrement (*Archir für Elektrotechnik*, 10, pp. 257-276, November, 1921). R.240.

F. Trautwein. Measurement of Losses at High Frequencies (*Jahrbuch Zeitschrift für drahtlose Telegraphie*, 18, pp. 261-290, October, 1921).
The method described is a null differential method for determining the losses in a condenser. It is discussed in great detail and numerical data are given. R.240.

H. Pauli. Decrement Measurements with Undamped Oscillations (*Zeitschrift für Physik*, 5, pp. 376-386, 1921; and *Jahrbuch Zeitschrift für drahtlose Telegraphie* 18, pp. 338-347, November, 1921). R.240.

H. Pauli. A New Method of Measuring Decrement with Electric Oscillations (*Zeitschrift für Physik*, 6, pp. 118-126, 1921; *Jahrbuch Zeitschrift für drahtlose Telegraphie*, 18, pp. 348-354, November 1921).
This is an ordinary ammeter-voltmeter method of determining the effective resistance in a tuned circuit. The novelty consists in tuning the voltmeter circuit so that it also takes a pure energy component current; this allows the current taken by the voltmeter to be corrected for as in D-C measurements. R.240.

E. B. Moullin. A Sensitive Direct Reading Voltmeter and Ammeter for High Frequencies (*Wireless World and Radio Review*, 10, pp. 1-6, April 1st; p. 54, April 8th, 1922).
The apparatus described is based on the rectification effect obtained when using a grid condenser and leak. The indicating galvanometer is joined in the plate circuit of the valve. R.250/260.

A. Leontiewa. The Discharge Potential of Small Gaps with Very High Frequency (*Physikalische Zeitschrift*, 23, pp. 32-35, January 15th, 1922).
Experimental investigation of the voltage necessary to spark across gaps less than 0·1 mm. with high frequency oscillations. λ=2-40 metres. For a gap of 0·05 mm it requires 1 000 volts if λ=40 but over 3 000 volts if λ=2 metres. R.260.

R. Mesny. Radiation Measurement (*L'Onde Electrique*, 1, pp. 54-61, January, 1922). R.270.

The Properties and Uses of Micas (*Journal of the Institution of Electrical Engineers*, 60, pp. 339-342 March, 1922; *Electrician*, 88, pp. 446-447, April 14th, 1922—Abstract).
A classification of various grades of micas, with an indication of their suitability for various electrical uses. R.280.

F. Schindelhauer. The Atmospheric Vertical Electric Current in Antennæ (*Physikalische Zeitschrift*, 23, pp. 36-39, January 15th, 1922).
A record of systematic observations of the current in both a high and a low antenna due to atmospheric electricity. R.290.

W. Arkadiew. The Production of Very Short Hertzian Waves of small Decrement (*Physikalische Zeitschrift*, 23, pp. 35-36, January 15th, 1922).
A note on the production of waves of a few centimetres length by means of Hertz oscillator and parabolic mirrors. R.290.

M. Brenzinger. A practical Cathode Ray Oscillograph (*Physikalische Zeitschrift* 22, pp. 491-495, September 1st, 1921).
The H.T. supply was obtained from a transformer, rectifying valve and smoothing condensers. The time axis was obtained by deflecting coils in series with a large inductance, only the lower approximately linear portion of the growth curve was employed. Some photographic results are given. R.290.

F. Zacher. High voltage polar oscillograms by means of a rotating Gehrke oscilloscope (*Zeitschrift für Technische Physik*, 2, pp. 250-256, September, 1921). R.290.

R.300. RADIO APPARATUS AND EQUIPMENT.

M. B. West. Improving Antenna Efficiency (*Q.S.T.*, 5, pp. 16-21, April, 1922) R.320.

H. H. Beverage. Improving the C.W. Ground System (*Q.S.T.*, 5, pp. 25-26, November, 1921). R.320.

Aerial Insulators for Wireless Telegraphy (*Electrical Review*, 90, p. 551, April 21st' 1922).
Describes the insulators fitted at Leafield and Northolt radio stations, and the tests applied to them. R.320.

D. S. Fine. Antenna Tower Erection for New York Radio Central (*Engineering News Record*, 88, pp. 230-234, February 9th, 1922). R.320.

H. M. Ryder. A "Dry Cell" Vacuum Tube (*Wireless Age*, 9, p. 29, March, 1922).
Describes and gives characteristic curves of a valve which requires a filament current of 0·2 A at 1·1 V. R.330.

W. R. G. Baker. The UV-217 Kenotron—its operation and application (*Wireless Age*, 9, pp. 20-25, February, 1922). R.330.

A. Blondel. On the Negatron (*Revue Générale de l'Electricité*, 11, p. 145, February 4th, 1922). R.330.

R. F. Yates. Future of Vacuum Tube in General Engineering Field (*Electrical World*, 78, p. 1 176, December 10th, 1921).
A short resumé of the various possible applications of the thermionic valve. R.330.

L. T. Jones. The Simplest Mercury Vapour Pump (*Physical Review*, 18, p. 332, October, 1921). R.330.

L. T. Jones. A New Rotary Mercury Pump (*Physical Review*, 18, pp. 332-333, October, 1921). R.330.

A. H. de Voogt. The double grid valve as a dynatron (*Radio Nieuws*, 4, pp. 289-292, October 1st, 1921).
The two grids are merely connected together and treated as one. R.330.

G. Beauvais. The power rating of a three-electrode transmitting valve (*Radio-électricité*, 3, pp. 112-113, March, 1922).
Points out the confusion that arises through inaccurate reference of the power rating to anode dissipation, input or h.f. output. R.340.

H. P. Waran. A New Form of High Vacuum Automatic Mercury Pump (*Proceedings of the Physical Society of London*, 34, pp.120-125, April 15th, 1922).
A modification of the Sprengel pump in order to obtain high speeds of exhaustion with the use of a small mass of mercury. R.340.

G. P. Kendall. Faults in Valve Circuits: Diagnosis and Cure (*Wireless World and Radio Review*, 10, pp. 95-97, April 22nd, 1922). R.340.

F. Marietti. The Resistance-coupled Amplifier (*L'Audion*, 2, pp. 16-18, April 1st, 1922). R.340.

H. E. Bussey. Improvements in Multi-stage Audio Amplifiers (*Q.S.T.*, 5, pp. 13-14, April, 1922). R.340.

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An illustrated article dealing briefly with the construction of thermionic vacuum tubes. R.340.

L. T. Lease. Measuring the Characteristics of Vacuum Tubes (*Radio News*, 3, p. 199, September, 1921). R.340.

A. Nasarischwily. A new Method of Generating Undamped Waves by means of a Cathode Ray Tube (*Annalen der Physik*, 64, pp. 759-760, September, 1921).
The primary of a transformer is inserted in series with the high tension battery between the cathode (incandescent filament) and the anode. The secondary of the transformer is connected to the deflecting plates or coils of the tube. High frequency current is produced which the author has employed for heterodyne reception. R.340.

J. Corver. New Circuits for Double Grid Valves (*Radio-Nieuws*, 4, pp. 257-261, September 1st, 1921).
A discussion of a number of methods of connecting up double grid valves for reception. R.340.

French Wireless Time Signals (*Nature*, 108, p. 351, November 10th, 1921). R.350.

E. H. Haneen. Signal Corps Valve Transmitter suitable for Amateur Use (*Radio News*, 3, p. 281, October, 1921). R.350.

A. H. Lynch. A practical Radio Telephony Set (*Science and Invention*, 9, pp. 536-537, October, 1921). R.350.

C. Jeghera. The reception of the FL Concerts (*L'Electricité pour Tous*, 4, p. 72, March 31st, 1922). R.360.

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The Hall Air Jet Relay for Recording Radio Signals (*Radio News*, 3, p. 809, Marc 1922). R.360.

H. de A. Donisthorpe. A method of Recording Wireless Signals by means of a Morse Inker (*Radio News*, 3, p. 813, March, 1922). R.360.

F. W. Dunmore. A Relay Recorder for Remote Control by Radio (*Journal of the American Institute of Electrical Engineers*, 41, pp. 310-313, April, 1922).
Describes the development of a recorder for direct operation by the radio receiver without the use of a delicate relay. R.360.

P. Maurer. Practical Radiotelephone Installations (*L'Electricien*, 53, pp. 188-189, April 15th, 1922). R.360.

R. Jouaust. On the Reception of Undamped Waves by "Modulation" (*Comptes Rendus*, 174, pp. 35-36, January 3rd, 1922). See next abstract. R.360

R. Jouaust. The Reception of C.W. signals by the "Modulation-method" and its Application to the French Type Z Amplifier (*L'Onde Electrique*, 1, pp. 26-33, January, 1922).
A heterodyne arrangement utilising direct coupling of the heterodyne to the detecting valve. R.360.

A. A. Campbell Swinton. Modern Wireless Telegraphy (*Engineering*, 112, pp. 636, November 4th, 1921).
Abstract of a lecture delivered before the Royal Society of Arts describing various methods of recording wireless signals. R.360.

Zevenbergen. The Reception of American Amateur Signals (*Radio Nieuws*, 4, pp. 359-362, December, 1921).
A discussion of various heterodyne methods of receiving short waves. R.360.

W. Borgsmüller. New German Receiving Sets (*Telegraphen und Fernsprech-Technik*, 10, pp. 173-178, December, 1921).
Description with photographs and diagrams of connections of simple compact sets for direct connection to a direct current supply for use in connection with the German broadcasting service. R.360.

L. G. Pacent. The Relay Antenna Transfer Switch (*Radio News*, 3, pp. 820-821, March, 1922). R.380.

A. S. Blatterman. Notes on the Design of Radio Frequency Intervalve Amplifier Transformers using Iron Cores (*Wireless World and Radio Review*, 10, pp. 48-51, April 8th; pp. 78-84, April 15th; pp. 104-107, April 22nd, 1922).
Discusses the theory of such transformers with practical applications, examples of design and experimental verification. R.380.

C. F. Phillips. Discussion on Methods of Amplification (*Wireless World and Radio Review*, 10, pp. 37-42, April 8th; pp. 74-77, April 15th, 1922). R.380.

V. H. Laughter. A Capacity Increase Method of Reception (*Radio News*, 3, p. 933, April-May, 1922).
The incoming signals cause the diaphragm of a telephone to change the capacity and frequency of a heterodyne so as to pass through the "dead-space" and thus to produce an audible tone and pitch determined by the natural frequency of the diaphragm. R.380.

H. Chrétien and P. Ditisheim. Electric Chronograph (*Comptes Rendus*, 174, pp. 999-1002, April 10th, 1922). R.380.

H. G. Evans. A Detachable "Pin-type" Resistance-capacity Coupling for H.F. Amplifiers (*Wireless World and Radio Review*, 10, pp. 133-134, April 29th, 1922). R.380.

H. Abraham and R. Planiol. On the Use of Valve Amplifiers in Chronographic recording (*L'Onde Electrique*, 1, pp. 18-25, January, 1922). R.380.

L. Brillouin. Resistance Amplifiers (*L'Onde Electrique*, 1, pp. 7-17, January, 1922; pp. 101-123, February, 1922).
Gives the theory of their operation. R.380.

M. J. Huizinga. A Simple Device for Selective Amplification (*Tijdschrift van het Nederlandsche Radiogenootschap*, 1, pp. 148-153, December, 1921).
A description of an arrangement consisting of an ordinary audion receiver with retroaction and a separate heterodyne generator, with tuned audio-frequency amplifier. R.380.

R.400. RADIO COMMUNICATION SYSTEMS.

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Discusses "frequency modulation" *versus* "amplitude modulation," and concludes in favour of the latter as utilising a narrower band of wavelengths and giving less distortion. R.410.

C. Lubben. High Frequency Telephony with Triode Transmitters (*Zeitschrift für Fernmeldetechnik*, 2, pp. 145-154, August, 1921).
A comprehensive collection of the various methods of modulation, with numerous references to patent specifications, etc. R.410.

C. R. Leutz. Notes on High Power Quenched Spark Sets (*Radio News*, 3, pp. 808-809, March, 1922).
Describes a number of experiments conducted on 10 and 20kW quenched spark transmitters. R.411.

Methods of Transmission used in Broadcasting Stations (*Radio News*, 3, p. 946, April-May, 1922). R.412.

L. G. Pacent. Radio Telephony (*Radio News*, 3, pp. 940-943, April-May, 1922). R.412.

M. E. Pelgrims. Portable Radio Telegraph-Telephone See (*Radio News*, 3, p. 925, April-May, 1922). R.412.

J. W. Harrington. Radiotelephone tests with the ss. *America* (*Popular Radio*, 1, pp. 34-37, April, 1922). R.412.

H. Yagi. Modulation Control in Radio Telephony (*Technology Reports of Tohoku Imperial University*, Vol. 2, No. 3; *Electrical World*, 79, p. 394, February 25th, 1922—Abstract). R.412.

L. Kühn. Wireless Telephony (*Elektrotechnische Zeitschrift*, 42, p. 1254, November 3rd, 1921).
Abstract of paper describing the recent methods of modulation. R.412.

G. Pession. Some Experiments in Radiotelephony (*L'Elettrotecnica*, 8, pp. 617-621, October 15th, 1921; *Wireless World and Radio Review*,, 10, pp. 164-168, May 6th 1922).
A description of tests made with a Poulsen arc with a tuned oscillatory circuit with which the aerial is loosely coupled. The modulation is by changing the resistance in a circuit coupled with the aerial. In some tests four carbon microphones were put in series directly in the modulating circuit; in others, three electrode valves were inserted in the modulating circuit, the grids being controlled by other three electrode valves, the grids of which were coupled up to the microphone circuit. The article is illustrated with diagrams of connections and Gehrke tube oscillograms. R.412.

L. Kühn. A new method for Wireless Telephony with Thermionic Valves (*Jahrbuch Zeitschrift für drahtlose Telegraphie*, 18, pp. 419-452, December, 1921).
The method is the well-known choke control which the author says was developed independently by Huth and Co., of Berlin. Very complete mathematical investigation is given of the necessary magnitudes of the choke coil and condensers. R.412.

J. F. Bront. Some Practical Points on Arc Operation (*Radio News*, 3, p. 701, February, 1922). R.422.

J. Marsten. A Sea-plane High-power Bulb Transmitter (*Radio News*, 3, p. 804, March, 1922). R.423.

A. Meissner. The Development of Tube Transmitters by the Telefunken Co. (*Proceedings of the Institute of Radio Engineers*, 10, pp. 3-23, February, 1922).
A well-illustrated account of various types of valves of German manufacture, and of various radio installations. R.423.

J. V. L. Hogan. Interference in Radio Signalling (*Radio Broadcast*, 1, pp. 5-8, May, 1922). R.430.

L. Hanson. The Super Differential Circuit (*Radio News*, 3, p. 287, October, 1921).
Combined arrangements of loop and elevated aerial and two loops in different directions are described for eliminating interference. R.430.

H. G. Möller. Selectivity and High Speed Wireless (*Elektrotechnische Zeitschrift*, 42, p 1253, November 3rd, 1921).
Abstract of paper pointing out that the attempt to obtain freedom from disturbance by using almost undamped receiving circuits is inconsistent with high speed signalling at the long wavelengths now employed. R.430.

L. G. Pacent. A Radio System for Simultaneous Sending and Receiving (*Radio News*, 3, pp. 812-813, March, 1922). R.460.

L. Jacquot. Duplex Radiotelephony (*La T.S.F. Moderne*, 3, pp. 4-8, January; pp. 58-63, February; pp. 105-108 March, 1922). R. 460/412.

H. R. Miller and H. E. Hallborg. "Breaking-in" with Amplified Signals (*Radio News*, 3, p. 702, February, 1922). R.460.

Successful Duplex Radio-Telephony (*Elektrotechnische Zeitschrift*, 42, p. 1177, October 13th, 1921).
The German Post Office and the Lorenz Company have carried out experiments between Berlin and Copenhagen, using a 4 kilowatt arc at Königswusterhausen. The Berlin subscriber could not detect that ordinary line telephony was not being employed, except that the loudness and clearness were better than usual. The modulation was done by causing the microphone current to vary the saturation of an iron cored inductance in the antenna, thus affecting the resonance.

H. S. Williams. Harnessing Waves to Wires (*Popular Radio*, 1, pp. 14-21, April, 1922). R.470.

Wired Wireless Telegraphy (*Post Office Electrical Engineers Journal*, 14, pp. 191-194, October, 1921). Notes *re* possible developments. R.470.

J. R. Carson. Radiation from Transmission Lines (*Journal of the American Institute of Electrical Engineers*, 40, pp. 789-790, October, 1921).
A discussion of the radiation of energy from overhead lines used for high frequency wire telegraph transmission. It is concluded that there is no additional attenuation of the current due to this radiation but that the radiation energy losses may be regarded rather as terminal impedances. Formulæ are given for the magnitude of the radiation losses. R. 470/190.

G. Giorgi. High Frequency Telephony on Overhead Power Transmission lines (*L'Elettrotecnica*, 8, p. 682, November 15th, 1921). R. 470.

M. A. Maior. High Frequency Multiplex Telephony and Telegraphy (*Revue Générale de l'Électricité*, 10, pp. 281-282, September 3rd, 1921).
Correspondence with regard to the invention of high frequency multiplex communication. R.470.

A. Meissner. Wireless telephony (*Telegraphen und Fernsprech Technik*, 10, p. 131, September, 1921).
A general description including high frequency line telephony.

H. Gewecke. High Frequency Telephony on High Voltage Transmission Lines. (*Telefunken Zeitung*, 4, pp. 3-14, September, 1921).
A semi-popular well-illustrated account of the principles of the system and of its application to the 110 000 volt Hirschfelde-South Dresden transmission line. R. 470.

H. R. Rivers-Moore; A. Crossley. Further discussion on Piloting Vessels by Electrically Energized Cables by A. Crossley (*Proceedings of the Institute of Radio Engineers*, 10, pp. 33-40, February, 1922). R.490.

A. Crossley. Improvements in Piloting Cable Receiving Apparatus (*Proceedings of the Institute of Radio Engineers*, 10, pp. 24-32, February, 1922).
Describes recent experiments, and discusses the design of the receiving coils and components of auxiliary apparatus. R.490.

E. H. Hanson. Audio Frequency Transmission (*Radio News*, 3, p. 929, April-May, 1922). R. 490.

A. Zacek. The Use of Electron Tubes in Experiments with speaking Arc-lamps and speaking Condensers (*Physikalische Zeitschrift*, 22, pp. 528-529, October, 1921).
In such experiments, the difficulty usually experienced is that due to the small current carrying capacity of the microphone; this can be overcome by using an amplifying valve. R. 490.

E. Dershem. Secret Photo-Electric Signalling (*Physical Review*, 18, pp. 424-425, October, 1921). R.490.

A. Bull. Fog Signalling by means of Polarised Sound (*Engineer*, 132, pp. 505-506, November 11th, 1921). R.490.

R.500. APPLICATIONS OF RADIO.

F. Marguet. The Plotting of a Radio Bearing (*Radioélectricité*, 3, pp. 110-111, March 1922).
Gives tables to facilitate the operation. R.510.

R. Lenier. Wireless Direction Finding as an Aid to Navigation (*Radioélectricité*, 3, pp. 117-118, March, 1922). R.510.

F. W. Dunmore. The Development of Radio Telephone Communications between lifeboats and shore stations (*Radio News*, 3, p. 694, February, 1922). R.510.

J. Erskine-Murray and J. Robinson. Directional Transmission of Electromagnetic Waves for Navigational Purposes (*Journal of the Institution of Electrical Engineers*, 60, pp. 352-362, March, 1922).
Describes several arrangements of directional transmitter developed by the Royal Air Force, including a new type of apparatus in which the wavelength is varied for each direction of radiation. R.510.

Radio for Lifeboats (*Radio Broadcast*, 1, pp. 67-68, May, 1922. R. 510.

P. G. Watson. The Operating Principles of a Radio Compass (*Radio News*, 3, p. 928, April-May, 1922). R.510/190.

M. E. Pelgrims. Improved Land and Marine Pattern Wireless Direction Finding Cabinets (*Radio News*, 3, pp. 922-923, April-May, 1922).
Describes apparatus manufactured by Marconi's Wireless Telegraph Co. R.510.

F. A. Kolster and F. W. Dunmore. The Radio Direction Finder and its Applications to Navigation (*Scientific Papers of the Bureau of Standards*, No. 428, Vol. 17, pp. 529-566, January 16th, 1922).
Gives a detailed description of the installations at New York, and the results of tests. R.510.

Wireless Direction Finding Stations; British Isles, France, Germany and Italy (*Flight*, 13, p. 664, October 6th, 1921). R.510.

Radio Thread will Guide future Ships of the Air (*Telegraph and Telephone Age*, 40, p. 153, April 1st, 1922). R.520.

P. Brenot. Wireless Telegraphy Applied to Aviation (*Radioélectricité*, 3, pp. 89-101, March, 1922).
Contains many illustrations of French aircraft wireless apparatus. R.520.

J. Boyer. The Guiding of Aeroplanes during Fog and at Night (*La Nature*, 50 (1), pp. 39-43, January 21st, 1922). R.520.

L. Whittemore. Some Physical Problems of Aircraft Radio (*Physical Review*, 18, p. 149, August, 1921).
Summarises the chief problems in connection with aircraft Radio work. R.520.

Wireless Telegraphy in Czecho-Slovakia (*Radioélectricité*, 3, pp. 114-117, March, 1922). R.530.

The Radio Broadcast (*Science and Invention*, 9, pp. 1148-1149, April, 1922).
Includes a list and map of the U.S. radiophone broadcasting stations. R.530.

A. Anselmi. Radiotelegraphy in the Canary Islands (*L'Audion*, 2, pp. 10-12, March 1922). R.530.

French Radio Time Signal Transmissions (*Radioélectricité*, 3, pp. 119-121, March, 1922). R.550.

Russian Time Signals (*Wireless World and Radio Review*, 10, p. 110, April22nd, 1922). R.550.

M. Bigourdan. Corrections to the Time signals measured at the Bureau International de l'Heure during 1920 (*Comptes Rendus*, 174, pp. 585-586, February 27th, 1922). R.550.

The Internal Radio Network (*Annales des Postes, Telegraphes et Telephones* 10, pp. 551-552, September, 1921).
A short account of the French internal communication network which is classified into four systems connecting respectively (1) Perpignan, Mont-Louis and Bourg-Madame; (2) La Roche-Sur-Yon and the Island of Yeu; (3) La Rochelle, Saint Martin-de-Re and Saint Pierre d'Olaron and (4) Nice, Fontan, Saint Martin, Vesubie. The last two of these are completed and practically ready for service. R.560.

S. R. Winters. The Vaughan radio-controlled car (*Radio News*, 3, p. 295, October, 1921). R.570.

S. Jourdan. The distant Control of Ships by Wireless (*La Nature*, 49 (2), p. 292, November 5th, 1921. R. 570.

L. Chauveau. Pilotless Aeroplanes and Motor Boats (*Radioélectricité*, 2, pp. 104-111, September, 1921).
Describes and illustrates apparatus invented by the author for distant control purposes. R. 570.

Radiophone for Trains (*Radio News*, 3, p. 949, April-May, 1922).
Illustrates equipment used in Germany.

G. Ferrié. The establishment of a new survey of the geographical positions of the principal points on the surface of the earth (*L'Onde Electrique*, 1, pp. 81-89, February, 1922). R.580.

A. Nasarischwily. New Experiments with the Telegraphone (*Elektrotechnische Zeitschrift*, 42, p. 1068, September 22nd, 1921).
Experiments are briefly described in which a message was magnetically recorded on railway lines and read in the locomotive which was equipped with an amplifier and telephone connected to a coil carried close to the rails. R.580.

D. Wilhelm. United States Radio Network (*Radio Broadcast*, pp. 21-27, May 1922).
Includes charts of U.S. Army and Navy radio stations. R.590.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Complete Specifications.

144 628 Conners, W. W. Method and apparatus for indicating the geographical location or movement of bodies and for control by wireless. (12/6/19.)
172 349 Charlet, H. Dynamo-electric machines. (2/7/20.)
147 033 Schroter, F. Vacuum-discharge apparatus for the protection of electrical circuits. (29/1/14.)
172 350 Taggart, J. Scott-, and Radio Communication Co., Ltd. Modulation systems for wireless signalling and the like. (6/7/20.)
147 701 Ges. für Drahtlose Telegraphie. Reception of electric oscillations. (2/5/16.)
148 576 Meyer Akt.-Ges., Dr. P. Driving-systems for alternating current meters according to the Ferraris principle. (12/6/19.)
148 894 Soc. Internationale pour l'Exploitation de la Bougie Sol. Sparking-plugs. (15/7/19.) (Patent of addition not granted.)
172 353 Rochford, T. H. Electric illuminating-devices for theatrical stages, cinemas, and the like. (21/7/20.)
172 357 Roberts, A. Electric stop-motions for machines operating with yarns or threads. (30/7/20.)
161 546 Electric Outlet Co., Inc. Electrical connecting and supporting devices. (9/4/20.)
172 593 British Thomson-Houston Co., Ltd. (General Electric Co.). Electron discharge devices. (24/8/20.)
172 376 Taggart, J. Scott-, and Radio Communication Co., Ltd. Radio-receiving systems. (31/8/20.)
172 384 Moll, J. Electrical rivet-heating machine. (1/9/20.)
172 387 Smith, H. H., and Healey, T. G. P. Self-regulating dynamos. (2/9/20.)
172 389 Taggart, J. Scott-, and Radio Communication Co., Ltd. Signalling systems, particularly wireless modulation system. (2/9/20.) (Cognate application 11 061/21.)
150 726 La Pichardais, D. M. G. R. de. Holders for electric incandescent lamps. (3/9/19.)
172 391 Price, W. A. Systems and apparatus for converting alternating electric current into direct current. (2/9/20.)
154 177 Etablissements Continsouza Soc. Anon. Electric arc projection apparatus. (19/11/19.)
172 394 Taggart, J. Scott-, and Radio Communication Co., Ltd. Radio-signalling systems. (3/9/20.)
172 396 Icranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). Rheostats. (3/9/20.)
150 957 Schaeffer, E. Luminous electric discharge lamps. (9/9/19.)
172 428 Olliffe, C. E. O. Telephone transmitter mouthpieces. (14/9/20.)
172 429 McGregor, D. Electrically-operated warning signals. (15/9/20.) (Cognate application 12 059/21.)
172 433 Rogers, T. W. (Krupp Akt.-Ges. F.). Overload electric switches. (16/9/20.)
172 436 British Thomson-Houston Co., Ltd. (General Electric Co.). Electric power limiting systems. (17/9/20.)
172 437 Urmston, J., James, R. N., and Callender's Cable and Construction Co., Ltd. System for measuring the capacities of electric conductors. (17/9/20.)
172 440 British Thomson-Houston Co., Ltd. (General Electric Co.). Means for controlling electric switches. (21/9/20.)
172 445 Evershed and Vignoles, Ltd., and Needham, J. C. Electrical means for indicating at a distance the direction of motion of an apparatus. (21/9/20.)
172 446 Illingworth, W. H. Electrical cut-out. (22/9/20.)
172 447 Miller, L., and Metropolitan-Vickers Electrical Co., Ltd. Electrical speed-regulator systems. (22/9/20.)
172 460 Automatic Telephone Manufacturing Co., Ltd. (Automatic Electric Co.). Telephone systems. (30/9/20.)
172 461 British Thomson-Houston Co., Ltd. (General Electric Co.). Casings for electrical and other apparatus. (30/9/20.)
166 097 Coolidge, W. D. X-ray apparatus. (9/7/20.)
172 482 Cosmophos-Werke Akt.-Ges. and Boltshauser, C. Electric pocket lamps. (20/10/20.)
154 885 Ges. für Drahtlose Telegraphie. Process of telephony and telegraphy by high frequency currents and stationary periodicity transformers. (26/10/20.)
172 510 Waygood Otis, Ltd. (Otis Elevator Co.). Push-button control electric lifts and the like. (23/11/20.)
154 533 Hanson, E. C. Radio signalling systems for lifeboats. (20/2/19.)
172 512 Lucas, H., and Turner, W. C. Electrical starting-mechanism for internal combustion engines. (24/11/20.)
158 542 Platschick, B. Hand-rests for electric polishing-lathes. (8/12/20.)
156 493 Eustice, A. L. Electric safety-fuse. (14/3/17.)
157 258 Lowenstein, F. Spark-gaps for electro-magnetic wave-signalling systems. (25/8/14.)
160 179 Trichard, P. Frequency multipliers for alternating electric currents. (16/3/20.)
172 582 Colebrook, W. Electric water-heater (22/9/20.) (Divided application on 152 012.)
168 320 Electric Outlet Co., Inc. Electrical connecting and supporting devices. (9/4/20.) (Divided application on 161 546.)
172 592 Hailwood, E. A. Miners' and other electric lamps. (25/8/20.) (Divided application on 24 597/20.)
172 666 Silica Syndicate, Ltd., and Reynolds, F. Mercury and other vapour electric lamps. (7/6/20.) (Cognate application 5 246/21.)
144 660 Siemens-Schuckertwerke Ges. Multi-phase dynamo electric machines. (14/12/17.)
172 671 Hamilton and Co., Ltd., R. F., Pile, F. S. J., and Srone, G. E. M. Electrical pyrometers of the thermo-couple type, and electrical measuring-instruments used in conjunction therewith. (10/6/20.) (Cognate application, 4 249/21.)
146 421 Mautsch, R. Systems of electro-mechanical starting and operating from a distance by multiple currents. (10/4/14.)
146 539 Radio Corporation of America. Thermionic valves for wireless telegraphy and other purposes. (1/2/16.)
146 908 Champion Ignition Co. Insulating-material and body composed thereof. (22/8/17.)
172 679 Fromont, G. Accumulators. (10/7/20.) (Patent of addition not granted.)
172 681 Alexander, A. E. (Stuart Electrolytic Cells, Inc.). Electrodes for electrolytic batteries. (4/8/20.)
172 694 Knapton, G. A., and New Union Electric Co., Ltd. Electric lamps for cinematograph apparatus. (1/9/20.)
172 703 Field, A. B., and Metropolitan-Vickers Electrical Co., Ltd. Ventilation of dynamo-electric machines. (7/9/20.)
172 717 Carpenter, R. E. H., Creed, F. G., and Creed and Co., Ltd. Electromagnetic apparatus specially suitable for use as a relay, switch, or like device. (10/9/20.)
172 718 Line, W. J., and Tucker and Co., Ltd., J. H. Contacts for electrical switches. (10/9/20.)
172 722 British Thomson-Houston Co , Ltd., and Young, A. P. Magneto-electric machines. (11/9/20.)
172 727 British Thomson-Houston Co., Ltd. (General Electric Co.). Electric induction-motors. (13/9/20.)
172 728 Heasman, R. W. Electrode holders. (13/9/20.)
172 731 British Thomson-Houston Co., Ltd., and Trencham, H. Electric power distribution systems. (14/9/20.)
172 735 British Insulated and Helsby Cables, Ltd., and Astley, J. W. Supporting devices for overhead contact and trolley wires for use on electric railways, tramways, and the like. (15/9/20.)
172 751 Lucas, O., and Turner, C. Electric switches. (21/9/20.)
172 757 Taggart, J. Scott-, and Radio Communication Co., Ltd. Thermionic relays, oscillation producers, and the like. (24/9/20.)
172 758 Taggart, J. Scott-, and Radio Communication Co., Ltd. Thermionic generators, amplifiers, and the like. (24/9/20.)
172 759 British Thomson-Houston Co., Ltd. (General Electric Co.). Electric heating-devices. (24/9/20.)
151 638 Bowen, R. S., and Rier, J. R. Timing-devices or rotary current distributors for ignition apparatus of internal-combustion engines. (26/9/19.)
172 771 British Thomson-Houston Co., Ltd. (General Electric Co.). Electric switches. (29/9/20.)
172 780 Murray, R. L., and Telephone Manufacturing Co. (1920), Ltd. Telephone transmitters. (1/12/20.)
172 785 Norris, A. F., and Holley, H. L. Electrical indicator. (4/10/20.)

APPLICATIONS FOR PATENTS.

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14 352 J. Touspaulos. Electric motor.
14 354 W. Preston, H. E. Sutherland and W. Walker. Electric switches.
14 355 and 14 356 W. Preston and H. E. Sutherland. Electric switches.
14 369 J. B. Bignamy. Starter transmission gears with automatic switch and dashboard indicator.
14 385 A. H. Clark. Switches for electric horns, etc.
14 390 F. W. Williams. Electric signs, etc.
14 400 Western Electric Co. Duplex motor and control therefor.
14 426 C. E. Iredell. Fusible cutouts for electrically heated articles.
14 428 E. P. Barfield and L. W. Wild. Electric furnaces.

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14 449 A. G. Mill. Gas or electric heating apparatus convertible into cooking apparatus.
14 452 G. H. Huntsworth. Telephone circuits.
14 455 Forges et Ateliers de Constructions Electriques de Jeumont. Terminal boxes for high voltage cables. (28/3/22, France.)
14 452 T. G. Anderson. Telephone circuits.
14 460 B. Schmelzer. Electric fan.
14 462 L. E. Taylor. Electric speed indicating devices.
14 469 H. Furse and J. B. Lovatt. Testing electric lamp filaments.
14 489 C. C. Garrard, A. H. Railing and W. Wilson. Starting and controlling apparatus for electric motors.
14 494 H. P. Rees. Wave length, etc., indicators for wireless telegraphy, etc.
14 502 E. Schattner and I. S. Dalgleish. Resistance coils, etc.
14 513 Western Electric Co. Loading signalling conductors. (16/8/21, U.S.)
14 516 H. W. F. Ireland and H. Lucas. Magneto electric machines.
14 518 Cambridge and Paul Instrument Co. and W. H. Apthorpe. Adjustable sensitive electric regulating device.
14 530 Creed and Co. and F. G. Creed. Electro-magnetically controlled switching apparatus.
14 535 P. Lonsdale. Timing device for telephones, etc.

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14 600 E. E. Moore. Relay for telegraphy.
14 611 English Electric Co. and R. A. R. Bolton. Automatic electric circuit breakers.
14 622 H. C. Braun. Insulated conductors.
14 625 A. C. Huskinson. Electric condensers of continuously variable capacity.
14 627 Evershed and Vignoles and J. C. Needham. Establishing electrical connection between movable contacts.
14 648 Ever Ready Co. (Great Britain) and M. Goodfellow. Electric torches.

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14 663 E. N. Bray. Electric resistances.
14 664 and 14 665 E. N. Bray. Starting switches for electric motors.
14 666 E. N. Bray. Starters, circuit breakers, etc., for electric motors.
14 667 E. N. Bray. Means for making electric connections.
14 678 J. Robinson, H. L. Crowther and W. H. Derriman. Directional wireless systems and apparatus.
14 685 A. F. Carter. Electric switches, cut outs, etc.
14 690 A. M. Taylor. Electric transmission systems.
14 694 A. C. Brown. Electric signals for fire, police or ambulance calls, etc.
14 709 A. C. Nobbs. Electric motor attachment for bathchairs, etc.
14 713 F. E. Pernot. Means for receiving a.c. signals.
14 729 F. J. Möller. Electric heating utensils.
14 731 F. Hamer. Conversion of kinetic energy contained in energy carrying fluids into electrical and mechanical energy.
14 740 E. E. Collins. Electric machines, etc.
14 765 W. S. G. Baker and J. Y. Fletcher. Holders for electric lamps.
14 773 B.T.-H. Co. Wireless signalling systems. (25/5/21, U.S.)
14 774 Lodge-Cottrell, Ltd. (Moller). Electrically separating suspended particles from electrically non-conducting gaseous fluids, etc.
14 781 Hart Accumulator Co. and F. J. Holmes. Terminals for batteries for miners' lamps, etc.
14 797 G. Weissmann. Electric battery. (25/5/21, France.)

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14 798 S. C. Midwinter. Electric clock escapement damper.
14 815 Rose Street Foundry and Engineering Co. and C. A. Hadley. Electric resistance welding.
14 820 R. Bosch Akt. Ges. Electric lighting and starting installations for motor vehicles. (30/5/21, Germany.)
14 835 M. Walker. Electric harmonic analysers.
14 873 R. M. Radio, Ltd. and H. R. Rivers-Moore. Detectors for wireless telegraphy and telephony.
14 874 W. H. J. Fuller and S. G. Sandeman. Electric testing apparatus.
14 887 Allgemeine Electricitäts Ges. Apparatus for winding spring motors. (27/5/21, Germany.)
14 901 R. C. Philpott. Incandescent lamps.
14 906 B.T.-H. Co. Protective devices. (26/5/21, U.S.)
14 908 L. N. Reddie (Officine Meccanische Italiane). Electric measuring instruments.
14 909 Hydrotherm Fabrik Elektrischer Apparate Ges. Electric hot water fountain. (8/6/21, Germany.)
14 917 Soc. Internationale M.D.M. Electric disconnector. (4/7/21, France.)

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14 942 A. M. Taylor. Electric transmission systems.
14 943 J. M. Ford and A. B. Wood. Synchronous motors.
14 950 A. Hewlett. Electric ignition systems.
14 974 B.T.-H. Co. (G.E. Co.). Electric relays.
14 980 and 14 981 H. L. Thomas. Multi-layer electric coils for wireless telegraphy, telephony, etc.
14 988 J. S. Smith. Suspension of reflectors from electric lamp holders, etc.
14 989 W. G. Hill. Amplification and rectification of oscillatory electric currents.

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CONTENTS.

Notes of the Week.

A "Char-à-Banc Convention."

This year's meeting of the Incorporated Municipal Electrical Association, which begins at Wolverhampton on Monday, should go down to posterity as the "Char-à-banc Convention." Owing to the hotel accommodation in Wolverhampton being limited it will be necessary for a proportion of those attending to live in Birmingham, and, for political reasons no doubt, arrangements have also been made for meetings to be held in the latter town and in Stoke-on-Trent. This will make essential the organisation of transport arrangements commensurate with those with which we were familiar during the war, and the convergence of a number of brilliantly painted vehicles on the chosen towns should not only add to the impressiveness of the occasion, but make for an increased pleasantness. Our only regret is that at an electrical convention the electric vehicle should not be in the ascendant. For, favoured by the weather and fostered by that care for comfort which is usual at these gatherings, nothing should be lacking to make the function an entire success, on both the technical and the social sides

Electricity Progress in the Far East.

The Municipal Council of Shanghai have every reason to be proud of their electricity department. It is in a very flourishing condition and excels the most enterprising of British electricity undertakings except perhaps Manchester. And while in 1920-21 nearly 200 000 000 units were sold in Manchester, compared with over 185 000 000 units in Shanghai, this year Shanghai takes for the first time the premier position. On the other hand, owing to the heavy power demands which represented sales of about 117 000 000 units in the past year, and to the exceptionally high load factor of 51·5 per cent., Shanghai possesses advantages which no British undertaking enjoys. The maximum load at Manchester in 1921 was 89 500 kW (against 41 074 kW at Shanghai), and the load factor only 25·46 per cent. But as the past year's net profit at Shanghai was £174 754, of which £104 167 was contributed to the municipal fund, it would seem as if the present tariff is too high; so that when the plant extensions on order are completed the prices should be revised, if not before.

Heavy Power Demands.

During the past year the Shanghai electricity undertaking appears to have made substantial progress in every department. The thermal efficiency of the plant at the power station was improved, three new generating sets were put into commission, about 2 700 additional premises (representing 10 519 kW) were connected to the mains, and nearly 41 000 000 more units were sold. Though the new power demands were not as great as were anticipated, yet the sales were over 38 million units more than in 1920; and as local industries are now being consolidated on a permanent basis, there will, no doubt, be a steady increase in the output for power for some years.

The Domestic Load.

We are also glad to notice that a substantial advance is recorded in the electric heating and cooking demands, notwithstanding the relatively high rates for these services. There was a particularly brisk demand for heating and cooking apparatus on hire, and though largely augmented stocks of radiators were carried by the Department, the requirements of customers again exceeded the supply, 1 769 radiators having been issued during the year. The result of the policy in increasing the size of hired radiators

from 2 to 3 kW has been justified, for the larger size is almost invariably selected by consumers. The Department, which is not hindered by the legislative restrictions on hire-purchase which prevail in this country, also let out ranges, motors and other apparatus on hire. Though the customs of the Chinese cook are said to impose a heavy handicap upon electric cooking progress, nevertheless a real advance was made. The hiring and showroom facilities of the Department are much appreciated and have greatly assisted in the rapid development of electricity for power and domestic purposes. We would like to see every electricity authority in this country equally well equipped for meeting prospective consumers' requirements. Meanwhile Mr. ALDRIDGE is to be heartily congratulated.

Are Two Public Inquiries Necessary?

DRAFT Orders constituting two Electricity Districts have recently been issued by the Commissioners, and the second public inquiries will take place later in the month. In both the districts concerned, South-East Lancashire and the South-West Midlands, it is proposed to set up Joint Advisory Committees in place of the Joint Authorities suggested in the Electricity (Supply) Act, but the chief point is of what use is further inquiry. The position was thoroughly investigated at the first hearing, and though there is a statutory obligation to hold a second inquiry after the adoption of a scheme and the preparation of the draft Order, it is only a waste of time and money. We therefore hope that if the second inquiry must be held and is protracted, those responsible will be compelled to pay for it.

A Contrast in Committees.

IN both cases some slight adjustments of the proposed areas, and some small amendments of the original schemes have been made, but each district gets substantially what apparently the majority of the authorised distributors want. That is, South-East Lancashire is to have a cumbersome Advisory Committee of about 50 members, who will, however, be dependent upon a much smaller committee of engineers; and in the South-West Midlands there will be a small Advisory Committee of four, two appointed by Birmingham Corporation and two by the Shropshire, Worcestershire and Staffordshire Electric Power Co. There could scarcely be a greater contrast in method, but then the economic eccentricities of Lancashire had to be placated and the peculiar position of the South-West Midlands taken into account.

Powers of S.-W. Midlands Committee.

THE South-West Midlands Order does not appear to confer many advantages or enlarge the powers of the authorised undertakers much beyond those already authorised by the Electricity Acts of 1909 and 1919. It does, however, define the spheres of influence of the Birmingham Corporation and the Shropshire Co., sanctions three agreements to safeguard the interests of the Leicestershire and Warwickshire Electric Power Co., and of the Worcester and Malvern Councils, and lays down rules for the constitution of the Committee of four, two of whom, we are glad to notice, are to be the chief engineers of the Corporation and company respectively. Three members are to form a quorum, and as the chairman, who is to be elected from amongst the members of the Committee, will not have a casting vote, there may be occasions when no decision can be arrived at. In this event the Committee must report to their principals who, if they cannot agree, are at liberty to submit the matter to the Commissioners for their decision. The Committee's functions are to be purely advisory, and are concerned with the operating timetable of the interconnected generating stations, the best load factor obtainable, the conservation of fuel, the proper return upon capital, the standardisation and regulation of supply, and any other matters that may be referred to it. All this seems to be vague and very general, but we have no doubt that the engineers of the parties will "carry on" without much assistance from the Commissioners being necessary.

That Cheap and Abundant Supply.

WE notice that it is solemnly laid down "it shall be the duty of the Corporation and the company to secure the provision of a cheap and abundant supply of electricity in the District." It is time this clap-trap about cheap and abundant supplies, so dear to ignorant politicians and to popular newspapers, was stopped. It is clearly to the advantage of both undertakings to supply as cheaply and efficiently as possible, and they would have done much more than they have if legislative restrictions had been earlier abolished. Even now the Commissioners can help materially by removing the obstacles to the use of overhead transmission lines, and thus getting rid of the restrictions upon expansion in rural areas, a matter of which a correspondent this week emphasises the importance.

Undue Preference in Methods of Charging.

WE imagine that the recent revival of allegations of undue preference may be ascribed to the increased charges for electricity which have become necessary since the war. Naturally, no one wishes to pay more than he is legally bound to do, but it is clear that charges of unfair preference are more easily made than proved, as shown by the judgment in Westminster Electric Corporation *v.* Wykeham Studios, Ltd., which we reported recently. Though this decision appears to be in conflict with the judgment of a Divisional Court in Linsdell *v.* Paignton Electric Light Co. it is substantially just and in accordance with previous judicial pronouncements upon the construction of sections 19 and 20 of the Electric Lighting Act of 1882, the basis of all methods of charging

The Legal Position.

BY section 19, where a supply of electricity is provided in any part of an area for private purposes, then, generally, every consumer is entitled to a supply on the same terms to which any other consumer is entitled *under similar circumstances* to a corresponding supply. By section 20 the undertakers must not, in making agreements for the supply of electricity, show any undue preference to anyone, and though they may make such charges as may be agreed upon, these must not exceed the limits set out in their Order. These clauses seem to be quite clear and sufficiently elastic for all purposes.

An Important Phrase.

INCIDENTALLY, it is well to remember that there is no reference in them to light or power, but only to electricity Light, power, traction and heating are later distinctions introduced by electrical engineers as the applications of electricity have expanded. In dealing with electricity tariffs many consumers seem to ignore the important phrase, "under similar circumstances," but it must be recollected that this has received a liberal judicial interpretation. It

has been held to embrace the amount of energy consumed, the expense of supplying and getting payment, the uniformity of the demand, and the time when the energy is required. Consequently different charges have been authorised for lighting power, heating, traction and other purposes, according to the load factor, diversity factor and other factors affecting each particular class of consumer. It is satisfactory to see, therefore, that the present judgment is based upon, and professes to maintain, these principles.

Is Electricity for Photographic Lamps Power?

One class of consumers—*viz.*: cinema theatres—will be specially interested in the judgment of Mr. Justice Swift, for it has decided that electricity supplied for photographic lamps is power and not light. As the contrary was held, we think rightly, in the Paignton case in 1920, all electricity authorities will now be called upon to give power rates for the supply to cinema lanterns where they have been charging at lighting rates. We have always contended that the cinema load is so good that special terms should be given to this class of consumer. As a matter of fact, many supply undertakings have introduced a scale intermediate between lighting and power for cinemas, and we hope that where this has not yet been conceded the matter will now be reconsidered. At all events, we should deprecate more litigation on the subject, because it will benefit no one but the lawyers, and will engender friction between the supply authorities and their consumers.

The Inefficiency of the Domestic Range.

The Fuel Research Board has published the results of a scientific investigation into the efficiency of domestic ranges and cooking stoves. Readers of The Electrician will not be surprised to learn that Mr. A. H. Barker, who made the tests upon which the report is based, finds that to design a range to do several things is only relatively economical, when it does all those things at once, and is most uneconomical, when it is only doing one at a time. At best the total efficiency figures only lie between 5 and 11 per cent., while in apparatus designed to do only one thing 30 per cent. is easily obtained. But with a range used for one purpose alone at a time efficiencies as low as 1 per cent. were obtained, the average being only 2½ per cent. It is not stated whether these tests were made with new equipment, but they probably were, and, as is well known, the efficiency of ranges, for reasons connected with the deterioration of the brickwork, cleaning and fixing, falls off very much with use. To overcome this waste it is suggested that a central (or rather communal) heating and water supply should be used even in cottages, as has been successfully done in the United States.

One Job, One Apparatus.

We need hardly say that we consider that matters ought to be carried a great deal farther than this. Without descending to propaganda, in which we are too modest to indulge, the policy in domestic life should be to use specialised apparatus of the most efficient kind for performing one operation and one operation alone. When it is not in use that apparatus should not be consuming fuel. Continuous fuel consumption to little purpose, apart from other considerations, is one of the gravest disadvantages of the kitchen range. To adopt our policy would mean labour saving as well as fuel economy, two objects which are well worth striving for in these stressful days.

Physical and Physiological Aspects of Science.

The Annual Report of the Council, presented at the meeting of the Illuminating Engineering Society on May 25, showed that the Society has of late had much to do with physiological aspects of illumination. The Presidential Address delivered by Sir John Herbert Parsons, who is an eminent ophthalmic surgeon, contained some happy allusions to the need for co-operation of scientists in dealing with that borderland between physics and physiology. For the scientific treatment of a physical problem measurement is a necessity. Advances in methods of measuring illumination have had much to do with progress in the art of artificial lighting, and in the field of natural lighting (notably the conception of the "daylight" factor attributed to Mr. A. P. Trotter) measuring instruments have also proved of value. But physicists too often forget that the basis of physical measurements is biological. The so-called "outer world" only exists for us by virtue of the sensations it arouses in our bodies, and physical measurements are open to the errors of all human observations. In the case of photometry, especially in the comparisons of sources of light which differ in colour, we soon become acutely conscious of the influence of personal error, which we can eliminate only by some system of averaging. Similar considerations arise in connection with the much-discussed problem of glare, to which Sir John also made allusion. We have at present been compelled to resort to practical compromises, such as those embodied in recent reports of the Departmental (Home Office) Committee on Lighting in Factories and Workshops. But there is still a great deal to be done on a joint physical and physiological basis before we can claim to have disposed of the problem in a scientific manner.

British Electric Traction Company.

Seeing that all tramway undertakings of the country have been experiencing a lean time, the British Electric Traction Co., the bulk of whose revenue is still derived from provincial tramway and transport enterprises, are to be congratulated on the results of the past year's working. For though the gross revenue was £262 900, a drop of about £22 000, the net revenue of £134 000 was only £1 000 less than in the previous year, so that expenditure must have fallen in a slightly greater ratio than receipts. An ordinary dividend of 4½ per cent. is recommended, compared with 4 per cent. last year, and, after placing £14 700 to reserve the amount carried forward is £194 200, though this is subject to three years' Corporation Profits tax. We notice that the company's investments, which now stand at £3 987 600, or £125 800 more than the preceding year, are spread over a variety of home and foreign securities, and that the average yield has fallen from 5·39 to 5·24 per cent. The tendency of the company appears to be to widen their sphere of operations, for a number of the new investments are unconnected with electric traction. This portion of the business has so far been quite successful, though some of the foreign Government securities in the list look a little risky.

Electric Power Demands in Lancashire.

One of the modern tests of the industrial progress of a district is the amount of electricity used in it for power purposes. If we judge the area supplied by the Lancashire Electric Power Co. by this standard, Lancashire enterprise cannot be in so bad a way as is sometimes represented. For the company generated (or purchased) nearly 63 000 000

units during the past year, compared with 60 686 500 in 1920, and the connections increased from 44 000 H.P. to 54 700 H.P., by far the highest figure for any year since the company commenced operations in October, 1905. The gross receipts and trading profit also showed a striking improvement, being £294 900 and £94 300 respectively compared with £249 900 and £47 400 in 1920. All the company's financing is done by the Lancashire Electric Light and Power Co., which has raised £800 000 in debenture stock and preference shares during the past two and a half years. Moreover there seems no reason why the company should not do still better once trade begins to revive.

Efficiency of Wireless Watchers.

THE findings of the Merchant Shipping Advisory Committee, which was appointed to report on the efficiency of "wireless watchers" and on the sufficiency of Sec. 1 (2) of the Merchant Shipping Wireless Telegraphy Act of 1919, are singularly lame and inconclusive. Though many witnesses were examined, the Committee state that the time at their disposal was not sufficient to enable them to investigate thoroughly the cases of alleged inefficiency of watchers. But they consider that even if the allegations should, on further inquiry, be sustained they do not afford grounds for altering the present regulations. The logic of this statement is difficult to understand and appreciate. An inefficient watcher is obviously a source of danger to all on board under the present requirements, but in any event the procedure involves delay as recent accidents at sea have shown. Watchers, whose employment cannot be much more economical than wireless operators, should either be thoroughly efficient or else be replaced by men with qualifications of the latter. We hope the Board of Trade will take steps to alter the regulations accordingly.

The Limitations of Broadcasting.

THE "broadcasting boom" shows no signs of diminution. Amateurs are still being pressed to invest in receiving sets, and instructed often with more enthusiasm than wisdom in their use and possibilities. Generally we have nothing to say against this, as it will be of both direct and indirect advantage to the electrical industry. There is, however, a possibility of having too much of a good thing, and when the suggestion is made that the broadcasting can be usefully employed for tracking and capturing mobile criminals that stage has been reached. We have no expert knowledge of criminal psychology, but such authorities on the subject as Sir ARTHUR CONAN DOYLE, MR. WM. LE QUEUX and Mr. JOHN BUCHAN lead us to suppose that operations of this kind are best conducted in secrecy. Now secrecy is no quality of broadcasting, and, as Sir CHARLES BRIGHT rightly points out, to distribute information of this kind by wireless means is more likely to lead to the criminal's escape than to his capture.

The "Commemoration Journal."

THE Commemoration Number of the "Journal" of the Institution of Electrical Engineers, which has just been issued, contains not only a full account of proceedings at the meetings which took place in February, but a number of additional communications from well-known pioneer members, and a series of photographs of both human and historical interest. The whole forms a record of enterprise, high endeavour, faith, with sometimes consummation and sometimes failure as their result, and generally a record which is tinged with humour, pathos, and human interest. It is a record to be read, studied and preserved. In fact, if any electrical engineer is on the look-out for a bedside book, he might do a good deal worse than take this number for that high purpose. For he will find in it qualities which give a quiet mind and lend rest after toil to the weary soul.

The Standardisation of Cooker Types.

WE have always protested against the too early standardisation of electrical apparatus. For, if not in its infancy, our industry is still young enough to make it wise to use every effort to avoid grooves, whether in policies or in more material things. At the same time ultimate standardisation should ever be kept in mind, and an immediately useful way of doing this is by a close and continued examination of all parts of the apparatus so that weak features can be eliminated or improved.

One Type, One District.

THIS is particularly necessary with cookers, and indeed with all domestic electric apparatus, and a step towards this end might be made by electricity supply engineers arranging to use only one type of cooker in their districts. In this way not only would they and their staffs become experts in the qualities of that particular type of apparatus, but consumers would be relieved from an embarrassment of choice, salesmen from embarrassment of another kind, and stocks of spares reduced to a minimum. The argument against this policy is that it is difficult to make the choice, and that specialisation is as necessary to avoid as standardisation. But no cooker on the market at the present time is of outstanding merit, while equally none outstandingly lacks merit. And supply engineers do meet for discussion from time to time when notes can be compared. Now, when the domestic load is growing, is the chance for taking what should be a useful step.

U.S. Power Station Practice.

CONSCIENTIOUSLY to attend the Annual Convention of the National Electric Light Association must be a devastating experience, both mentally and physically. Commenting on the proceedings of this body two years ago we pointed out that no less than twenty-one papers were down for reading, while seventy-three reports were to be presented for discussion. In addition there were the usual dinners, municipal welcomes and social functions which, though a change from the more technical labours, are equally tiring. At this year's convention, held at Atlantic City last month, the figures, though we have not actually taken a census, must be quite as large, and we are not therefore surprised to find the opinion growing that the whole proceedings are too gargantuan to be useful. For not only are the programmes of the various sessions overcrowded, but, two or more sessions being held in parallel, it is difficult for even the most energetic to get the full benefit from them.

The Better Way.

WE cannot help thinking, therefore, that ours is the better way. To take this year's I.M.E.A. Convention as an example. Three papers only, all on important subjects, are to be discussed; and the time provided for this purpose is adequate, if not generous. The social functions and the visits to works are not too numerous or too exhausting, and there will therefore be no excuse for anyone attending not taking his or her full share in every item in the programme. On the other hand, there are conventions even in this country where the programme is over

crowded. We hope that when the British National Electrical Convention comes into being the better example will be followed. For there is such a thing as mental gourmandising with its consequent ill-effects.

Turbine Performances.

In making these criticisms we have no wish to minimise the usefulness of the information published at the National Electric Light Association's Convention. Some of the reports, which represent a year's calm work, should be especially interesting to electrical engineers in this country. For example, the Prime Movers Committee gives data of the performance of seventy-eight turbines with outputs of from 20 000 kW to 45 000 kW. This data shows that much has yet to be learned in the design and manufacture of these large units before finality can be said to have been reached. At present breakdowns are frequent and lengthy. In the case of one 35 000 kW machine running at 1 500 revs. per min., the period during which it was shut down for various purposes amounted to no less than 47·2 per cent. of the total time in service, while in the case of a 20 000 kW machine also running at 1 500 revs. per min. it was 32·6 per cent. It is only fair to say that in several other cases the ratio of time in use to total time was extremely high ; nevertheless we think the committee are justified in stating that 100 per cent. availability of generating equipment is essential from a service standpoint, and that as existing units do not approach this figure it would generally be better to invest money in improving their reliability than to arrive at the same end by purchasing reserve units.

The Question of Turbine Size.

A correlated question is the best and most economical size of turbines for large generating stations. In this country we seem to have become crystallised round about 15 000 kW or 20 000 kW, and it is doubtful whether on the balance anything is to be gained by going much higher. The very large machines now in use in the United States, as Mr. Patchell, among others, has shown, have their own peculiar disadvantages, while the fact that in many cases they cannot be fully loaded for a great part of their life will, we hope, combine to limit their use over here.

Boiler House Practice.

The same might be said about boiler house practice. In the States the trend seems ever upward, a boiler with a normal rating of 2 982 h.p. having been installed in the Congress Street heating plant of the Detroit Edison Company. In this country it may be said that we have gone far enough. In the United States, as over here, there is a continued tendency towards higher pressures, the present maximum being 350 lb. with a steam temperature of 700° F. This compares with the steam pressures of 270 lb. and 300 lb. at Runcorn and Edinburgh, where the total steam temperature is about 700° F. Rumour hath it, however, that the New North Tees station is to show us something extraordinary in this respect.

Boiler House Economics.

As Mr. Mitchell pointed out in his Paper on the Dalmarnock station, read before the Summer Meeting of the Institution of Electrical Engineers, the place where economics in generation are now to be primarily sought for is in the boiler house. A careful record of results is one of the most important means of achieving this end. But equally important is the careful design of the equipment employed and a rigid examination of the materials used in manufacture and of the effect of these materials on the initial and ultimate performance of the plant. Working on these lines, attention has been given by the Prime Movers Committee to the study of refractories both as regards temperature effects and mechanical strength, with a result that the specification of the Panama Canal Commission for firebrick has been recommended for use.

The Auxiliaries Problem.

The problem of how most economically to drive the power station auxiliaries is one that is much exercising the minds of electricity supply engineers in this country. Here again we may obtain some useful hints from the Prime Movers Committee's report. Reliability, they insist, quite rightly, is the first essential, and it is also essential that the equipment should be in duplicate. Otherwise there seems to be as great a variety of practice as in this country. The house turbine is the favourite method to employ either in conjunction with steam-driven sets or with an emergency electric drive for the main bus bars. A third course is to bleed the main turbines to supply the auxiliary steam drive. It is pointed out that theoretically the greatest economy is gained from multiple stage bleeding of the main unit, but that practical operation has limited the bleeding points to two. It is interesting to note the recommendation that the control of the auxiliaries should be in the hands of one man who should be responsible for maintaining a heat balance at all times. There is no question that the proper operation of auxiliaries has a most satisfactory downward effect on the coal consumption per unit generated, and if the introduction of a psychological factor is likely to assist economy it is certainly worth trying.

Other Useful Reports.

In examining at some length the findings of the Committee on this important subject we have been obliged to neglect other reports which are of almost equal interest. These include one on electrical apparatus to which we shall hope to refer in a later issue, as it includes an important discussion on the rating of circuit breakers and automatic substation practice ; another on inductive interference, on which subject agreement has apparently been reached between the electricity supply and telephone authorities, and particularly a mass of information relating to merchandising finance and selling. These reports all show that electrical engineers in the United States are fully alive to the possibilities of the commodity with which they have to deal. They equally show that there is much to be done before that commodity has that universal application which is its right.

A Poll—and its Result.

As an example of this we may quote one incident at which we were more than a little relieved. At a meeting of the merchandising section a count was taken of the number of men in the room who used electric ranges in their own homes. There were twenty less than 10 per cent. of the audience. We really thought they were more progressive in the United States. What would be the result of a similar poll at one of the meetings of the I.M.E.A.—say when Colonel Vignoles' paper on "The Extension of the Use of Electricity for Domestic Purposes" is read next week? But even about this backwardness we may be optimistic, for it shows what a vast deal yet remains to be done, and that electrical engineers at least will not need to look for work just yet awhile.

Considerations Relating to the Design of Oil Circuit Breakers.

By D. R. DAVIES, A.M.I.E.E.

In the first part of the article the author discusses the methods usually adopted for reducing the losses in oil circuit breakers. Information is also given which can be used for estimating the maximum temperature rise of small conductors during short circuit. Such information is, of course, quite applicable to potential transformer connections or the like.

The interruption of alternating current is now almost universally accomplished by means of the oil circuit breaker, and although air break types are used both on the continent and in America, they are only to be found on small subsidiary circuits.

The disadvantages of the air break switch are :

(1) The length of time during which the arcing lasts.
(2) The uncertainty of breaking all three phases simultaneously.
(3) The amount of space required when used indoors.
(4) Impossibility of breaking very heavy currents.

Certain test results for this type of switch were published in the "General Electric Review" for September, 1914, and the average arcing time is given there as about six seconds, whereas in a good oil switch it would probably not exceed half a cycle.

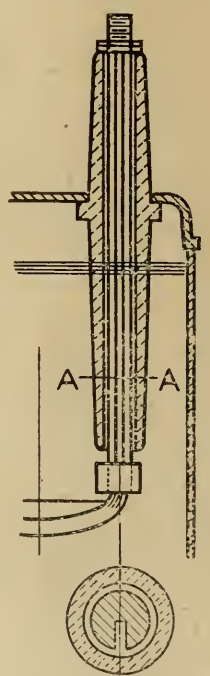

FIG. 1.—SHOWING METHOD OF REDUCING EDDY CURRENT LOSS.

Although the use and manufacture of the oil circuit breaker has been in vogue for the past twenty years, there is still a dearth of reliable information concerning the behaviour of arcs in oil, and consequently designers must rely to a certain extent upon semi-empirical data, derived from tests on existing breakers. An inspection of most recent designs will show that, in the way of tank strength, air chamber, and head of oil, modern breakers are more liberally proportioned than their predecessors. Electrical operation is now the recognised system adopted for central station oil circuit breakers, and to a smaller extent for sub-station work; in fact it would be impossible to close manually some of the larger sizes of breaker with the rapidity necessary for synchronising.

Current to be Dealt With.

The current that must be interrupted under fault conditions greatly exceeds the normal load current, and oil circuit breakers therefore have a normal rating, and a short circuit rating, commonly called the breaking capacity. Breaking capacity may be defined as the maximum kilovolt-amperes which the circuit breaker can break under prescribed conditions, at stated intervals, a specified number of times. The value of the maximum kilovolt-amperes is the product of the rated working pressure in r.m.s. kilovolts, and the actual r.m.s. current at the time of separation of the contacts, multiplied by 1, 1·73 or 2, for single-phase, three-phase or two-phase systems respectively.

The short circuit rating is by far the more difficult one to meet, and is the one mainly responsible for the size and cost of the breaker. It must be remembered, too, that in the case of large breakers there is not the same opportunity for testing the ability of the breaker to fulfil this rating before going into commission as is the case with other electrical apparatus.

The class of service for which a breaker is intended determines to a great extent the amount of consideration that must be given to certain features. Breakers having short circuit ratings up to about 50 000 kVA enjoy a more extensive market than larger sizes, and their manufacture on mass production principles must therefore influence the designer in his conclusions.

Heating during Normal Conditions.

During normal operation the maximum temperature rise should not exceed the following limits :—

(*a*) For breakers rated up to and including 2 000 A, the temperature rise should not exceed 30 deg. C.
(*b*) For breakers rated above 2 000 A, the temperature rise should not exceed 40 deg. C.

Although no difficulty is experienced in keeping within these limits on breakers intended to carry less than 1 000 A, more attention must be paid to heavier currents in order to avoid trouble due to local heating.

The losses occurring during normal service are :

(1) Copper loss (I^2R) in contacts, stems, etc.
(2) Iron loss in top cover and tank walls.

Contact stems intended for currents of the order of 2 000 A may either be built up from a number of copper straps in parallel, or solid round rod may be used. Although the use of straps is undoubtedly desirable for keeping down the heating, such an arrangement lacks the requisite stiffness, and is difficult to insulate at the point where it passes out through the top cover. This is mainly the reason why strap conductors are more suitable for breakers where their length may be comparatively short, and the voltage low. On the other hand, round rod permits the use of porcelain insulators, and also makes a sound job mechanically. It is well known that conductors offer a greater resistance to the flow of alternating current than they do to direct current, owing to the skin effect. By referring to Table 1 it will be seen that when conductors as large as 2 in. diameter are used on 50 period circuits, this increase in resistance becomes quite appreciable.

TABLE 1.

Diam. in.	Ratio $\frac{\text{Resistance A.C.}}{\text{Resistance D.C.}}$
1·00	1·09
1·25	1·18
1·50	1·38
1·75	1·60
2·00	1·75

Another cause of heating in large solid conductors is due to the eddy current loss, and, as this loss increases as

the fourth power of the diameter of the conductor, the heating increases very rapidly. Therefore, when solid conductors as large as 2 in. diameter are used it is necessary to have a small slot milled down nearly its entire length as shown in Fig. 1.

Heating Precautions Unnecessary for Small Currents.

Generally speaking special precautions to prevent heating due to iron losses are unnecessary on breakers designed to carry less than about 350 A. Larger currents, however, demand certain modifications to the top cover, and the designer must either introduce short air gaps into the magnetic circuits, or else specify the use of non-magnetic metal.

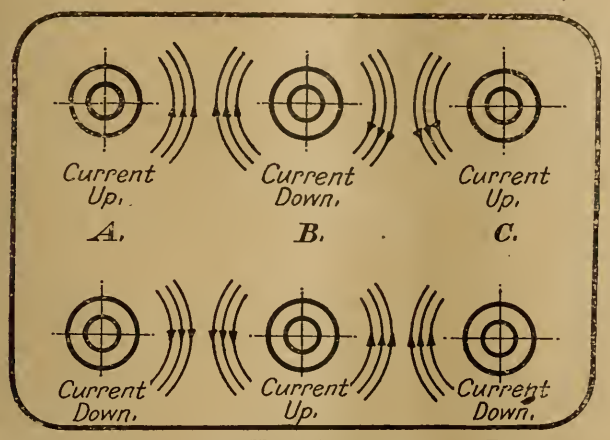

FIG. 2.—SHOWING HOW HIGH FLUX-DENSITY IS PRODUCED BETWEEN PHASES.

Fig. 2 shows the plan of a typical small breaker, and it will be noted that at the particular instant of time when the current in phase B is at its positive maximum, that in phases *A* and *C* is half the negative maximum, so that when the normal load exceeds about 350 A the flux-density becomes great enough to heat up the top cover unless the usual precautions have been taken.

The heat generated in the oil is conveyed by convection currents to the tank side, from which it is then dissipated by radiation to the surrounding atmosphere. In order to assist the oil to circulate in the tank it is essential that :

(1) An oil layer be left between the lining and the tank wall.
(2) The top edge of the lining is beneath the oil surface.
(3) The lining is arranged so that it can only rest on the tank bottom at certain places.

A further advantage of allowing these spaces is that, the oil being in direct contact with the tank side, the heat flux is not constrained to pass through the lining before reaching the tank wall, and the temperature gradient is therefore uniform.

Circuit Breakers for Furnace Equipments.

The rapid development of the electric furnace during the war created a demand for very heavy current breakers for low voltage service. As the heat developed in this type of breaker is great in comparison with the mass of oil and the area available for radiation, certain special features must be incorporated in the design, such as, for example, the corrugated tank, non-magnetic top, or even perhaps the main brushes may be mounted outside, the arc tips only being immersed in small oil tanks.

Heating of Conductors during Short Circuit.

So far the heating of the copper contact stems due to the passage of the normal load current only has been considered, and, even when breakers are intended to interrupt currents of the order of 30 000 A r.m.s. the thermal capacity of the stems is always sufficient to prevent any excessive rise in temperature, although their sectional area may have been determined from the point of view of the normal current carrying capacity only.

Even in an extreme case, where a purchaser would require a breaker capable of carrying, say, 300 A normally, and to interrupt 30 000 A on short circuit, it is very doubtful whether any manufacturer would offer a breaker having a normal current rating of less than 600 A.

The cost of the copper is only a small percentage of the total cost of a large breaker, and from the manufacturer's point of view the saving effected by a design with a normal rating of less than 600 A does not really justify carrying the extra number of parts in stock.

Generally speaking, a breaker having leading-in stems not less than $\frac{7}{8}$ in. diameter is quite capable of dealing with 30 000 A, during short circuit conditions, without producing a temperature rise sufficient to cause damage. We can say, then, that to a certain extent the area of the leading-in stems is independent of the short circuit rating of the breaker.

Design of Arcing Contacts.

When we come to consider the design of the arcing contacts, however, the conditions are very different, and the flimsy pieces of copper which are sometimes provided for this purpose are wholly inadequate for their duty. It is important to remember, when designing arcing contacts, that the sectional area and contact area are both functions of the short circuit current only, and both are therefore entirely independent of the normal load current of the breaker. Arcing contacts which are intended to carry currents of the order of 30 000 A or more during the arcing period should receive special consideration, and anything in the nature of flexible shunt leads should have an ample sectional area, or the danger of fusing them is always present.

Temperature Rise.

The following information, together with the curves, Fig. 3, will enable those interested readily to determine the temperature rise obtainable under the worst possible

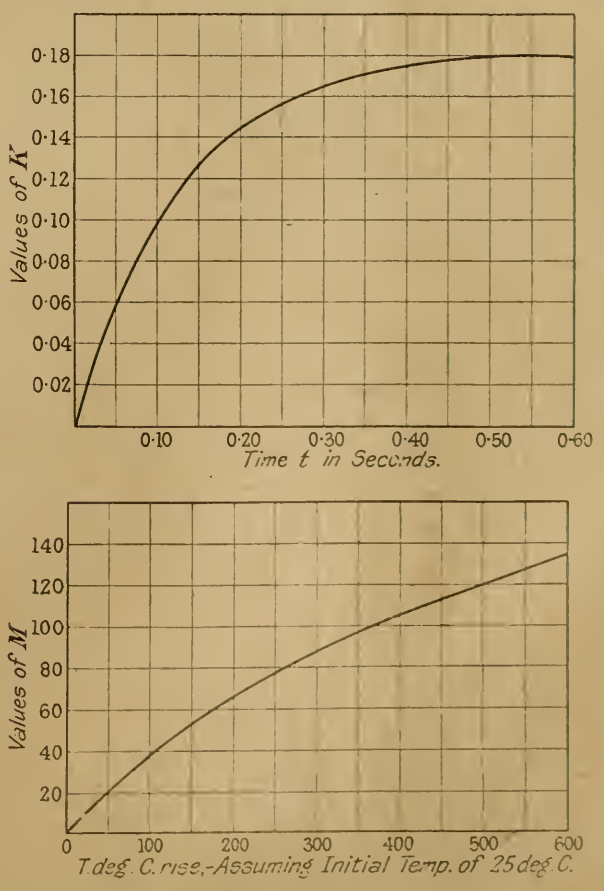

FIG. 3.—HEATING OF CONDUCTORS ON SHORT CIRCUIT.

conditions, *i.e.*, when a breaker is closed on an incipient

fault which develops at the instant at which the arcing contacts separate.

Let t = time in secs. from moment of short circuit.
T = temperature rise in time t (in deg. C.).
i = instantaneous value of the current.
α = temperature co-efficient of copper per deg. C. = 0·428.
A = cross-section of conductor in sq. cms.

Then, neglecting the heat radiated, the necessary condition is :—

$$A^2 = \frac{2\int i^2.dt \times 10^{-7}}{\frac{1}{\alpha} log_{10}(1+\alpha T)}$$

The value of i^2 depends upon the machine constants and the point of the voltage wave at which the short occurs. If we assume that the current falls to about one-half its initial value I in 10 cycles then we can write $i^2.dt = 2I^2 \times K$ where K is given by the curve (Fig. 3), and I is the r.m.s. value of the first alternation.

These values of K are based on the machine damping constants generally found in practice. Substituting for $i^2.dt$ in the above equation we obtain

$$A^2 = \frac{2I^2 \times K \times 10^{-7}}{\frac{1}{\alpha} log_{10}(1+\alpha T)}$$

or

$$M = \frac{2I^2 \times K \times 10^{-7}}{A^2}$$

Where

$$M = \frac{1}{\alpha} log_{10}(1+\alpha T)$$

Values of T corresponding to those found for M may be obtained from the curve, Fig. 3.*

Not only must the sectional area of the shunt path through the arcing contacts be sufficient to deal with the short circuit current, but the contact area of the arcing contacts themselves must also be capable of dealing with the current in the arc. We know quite well that an arc can only be maintained by supplying to the electrodes sufficient heat to keep them at incandescence.

We can imagine this heat as penetrating for a short distance below the face of the arcing contact, and this depth, multiplied by the contact area, would represent approximately that portion which becomes volatilised by the arc.

Clearly, then, according to this reasoning, the greater the contact area the less will be the depth of penetration, and the longer will the arcing contacts give service before requiring renewal.

Heating of Closing and Trip Coils.

Closing coils and trip coils for use with oil circuit breakers are usually proportioned so that the temperature rise cannot exceed 50 deg. C. in 30 seconds.

The effect of radiation is, of course, neglected, and the total watt loss is considered as being consumed in heating up the copper.

The heat loss produced in the coil in 30 seconds is clearly

$$30I^2R \text{ watt-seconds.}$$

Also if

s = specific heat of copper = 0·095 cal. per grm.
θ = temperature rise = 50 deg. C.
M = mass of copper in grms;

then, since 4·2 calories per second = one watt per second, we can write

$$30I^2R = 4{\cdot}2sM\theta$$

Now one lb. = 453·6 grms

Therefore $I^2R = \frac{4{\cdot}2 \times 0{\cdot}095 \times 453{\cdot}6 \times 50}{30}$

Whence $I^2R = 302$ W. per lb. of copper.

Conditions Existing during the Arcing Period.

The interruption of a flow of current is analogous to the introduction into the circuit of a resistance rapidly increasing in value to infinity. In the case of an oil circuit breaker, a thin film of oil is interposed directly in the path of the current at the instant at which the arc tips separate. Such a small quantity of oil must necessarily have a high ohmic value and an extremely low thermal capacity ; consequently, the passage of even a small current in the form of a spark is at this instant sufficient to produce a high temperature in the immediate region of the arc tips, and the original thin film of oil becomes dissociated by the heat into a bubble of ionised gas. A condition is then established which is favourable to the formation of an arc, and this condition will remain so long as a certain relationship is maintained between the voltage and gap length. The intensity of the spark following the interruption must be due primarily to the self-inductance of the circuit, and therefore the initial arcing conditions are to a certain extent independent of the particular values of voltage and current when separation occurs. The E.M.F. of self-inductance is in quadrature with the current, and even when separation takes place at zero current, the gap length can never, with a finite switching speed, increase with sufficient rapidity to prevent the E.M.F. of self-inductance puncturing the oil film and initiating a spark.

When the breaker is operating on normal load it is quite reasonable to regard the line voltage as assisting under certain circumstances in establishing the arc at the moment of interruption ; but obviously under short circuit conditions, when the voltage is practically zero, the creation of the arc must be due to the E.M.F. of self-inductance.

(To be continued.)

* The writer is indebted to Mr. S. Neville, B.Sc., A.M.I.E.E., for the mathematical investigation of this problem.

Indian Trade in 1921-22.

H.M. Senior Trade Commissioner in India, in forwarding to the Department of Overseas Trade the March number of the monthly trade returns of the Government of India, states that the total imports of merchandise into India declined from 335·5 crores in 1920–21 to 206·4 crores in the year under review. Imports from the United Kingdom fell from 204·5 to 150·9 crores (26 per cent.), while those of the United States fell from 35·3 to 21·6 crores (39 per cent.), and those from Japan from 26·4 to 13·5 crores (50 per cent.). The most noteworthy feature was the increase in the imports from Germany from 4·75 to 7·24 crores, the increases being mainly in dyestuffs, hardware, glassware, iron and steel.

Machinery Imports.

The most remarkable feature of the year was the prodigious import of machinery and millwork equipment. In 1920–21, the total was 22·37 crores, but in the past year this increased to 34·25 crores, of which the United Kingdom supplied 28·32 crores and the United States 4·51 crores. British shipments increased during the year by almost 11 crores, and American supplies by ½ crore. The principal increases were under the following heads: Cotton machinery (from 3·67 to 7·64 crores), jute machinery (2·77 to 4·32 crores), electrical machinery (2·19 to 3·90 crores), and boilers (1·59 to 2·55 crores). There were also substantial increases in machinery for mining, oil crushing and refining, paper, rice and flour mills. The only serious competition in machinery at present is that from the United States, but the United Kingdom more than maintained its position. An increase in imports from Germany (from 17 to 55 lakhs) was largely due to rice mill machinery and sugar plant.

The total imports expanded from 14 to nearly 19 crores, of which the United Kingdom supplied 18·4 crores. In this enormous trade there is as yet little competition, the imports from America being only 13 lakhs. Imports from Australia (mainly sleepers) rose from 12·4 to 20·5 lakhs, while those from Canada fell from 20·75 to 2·14 lakhs. The expansion in this valuable trade may be expected to continue in view of the new capital expenditure programme on railways, which amounts to 30 crores per annum for five years.

The trade in iron and steel products showed a considerable reduction, but German and Belgian wire nails, steel bars and channels, etc., showed increases.

Electrical Instruments and Apparatus.

This trade has been well maintained, the total imports in 1920–21 being 4·18 crores, compared with 4·06 crores in the past year. Supplies from the United Kingdom show little alteration, and are roughly 70 per cent. of the total (2·84 crores). American shipments were, however, reduced from 95 to 80 lakhs, while those from Italy rose from 7½ to 16½ lakhs.

Recent Developments in Power Production.*

By D. L. SELBY-BIGGE.

The Paper is a summary of the advances that have been made in the economics of power production during the past eleven years. The need for remodelling steam-raising plants is pointed out, the tendencies in steam-raising methods are noted, and the advances that have been made in turbine and condenser design are detailed. Finally a typical colliery power station is described. The author thinks much remains to be done before the bedrock of economy in power production is reached.

Eleven years have passed since the author read his last paper before the Iron and Steel Institute. Abnormal trade conditions now prevail, and various developments have taken place in power production which tend to greater economy. The main source of power in this country is primarily derived from coal. This is the datum line from which we must start in the investigation of the problems of power production. Immense quantities of combustible fuel of low-grade quality and waste gases, which with modern appliances and treatment can be economically converted into steam or other assets of great value, still remain unutilised.

The Economic Problem.

Of late, however, the economics of power production have been more closely studied. Present methods in the generation and transmission of electric power have reached such a high standard that we can only expect small economies in the engine-room or power station. We must turn to the boiler-houses and the efficient use of various grades of fuel for further savings. Here an immense field for economy exists. Consideration will also be given to the utilisation of waste assets—*e.g.* blast-furnace gas, coke-oven gas, and gas from reheating and regenerative furnaces, for steam-raising for power production purposes. One very important point is the need for skilled supervision and control in the boiler-house. In most collieries and works the boiler staff employed is not of such a high standard as the staffs usually employed in the engine-room. Possibly collieries and iron and steel works have hitherto not required to work on such fine margins as a corporation or public supplies, and have therefore used coal and waste-heat in a prodigal manner.

In collieries advances in washing and grading fuels, and in the installation of coking and by-product plants, have reduced the amount of fuel usually allocated to boilers, and have increased the quantity of low-grade fuel, which will not bear the cost of transport and for which in normal times there is not a ready sale. In iron and steel works the introduction of the more efficient turbo-blower has liberated large quantities of waste gas, which is now available for power production.

Much has been heard during the last few years of the urgent necessity for an abundant supply of cheap power. The right source from which to obtain such power is from the coal at the collieries, and the waste gases at iron and steel works.

Coal Consumption.

There is a wide field for the remodelling of steam plants at collieries, which consume about 18 000 000 tons per annum, or over 7 per cent. of the total coal raised.

In twenty-four collieries studied by the Board of Trade Coal Mines Department in 1918, the consumption of coal varied from 4·5 to 16·5 per cent. of the total production. In certain districts—notably South Wales—much attention is being paid to coal economy, but there are still many cases where little is being done. Interest attaches to the possibility of utilising "pit heaps," many of which have been standing for forty or fifty years. Mr. David Wilson gave, in 1918, a comprehensive analysis of these fuels.

It was calculated that there were some three million tons of refuse coal lying at the pit heads, of an average estimated calorific value of 5 000 B.Th.U.'s.

The author reproduces a table from the paper specified to illustrate the great variety of such waste-heaps. Thus calorific values varying from 3 825 to 10 240 B.Th.U.'s are recorded; the ash percentage varies from 10·51 to 67·65, the moisture content from 1·75 to 27·39. It was proved that a great deal of this material could be used for steam-raising.

For the iron and steel industry the estimated consumption for 1913—the last available normal year—was 31 000 000 tons (including coal used for smelting and blast-furnaces as well as steam-raising). It appears the consumption of coal under boilers in the iron and steel industry is approximately 5 500 000 tons per annum.

In the report issued by the Electricity Commissioners in January of this year the number of stations is given as 403, the total units generated as 4 965 514 403, the average coal consumed 3·32 lb. per unit generated, the lowest coal consumption 1·7 lb. per unit, and the highest thermal efficiency recorded 17·75 per cent.

The Cleaning of Coal.

The Froth flotation processes for cleaning fine coals deserve mention. Coal or coal-bearing waste crushed to pass a screen of about 1-10 in. linear aperture is treated as a pulp consisting of approximately four parts of water to one part of coal. There is a series of units each composed of an agitation box and a frothing box. The pulp is initially mixed with about 1 lb. per ton of coal of a suitable oil reagent; minute air bubbles are then formed and become attached to the coal particles. The pulp then passes from the agitation box to the first frothing box, where it is brought to comparative rest, the air-buoyed coal being permitted to rise to the surface and form a froth, which is automatically skimmed from the surface and contains approximately one part of water to one part of dry coal, and, as it is free from clay or shale slime, filters with readiness. Continuously operating filters can deal with over 2 000 lbs. of dry coal per sq. ft. of surface per 24 hours on this material, delivering a product containing 12 to 14 per cent. of moisture.

Recoveries of 98·9 per cent. and over are recorded. Several units having capacities of 40 tons hourly are now in course of erection, and with an average cost of coal-cleaning (inclusive of power and labour, but exclusive of interest and depreciation) of 4d. per ton treated. The potentialities of these processes are therefore considerable.

Steam Production.

The author then refers to several main tendencies in steam production, leading to advances in efficiency. Water-tube boilers capable of evaporating normally 130 000 lb. per hour have been absorbed; in the Ladd boilers at the Detroit works of the Ford Motor Company 276 000 lbs. of water per hour for fifteen hours, and 327 000 lb. per hour for one hour, were actually evaporated from one of these boilers. There appears no limit to the size of boilers, but with industrial plants 30 000 lb. capacity is a convenient size.

Pressures of 250 lb. are now common and several boilers work at 350 lb. One large new boiler-house is being even operated at 475 lb. per sq. in. Higher pressures seem feasible if desired. Integral superheaters to give a final steam temperature of 650-750° F. are available. This maximum is unlikely to be exceeded, as it approaches the limiting temperature of steel tubes.

The stokers employed are now largely mechanical, and include the chain grate type with natural and forced draught, sprinkler and coking stokers and multiple retort types. These varieties are described and illustrated in the original paper. Among the advantages claimed for the underfeed stoker are (1) greater economy and boiler efficiency with a given coal; (2) ability to burn a wider variety of fuels; (3) ability to meet sudden demands for steam, and other constructional advantages such as less space occupied in front of boilers, examination and repair of stokers without removal, no necessity for high chimneys, self-dumping clinker plates, etc. The chief feature of the multiple retort stoker is that no refractory brickwork setting is needed. Such a stoker can be assembled from any number of retort units, without limit to size and capacity of furnace The type is specially useful for modern large unit boilers. The development of these stokers has been very interesting, a feature being the continuous automatic slicing of the fire-bed whereby incombustible residues are reduced to a minimum. Maximum thermal efficiency is attainable both with good and very bad coals. A brief account is also given of the well-known Bennis sprinkler with compressed air furnace, with which very poor coal, containing up to 53 per cent. of incombustible material, can be used.

Production of Power from Waste Gases.

(A) *Blast-furnace Gases.*—In general, blast-furnace gases in this country are uncleaned. When using such gas for firing boilers an external chamber is provided. This does not give such a good intermixture of air and gas as a Bunsen type burner, but has the advantage of not becoming clogged up with

* Abstract of a paper read before the Iron and Steel Institute.

dust. With the advent in iron and steel works of gas-cleaning apparatus, the tendency is now to fit boilers with Bunsen or multiple-type burners. With clean gas and burners the efficiency can be raised and 73 to 75 per cent. (as compared with 63 to 65 per cent.) obtained, so that for each lb. of actual steam evaporated about 16 cub. ft. of gas at 100 B.Th.U.'s per cub. ft. is required.

In a test using blast-furnace gas in conjunction with a Harrison furnace, the water evaporated per hour from and at 212° F. was 12 495 lb.

(B) *Coke-Oven Gases.*—There is a wide field for the use of surplus heat from coke-ovens and by-product coke-oven plant. As an average 80 per cent. of the gas will be available in the form of waste heat at a temperature of 1 800° to 2 000° F., and 20 per cent. in the form of surplus live gas with a calorific value of 450 to 500 B.Th.U.'s.

By using waste heat and surplus live gas 1¼ tons of water can be evaporated from and at 212° F. per ton of coal carbonised. This gas is generally burnt in Bunsen burners. Efficiencies for the boiler and economiser combined as high as 80 per cent. have been obtained. Under normal working conditions, an efficiency of 70 per cent. can be relied upon for the boiler alone.

(C) Great scope for the use of waste heat from reheating puddling and other furnaces, where burned gases are available at 1 800 to 2 000° F., also exists. With a well-designed boiler 5½ to 6 lb. of water can be evaporated per lb. of coal burnt.

One firm installed a water-tube boiler for utilising the waste heat from two hoop-mill furnaces consuming about 10 cwt. of coal per hour, and was able to save approximately 42 tons of coal per week.

(D) *Gases from Regenerative Furnaces.*—In furnaces of this type, with gases available at 1 000° to 1 150° F., the draught requirements are generally about 1 in. W.G. This difficulty is overcome by installing a boiler combined with an induced draught fan.

As a general rule, the coal consumption at the producers is 5½ to 6 cwts. per ton of steel produced. An average evaporation of about 2 000 to 2 200 lbs. from and at 212° F. can be obtained per ton of steel with gases entering at 1 100° F.

Waste-Heat Boilers.

Kirke Waste-Heat Boiler.—This boiler consists of a drum traversed by straight tubes of abnormal length relative to their bore, through which hot products of combustion already burnt in some other furnace are drawn at a high mean velocity not less than 40 ft. per sec., by means of an induced draught fan or other mechanical means.

In the front of the boiler a superheater may be arranged, over which the products of combustion pass before entering the boiler tubes. An economiser is not absolutely necessary, but the heat available for transference to the water therein is so much reduced that the whole of the water heated in the economiser can be usefully used in the boiler instead of only a portion of it.

This type of boiler claiming tube efficiencies of 90 per cent. or over, minimum radiation losses and exceptional cleaning facilities, justifies its use with even very low grade heat.

Thus, in a case mentioned, an evaporation of 2 300 lbs. from and at 212° F. per hour was obtained. This boiler is suitable for generating steam from blast-furnace gas which, owing to its poverty, produces products of combustion at a moderate temperature (say 1 000° C. only).

A brief description of the Kirke gas-fired boiler, which is generally similar to the above, is also given. It is mentioned that a boiler 7 ft. diameter, working on producer gas, with 2 in. draught, can evaporate 12 000 lbs. of steam per hour.

Pulverised Fuel.

The idea of pulverised fuel is not new. In 1831 an English patent was issued to Mr. J. S. Daws, and this was rapidly followed by a number of patents in England, the United States, and on the Continent.

There are not many applications of the system in this country, and more attention has been given to the subject in the United States and on the Continent. Two years ago, in the United States 11 000 000 tons of coal were used per annum in powdered form. The amount is now much increased. In France progress has also been rapid. Installations were only commenced in 1918, and there are now more than 200 turbo-pulverisers alone in successful operation.

The pulverised coal system for steam generation at the plant of the Puget Sound Power and Light Company consists of ten boilers, with a total heating surface of 41 000 sq. ft., together with complete drying and pulverising plant. The combustion volumes of the furnaces per square foot of heating surface were 0·2 cub. ft. under four 3 000 sq. ft. boilers and three 4 000 sq. ft. boilers; 0·3 cub. ft. under one 5 000 sq. ft. boiler and one 6 000 sq. ft. boiler; and 0·45 cub. ft. under one 6 000 sq. ft. boiler. The coal used is refuse material accumulated during the last twenty years, and is very fine, practically all of it passing through a 20-mesh screen. The heating value averaged 9 300 B.Th.U.'s. About 190 000 tons of this coal have been burned with an average boiler efficiency of 80 per cent., and very high evaporation was obtained. Altogether the results appear to be remarkable.

Other instances in America are the powdered coal installation at the boiler plant of the Missouri, Kansas, and Texas Railway at Parsons, Kan.; the new Lakeside Generating Station of the Milwaukee Electric Railway and Light Company, and at the comparatively new River Rouge Boiler Plant of the Ford Motor Car Works at Detroit.

At the Ford installation the boilers, which are without economisers, and are four in number, have each 26 400 sq. ft. of heating surface. It is said that 276 000 lbs. of water per hour were evaporated from one of these boilers for fifteen hours, and for two hours 327 000 lbs. of water from one boiler per hour. These boilers are probably the largest boilers ever installed. At the maximum the evaporation was just under 12½ lbs. of water per square foot of heating surface. Favourable experience of powdered fuel installations on the Continent is also quoted, and a brief account is given of the use of powdered fuel in reheating processes.

Steam Turbine Progress.

Recent improvements in steam comprise the use of higher steam pressures and higher superheat, and the adoption of higher turbine speeds.

Mixed pressure turbines have played a prominent part in connection with steam-driven winders and rolling-mills utilising the exhaust steam. However, the centralisation of power production in collieries and steelworks and the electrification of the entire plant tends to lessen the field of application of the mixed pressure turbine.

Figures are given for pressure, temperature, &c., steam consumption, &c., of various types of turbines. Thus, with some Metropolitan-Vickers (Rateau) types values ranging from 12·6 to 16·8 lbs. per kWh are recorded, with Parsons high-pressure type consumptions from 13·5 to 14·92 lbs. per kWh.

Reducing turbines have recently been preferred. This machine is arranged automatically to bleed steam at a certain pressure for process work, mainly in paper mills, oil factories, distilleries, &c., or for heating purposes. When large quantities of low-pressure steam are required—*e.g.* in paper-mills, the saving is considerable.

Turbo-compressors find an extensive application where compressed air in pneumatic tools for mining operations, for coal cutting, for riveting in shipyards, &c., is needed. One of the largest compressors built in this country has a normal capacity of 30 000 cub. ft. of air per minute, compressing this quantity against 100 lbs. per sq. in. G.

Turbo-blowers are machines working against moderate air pressures, up to 40 lbs. per sq. in. The 35 000 cu. ft. is a common size, but upper limits are determined solely by economic considerations.

Condensers.

With reciprocating engines little can be gained in steam economy by the installation of condensers to give more than 26 in. Hg. vacuum with the barometer at 30 in. This does not apply to steam turbines with which the highest obtainable vacuum can be fully utilised.

Available types of condensers include: (1) Surface condensers; (2) Jet condensers with water extraction pumps and separate air pumps or other air extraction appliances; (3) Ejector condensers with water-circulating pumps and no separate air pumps.

With surface condensers condensed steam can be used for the boilers, but the first cost is high, and their use, where clean condensing water cannot be obtained, necessitates troublesome and costly cleaning of tubes and periodical renewal. The modern method of dealing with boiler feed water by heat and soda ash has extended the application of condensers of the jet or ejector types.

Industrial sites are only rarely near a natural and adequate supply of water for condensing. However, with a loss by evaporation of about 80 per cent. of the boiler feed, the condensing water can be re-used after cooling in towers or by spraying over ponds.

For high vacuum plants with artificial cooling the ratio of condensing water to steam condensed should not be less than 60 : 1. This gives a maximum requirement of temperature reduction of 10° F. for the cooling installations.

The area required for cooling towers is 0·8 to 1 sq. ft., and for spray cooling plants 4 to 5 sq. ft. per kW of plant installed. Where space is available, spray cooling is preferable to tower cooling, as the first cost is lower and better cooling is obtained with sprays. Moreover, maintenance charges are negligible, whereas with cooling towers maintenance and depreciation may involve a heavy charge.

Example of a Typical Industrial Power Station.

It is of interest to describe a typical industrial power station, *viz.*, the actual case of a colliery power station in this country.

This station supplies a group of collieries principally for underground power (pumping, hauling, coal cutting, and general purposes, and also for main shaft winding). The system of supply settled in 1907 was 3 000 V 3 phase, 50 cycles.

The station equipment now comprises one 1 500 kW and two 3 000 kW turbo-alternators. The condensing plant is of the multi-jet type, all the water for condenser purposes is re-cooled through spray nozzles. A vacuum of 28 in. under full load conditions on the large units (with bar. at 30 in.) is maintained. There are six large boilers of the water-tube type, each capable of evaporating 22 000 to 27 000 lbs. of steam per hour. The steam pressure is 200 lbs. per sq. in., with superheat to 588° F. The condenser equipments are all joined together; any of the three circulating pump equipments will operate any condenser.

No. 1 condenser is operated by a steam-engine, the other two by motors. There is also a steam-driven exciter and a motor-driven exciter, the latter of full capacity for all the units in the station. The exhaust steam from the condenser and exciter engines, feed pumps, and fan engines is used for heating up the feed water, which is treated in a heater softener by the temperature and soda ash method.

The Erith stokers are each of the seven retort type and are capable of burning approximately 4 340 lbs. of low-grade fuel per hour. The first four are operated by electric motors, the fifth and sixth are operated by steam. Hydraulic wagon coal-tippers are used. Each boiler is fitted with an independent elevator and all elevators are separately driven.

The fuel was charged at approximately 11s. 7d. per ton. With low-grade fuel charged, as is possible in many cases, at 5s. per ton at the colliery, the fuel cost would be reduced to 0·077d. per unit, and the cost of production would then become 0·13d. per unit.

Gas Engines.

Single installations of from 15 000 to 20 000 H.P. of gas engines working upon blast-furnace gas are already in operation in this country.

In a modern furnace producing 1 million cub. ft. of gas per hour, only 0·55 of this is required for the furnace, leaving 0·45 million or 450 000 cub. ft. of gas available per furnace for other purposes. This at 150 cub. ft. per kWh is equal to about 3 000 units per furnace per hour. With fifty furnaces the aggregate would be 150 000 units per hour and 1 030 510 000 per annum; this with the boiler saving represents an economy of about 400 000 tons of coal per annum.

Results are presented for a 1 500 H.P. gas engine, the B.Th.U.'s per B.H.P.-hour being 10 400 in the first half-hour and 9 650 in the third half-hour's working. Particulars are also given of a 450 H.P. engine using coke-oven gas at a colliery a thermal efficiency of 28 per cent. on overload and 24·4 per cent. on half load being attained. In the former case 9 100 B.Th.U's per B.H.P. was consumed.

Oil Engines.

Some particulars for internal combustion engines working on oil are given. Thus, in a test on Sultzer-Diesel engines of 2 000 B.H.P. the total running cost of 0·384d. per B.H.P. hour.

Other cases are mentioned where cost per kWh worked out to 0·745d. and 0·810d. respectively.

Conclusion.

Much remains to be done before the bedrock of economy in power production is reached. Water power and tidal power have not been discussed in this paper. Coal, however, remains the basic source from which we derive the bulk of the power in this country.

Attention may with advantage be directed towards the following points :—

1. The cleaning of fuel from ash and other impurities prior to combustion.
2. The reduction of labour, and economical burning of fuel :
   (*a*) by the use of efficient mechanical stokers ;
   (*b*) by fuel in powdered form.
3. The purification, softening, and heating of boiler feed-water and provision of efficient cooling plant for condensing purposes.
4. A closer and more scientific control in the boiler-house.
5. A more comprehensive utilisation of waste gases from blast-furnaces, coke-ovens, and producers.
6. The development of markets, either industrial or public supply, to absorb the surplus power available from collieries and iron and steel works.

Reviews.

Rays of Positive Electricity and their Application to Chemical Analyses. By Sir J. J. THOMSON, O.M., F.R.S. (London : Longmans, Green & Co.). Second Edition. 16s. net.

This is a well-known work devoted mainly to a new method of determining atomic weights by the simultaneous electrostatic and magnetic deflection of positively charged atoms. Since the magnetic deflection is inversely proportional to mv, and the electrostatic deflection is inversely proportional to mv^2, where m is the atomic weight and v the velocity of the atom, the simultaneous deflection allows us to determine both m and v. If both deflections are recorded on a screen normal to the original direction of the atomic "rays," a gradual increase in the velocity of projection will trace out a parabola on the screen, which is then measured for the purpose of the above determinations.

The present second edition of the book is about double the size of the first edition, which was published in 1913. It contains many new chapters, notably on the use of hot cathodes covered in the lime, and on Aston's focus method, by which particles of the same e/m but different velocities are made to converge towards the same point. There is also an account of the Doppler effect in positive rays and of the polarisation of the light from them, both discovered by Stark. The author discusses the origin of the mysterious parabola indicating an atomic weight 3, and guardedly refers to Fabry's discovery of a line in the spectrum of certain nebulæ, which also indicates that atomic weight.

The value of the new method of chemical analysis lies chiefly in that it is not affected by impurities. It has already led to the discovery of two forms of chlorine, of atomic weights 35 and 37 respectively, and has brought the atomic weights closer to integral numbers than ever before.

E. E. FOURNIER.

Practical Testing of Electrical Machines. By L. OULTON and N. J. WILSON. (London : Sir Isaac Pitman & Sons, Ltd.) Pp. iii+158. 6s. net.

This is a useful book on the testing of electrical machines and transformers, which should be of value to the college student or apprentice, as well as to the engineer actually engaged on a works test plate, or in working up tests in a design office. A full description is given of the tests which are usually employed commercially to determine the satisfactory operation of any machine, both from the standpoint of design and manufacture. Numerical examples are included, which are worked up into curves, thus explaining the uses to which test figures are put, and indicating the information to be obtained from them. It is regrettable that in revising the book for this, the second, edition, the symbols have not been brought into line with the recommendations of the International Electro-technical Commission.

A useful appendix is formed by the inclusion of the principal rules of the B.E.S.A. for the standardisation of electrical machinery.

L. H. A. CARR.

The C. M. and M.-Delas Air Extractor.

Interesting Test Taken in Paris.

A short while ago we gave an account of a new air extractor which had been designed for use with condensing plant, and we are now able to give details of some tests on this equipment which were carried out in the Paris workshops of the Société Condenseurs Delas, by whom the apparatus is made. The tests were carried out with an air pump made for a large turbo set to substantiate the claims with regard to steam consumption made by COLE, MARCHENT and MORLEY, who are licensees for the manufacture of these condensers in this country, and who had put them forward in connection with an extension scheme at a Corporation Power Station. The air pump makers made satisfactory arrangements to reproduce working conditions. These consisted of complete means for loading the air pump, both with air and vapour in any desired proportions, and for regulating a supply of water at any desired temperature to an intermediate condenser, and thereafter extracting it.

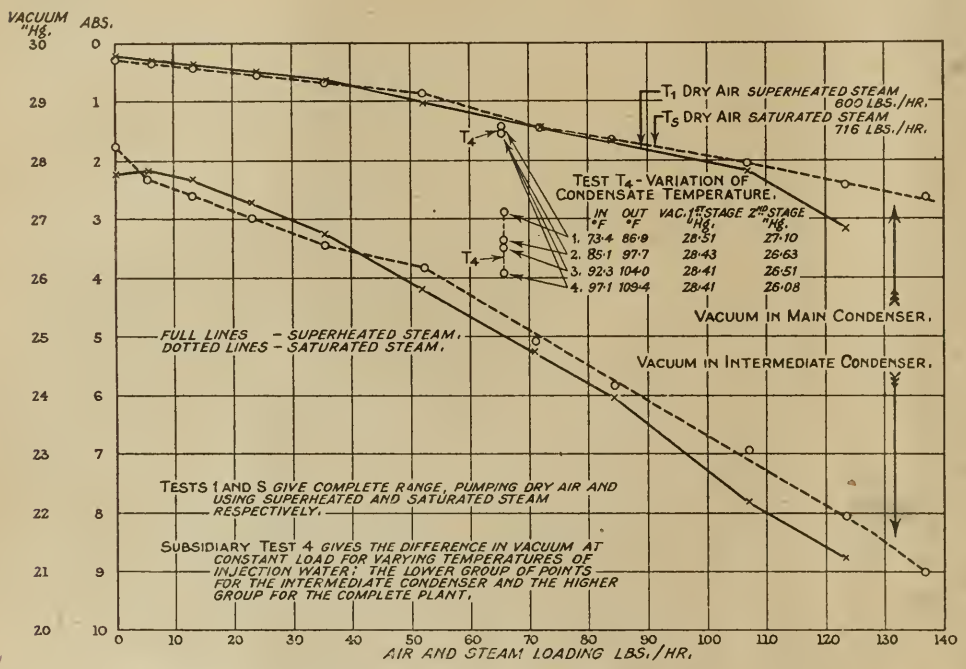

FIG. 1.—CURVES GIVING RESULTS OF TESTS ON DELAS EXTRACTOR

The Air Pump.

The air pump in question is one in which the air and vapour to be extracted from the condenser is compressed in two stages. Each of these stages is operated by a single steam jet and diffuser. The steam used by the first jet is condensed by a portion of the condensate used as the condensing water of a small jet condenser. The special features of the pump are that the diffuser is of the parallel type in each case, and is completely water-jacketted. It is claimed that this construction does away with the instability observed in other makes of pump when used for very high vacuum with very little loading. It is stated that the water-jacket to the diffuser is a necessary feature in connection with the use of a parallel diffuser, the tendency of the combined stream of " working steam " and " gases pumped " to diverge being counteracted by the rapid condensation caused by the water-jacketted diffuser.

Details of the Tests.

The pump was tested for the full range of the experimental apparatus when pumping dry air, and also when using for its working steam superheated and saturated steam alternatively. A series of supplementary tests were taken in which to the dry air were added definite quantities of saturated steam, all the results being tabulated in the following tables and plotted in the curves which are given herewith.

It will be noted (from the curves Fig. 1) that the pump does not give the same vacuum weight for weight when part of the duty is steam. This is obviously because the steam has a much greater volume than the equivalent weight of air and the pump has, to some extent, a " volume " characteristic as well as a " weight " characteristic. The difference is not very serious.

We understand the pump showed an extraordinary stability over all working ranges explored, and no change was made in the apparatus or adjustments in changing from superheated to saturated steam.

It will be noted from the curves and tables that the steam load was entirely condensed in the intermediate condenser, since the second stage compression was just the same when steam load was added to the air load as when air load alone was dealt with.

A further subsidiary test was made in which the load of air and steam was kept constant. The temperature of the injection water was varied by heating it up with steam previously to its use. The vacuum in the intercondenser naturally followed this injection temperature, but the net result was that the first stage took up almost all the work that the second stage was compelled to drop. This shows that the pump is not particularly sensitive to condensate temperature, and can therefore work at a high efficiency when connected to the actual condenser.

Limit of Load Obtainable.

The limit of the load obtainable with the experimental apparatus can be seen by reference to the diagram of the experimental apparatus (Fig. 3). In this diagram it will be noted that an artificial " U " or water seal had to be provided to imitate working conditions. When the pressure in the intermediate condenser was greater than the vacuum in the hypothetical condenser A, then, of course, the water on the right-hand side of the limb was depressed. As the pressure in the intermediate condenser increased, it is naturally seen in the limit that the water seal would be blown. With a greater water seal, of course, the range of the pump could have been taken further, but this would have served no useful purpose as being outside the working range of the pump.

When considering the above report and results of tests allowance should be made for the condensation of the steam which passes through the nozzle to extract a mixture of air and steam. As is well known, this is very detrimental to the results.

Again, the vacuum in the intermediate condenser remains approximately the same for any variation in temperature of between 86·9° F. and 109·4° F., and it should be remembered that in practice the condenser temperature never varies between such limits, otherwise the vacuum in the main condenser would drop because the temperature of the circulating water would be too high for the same vacuum to be obtained as with circulating water at a lower temperature. Therefore too much steam is used by the nozzles of the first stage without gain in vacuum. A vacuum of 28·5 in. is never required with the condensate at a temperature of 97·1° F.

After taking the above into account it has been found that in practice nearly half the steam used by the first jet could be saved.

Working Conditions.

As mentioned above, the experimental apparatus only admitted of a limited range for the test. The reporter, therefore, arranged to inspect a pump actually working and was enabled to do this by a visit to Billancourt Station, where a Delas pump was seen maintaining an excellent vacuum on a 6 000 kW set. A photograph of this pump *in situ* (Fig. 2) is given herewith. The pump exhausted the condenser to a vacuum of 25·3 in. eighteen minutes from the start,

using the second stage of the pump only, and completed the exhaustion to 29·5 in. on adding the first stage after a further three minutes' operation.

The actual steam consumption of the extractors at this station was approximately 500 lb. of steam per hour for a vacuum of 28¾ in., but the jets had been designed according

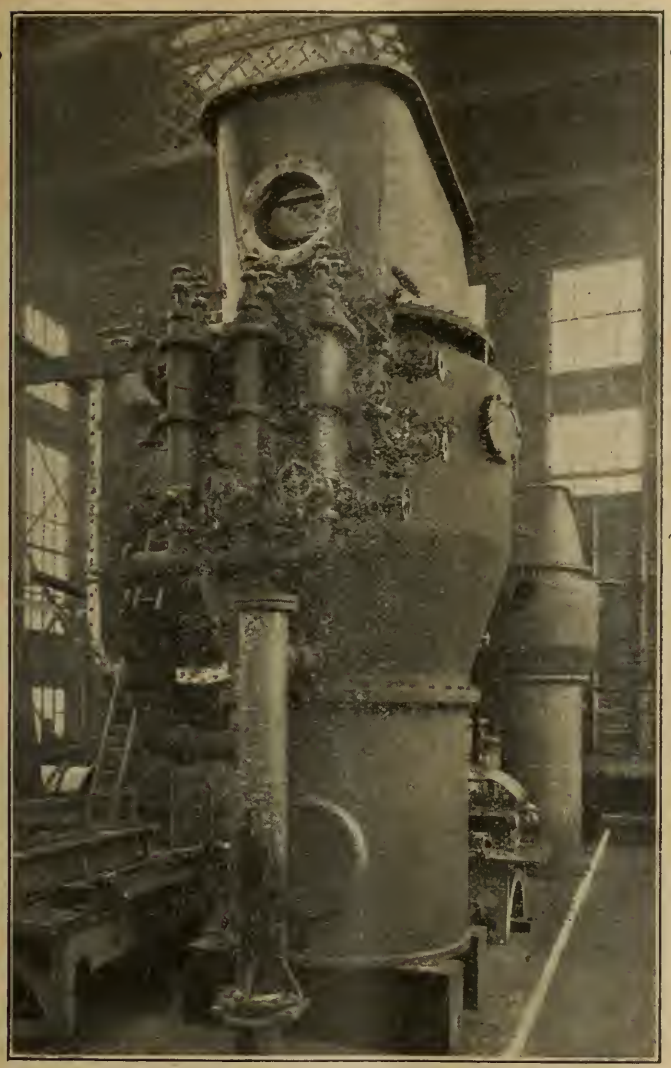

FIG. 2.—C. M. & M. JET CONDENSER, HAVING A CAPACITY SUFFICIENT TO DEAL WITH 82 000 LB. OF STEAM PER HOUR, FITTED WITH THREE SETS OF C. M. & M.-DELAS STEAM JET AIR EXTRACTORS OF THE INTERMEDIATE CONDENSER TYPE.

to the French method—*i.e.*, for securing the best results when extracting dry air. When dealing with saturated air the first jet is, of course, too large in diameter; and if designed according to English practice for dealing with saturated air, the steam consumption would be very considerably reduced, as only about half the amount would be required for the first jet.

In support of the statements made by Cole, Marchent and Morley, Ltd., as to steam consumption, which was the primary object of the inquiry, it was found that, on comparing results of the C. M. & M.-Delas air extractor with other first-class makes of a similar type, the reporter was able to give the following comparative results :

Vacuum maintained inches.	Steam used by the C. M. & M.-Delas Pump per cent. less.
28·25	24·9
28·5	19·0
28·75	22·4
29·0	20·0

As a result of the test it was considered that the claim made by the firm that this pump is an improvement on existing equipment was substantiated by the tests made, and the

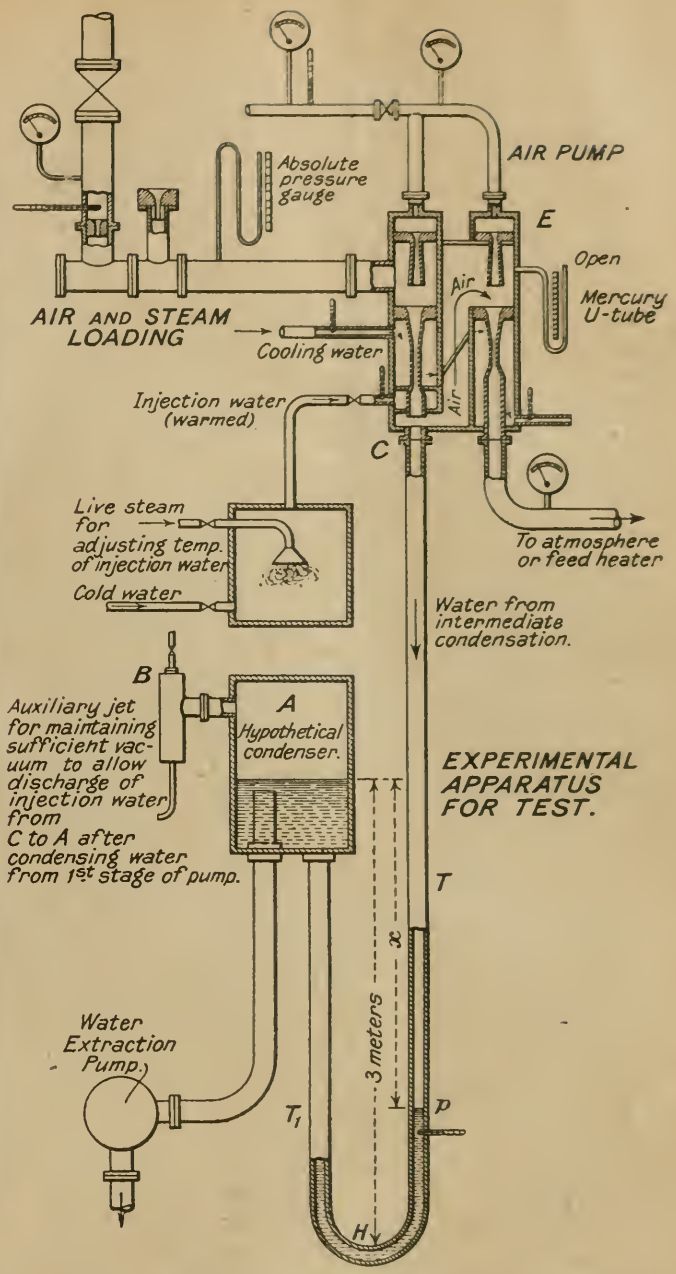

FIG. 3.—DIAGRAM OF THE EXPERIMENTAL APPARATUS USED FOR THE TESTS.

C. M. & M.-Delas pump was recommended for the plant for which the test was carried out.

Tests of Delas Air Extractor.

Working with Superheated Steam and dealing with Dry Air.
Barometer at 30 in. of mercury.
Back Pressure of Exhaust, 3·28 ft. of water.
Steam Pressure at the Jets, 242 lb. per sq. in.
Steam Consumption, 600·5 lb. per hr.

Air Nozzle Diameter(s) inches.	Boiler Steam Temp. ° F.	Abs. Press. Main Suction, inches mercury.	Suction Second Compression, inches mercury.	Air introduced, lb./hr.	Vacuum, inches mercury, Barometer 30 in. mercury.	Corrected Intermediate Press.: inches mercury, vacuum 30in. Barometer.
0·0	665	0·236	27·8	0	29·764	27·76
0·079	695	0·295	27·8	6·2	29·705	27·84
0·118	707	0·354	27·7	13·7	29·646	27·68
0·157	717	0·512	27·3	23·8	29·489	27·29
0·197	700	0·670	26·8	36·4	29·33	26·76
0·236	690	1·062	25·8	53·0	28·94	25·80
0·275	680	1·457	24·7	72·0	28·55	24·70
0·275 & 0·118	695	1·690	23·9	85·7	28·31	23·95
0·275 & 0·197	700	2·210	22·1	108·4	27·8	22·15
0·275 & 0·236	700	3·185	21·2	125·0	26·82	21·20

Note.—Pump was discharging against a back pressure of 3·28 ft. of water = 2·9 in. of mercury.

The Problems of Technical Education.

At the annual conference of the ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS, held last week in London, the necessity for the immediate appointment of a special committee of inquiry to investigate the whole field of technical education in its relation to education generally and to industry was urged. In his presidential address Mr. J. PALEY YORKE pointed out that it was now forty years since any national inquiry on technical education had been made, and that the advance of scientific knowledge and the development of the applications of science to industry and manufacture since that time had been tremendous. Technical education had developed too, but it had developed furtively and unobtrusively; and it had developed beyond the recognition of many of those who were supposed to be its guardians. The conference urged that some qualified committee should advise whether or not technical education should be promoted, and, if so, to advise what measures were necessary for that promotion in the interests of those industries and professions which depend upon the applications of science.

Lord Burnham's Opinion.

Lord BURNHAM expressed the opinion that technical education was slowly gaining its proper place in the assessment of national values. In reality it was only thirty years old, and it had not proceeded from motives of State policy in this country as it had in Germany, nor had it been created by the wands of multi-millionaires as in the United States. It had not come from the urgent demands of the great industries, and comparatively little had been done for its foundation either by employers or employed. Lord BURNHAM thought, however, that employers were showing a livelier sympathy with technical training, though he noted that the Trades Union Congress agenda paper contained small reference to it.

Real Scientific Education.

The PRESIDENT also urged that technical education, which is definitely scientific education, was as essential educationally and culturally as any other brand of intellectual activity. He said that the time had come when reconsideration should be given to the essentials of "a good general education," and whilst he would not urge for too early specialisation, yet submitted that the sum total of knowledge was so great that it was inevitable that each individual should be a smatterer in most things and something of a specialist in one. He asked for careful investigation of the old idea that any subject which approaches the region of usefulness could not possibly be of any educational value. Sir William Noble had said that those would have the best chance and hold the field who had 70 per cent. of specialised knowledge and 30 per cent. of the habit of dealing with men. Lord BURNHAM did not think that education should exist in water-tight compartments such as that which prohibited the teaching of modern languages in junior technical schools, and, having regard to the world-wide problem, he would say to technical teachers that they could not make their field too wide, provided that it was in accord with and in subordination to the first principles upon which they had drawn.

Need for Research Facilities.

Attention was also drawn to the fact that the opportunity for research work in technical institutions was scant, and that it was essential that teachers of technology should have both the opportunity for research and for contact with industry. The difficulties and the possibilities of abuse were recognised, but the mutual advantage which would accrue both to education and to industry was so great that it was suggested some scheme might be devised whereby industrial directors could submit problems to the education authorities and through them to the technical institutions in the area. It was recognised that, owing to a certain amount of necessary publicity, all research problems could not be dealt with that way, but much good work could be done.

No Reduction in Grants.

The proposals to reduce the grants for scientific research and national scholarships for higher education were criticised. It was pointed out that these reductions would imperil scientific and industrial development; and that the percentage reduction in the estimates for these items was greater than that for items in other branches of educational work.

Useful Co-operation.

Reference was also made to the scheme of examinations which had been inaugurated by the Institution of Mechanical Engineers in conjunction with the Board of Education. It was foreshadowed that other professional institutions would inaugurate similar schemes. Whilst the conference looked with considerable interest upon the scheme, which seemed to be full of promise, it was made clear that that interest would speedily evaporate if it developed merely into an examination.

Our Spoon-fed Traders.

By SIR ERNEST BENN.

Our business men are not rising to their opportunities. There never were so many opportunities in the world, and trade was never so slow. So far as I am able to diagnose the position this unfortunate situation arises from the habit of spoon-feeding into which trade and industry has sunk. For the purposes of war everything had to be arranged for everybody, military discipline had to be imposed upon us all, we were enjoined to obey and to submit our will and our opinion to higher authorities. We absorbed this habit so thoroughly that we have almost forgotten how to act upon our own initiative. If anything is wrong the only thing we seem capable of doing is to pass a resolution and send it to some Government department. If, as of course happens, we get no satisfaction in that way, we then content ourselves with pious reflections upon the plight of the foreigner or the follies of somebody else, and we fold our hands and wait for trade to revive. Could anything well be more silly?

Getting Back to Smiles.

As a nation of business men we need to get back to Samuel Smiles; we want a big dose of his old-fashioned self-help. If some of the great men whom Smiles catalogues for us could come back to life and compare present conditions with those with which they had to struggle they would be amazed at the apathy, the indifference, the helplessness, of the modern commercial mind. The working-man no longer thinks for himself, he does what his trade union leader tells him. His master is following in the same foolish way.

Now trade is what we make it and will never be anything else. The conditions of which we complain are very largely the result of our own actions. Politicians and Government departments can only deal with them after they have arisen.

Progress and Individual Effort.

It is not necessary to go back so far as dear old Samuel Smiles in order to illustrate these points. Such men as Westinghouse and Stokes in modern times have not relied upon trade associations, upon Government development departments, upon outside agencies or public opinion. They have invariably had all or most of these things against them. A study of progress shows that everything we enjoy has been forced upon us by individual effort on the part of someone who was strong enough to believe that his salvation rested in his own hands, and that he had a duty to perform quite independent of anybody's opinion. Other people cannot arrange our fortunes for us, nor can we arrange a fortune for other people. Our salvation is in every case in our own hands, and that salvation is spelt WORK.

A Contrast.

These truths are so evident to-day that it seems almost absurd to state them. We can see them demonstrated in individuals and in nations. In Russia we have one great and valuable illustration which ought to satisfy the world for all time of the futility of organisation, administration, and all those other fetishes which we call Bolshevism when we see them in the Russian form, but fail to describe them properly when we are ourselves practising the same vices in our own arrangements at home. In Germany we see the other side of the matter; the whole world is busy arranging affairs for Germany; every Government in Europe is telling Germany what it ought to do; supreme councils and world-wide conferences meet regularly in order to put Germany right. Germany the while goes on quietly working, and by that simple expedient will, in course of time, defeat the lot of us.

It is no good bothering what other people do or what other people think. From a business point of view this attitude of mind is fatal; the business man who talks of trade as bad, who tries to find in the faults of others excuses for his own failings, who is waiting until others make trade good, before he will himself become active, is no business man at all; he ought to join the most socialistic trade union he can find.

New G.P.O. Chief Engineer.

Major T. F. Purves, O.B.E., the new engineer-in-chief of the Post Office, was born at Blackadder Mount, Berwickshire, on December 31, 1871. He was educated at Greenlaw and at the Duns Academy. He entered the Post Office service by open competitive examination in 1889, and was appointed telegraphist at Edinburgh. He studied science at Heriot-Watt College and Edinburgh University, and in 1892 won the first medal of the Heriot-Watt College in electricity and technical telegraphy, as a result of which he was in that year selected for transfer to the engineering department in Edinburgh. In 1894 he secured, by departmental examination, an appointment as mechanical and electrical draughtsman in the Engineer-in-Chief's Office, London, and in 1900, after a further competitive examination, he was appointed Technical Officer on the Headquarters staff of the Engineer-in-Chief. In 1905 he became assistant superintending engineer for London, and the following year he was transferred to a similar position in the Southern District of England. In 1907 he returned to headquarters as staff engineer in charge of the designs section.

War Services.

On the outbreak of war he took a keen interest in the supply of electrical equipment to the Army Signal Services, in which many thousands of the P.O. engineering staff were engaged. To meet

Major T. F. Purves, the New Engineer-in-Chief of the Post Office.

modern trench warfare conditions he devised and sent out special adaptations of telegraph and telephone apparatus. As a result he took up a commission in the Royal Engineers as a liaison officer between the Army Signal Services and the Post Office. He also designed a series of new types of electrical signalling and detecting apparatus for military purposes, and controlled their manufacture and supply.

Assistant Engineer-in-Chief.

In June, 1919, Major Purves was appointed Assistant Engineer-in-Chief, in succession to Sir William Noble, whom he now succeeds, at the age of 50, in the premier position of Engineer-in-Chief. As the position of the Engineer-in-Chief is one of the most onerous in the country, involving the supervision of almost every type of electrical engineering plant, to the value of nearly one hundred millions sterling, the responsibility for an expenditure of about fifteen millions per annum on new construction and maintenance, and the control of a highly technical staff of about 25,000, this wide experience will be a great advantage.

Future Developments.

In the course of an interview with a representative of "The Times," Major Purves said he hoped to be Engineer-in-Chief for ten years, and in that time, if the country continued to prosper, the number of telephones in use should approach four millions. All overhead wires and aerial cables in our large towns would be cleared away. Exchange accommodation and line plant would overtake requirements, and in all parts of the country the service would be available at short notice to any subscriber. The underground trunk system of telephones and telegraphs would be extended to link up all important centres of population. The main telephone cables would each contain from four to five hundred speech channels. The equipment of the London telephone service with automatic exchanges would be two-thirds completed, and the automatic would have become the standard system in most provincial towns.

Correspondence.

OVERHEAD WIRES AND PRIVATE PROPERTY.

To the Editor of THE ELECTRICIAN.

Sir,—Further to your Editorial Notes on Overhead Equipment in this week's Electrician, as I have had untold difficulty over this matter I think the following observations might interest your readers.

Originally when roads were being constructed and fields divided the owners marked out a length 6 ft. wide, the earth from three of which they threw on to the other three to form a bank or "cop." In the centre of this they planted a hedge, the excavated portion becoming a ditch for irrigation purposes, so now in conveying land the hedge belongs to the man with the ditch. By the above you will see a landowner can only claim 18 in. from the centre of the hedge to the road, however wide the hedge or bank may be.

At various times walls have been erected which in course of time have become covered with soil, but this concealed wall is the boundary, as no sane man would set his wall back so as to present land free to the highway, and this boundary also applies to fences unless in the latter case there are only a few yards fixed in the centre of the bank to make good a dilapidated hedge.

Care should be taken, however, that no wire be over a bank or wall. In one case an owner looked up from the top of his garden wall and found my wire above it, and it cost me nearly £10 to remove.

Should trees be overhanging a road they are trespassing and the highway authority can demand their removal or, on giving due notice, can themselves prune or cut them, but the difficulty is for a private company to get the authority to move in the matter.

At the present time it is advisable to watch the Post Office, as they are overhauling all their overhead lines and are demanding very serious alterations, but I would far sooner deal with their engineers than with private landowners.

For small companies where there is, say, gas competition, it is better to get the prospective consumers to obtain wayleaves, as then the dispute and insults are between them and their neighbours.—I am, etc.,

C. A. Coppinger.

Bentham.
June 10.

RADIO TELEGRAPHY IN CHILE.

To the Editor of THE ELECTRICIAN.

Sir,—In your issue dated May 26 there appears the following paragraph under the heading "Submarine and Radio Telegraphy."

The Chilian Government concluded a contract in October, 1921, with the Siemens-Schuckert Co. for the erection of eleven radio telegraph stations at Santiago, Valparaiso, and Punta Arenas (all capable of communicating with Buenos Aires) and at Iquique, Antofagasta, Taltal, Tocopilla, Caldera, Concepcion, Valdivia and Chiloe, with a maximum radius of 1,550 miles. The contract price is $1 385 000, and the Telefunken system will be installed.

We should like to say that according to our information, that statement is incorrect, the Chilian Government not having concluded such contract with the Siemens-Schuckert Company or any other company.—We are, etc.,

Marconi's Wireless Telegraph Co., Ltd.,
Henry W. Allen,
Joint General Manager.

London, W.C.2.
June 7.

[This information was taken from the report of Mr. W. F. Scott, Commercial Secretary at Santiago.—Ed. E.]

Railway Companies' Power Supplies.

The inquiry by the Electricity Commissioners into the proposals of the S.E. and C. Railway Companies and the West Kent Electric Company for the erection of power stations at Angerstein's Wharf, Greenwich, and at Belvedere, respectively, was concluded on Wednesday.

West Kent Company's Scheme.

In opening the West Kent Electric Co.'s case, Mr. Tyldesley Jones said the Kent Electric Power Act of 1902 authorised the incorporation of a company to supply electrical energy in Kent. An Act of 1906 made some amendments, and authorised the company to supply to authorised undertakers, to anybody for power, and for lighting in any area which at the date of the Act of 1902 did not form part of the area of supply of any authorised undertaker. The company could be required to supply to authorised undertakers, and to anybody for power purposes, on terms which had to be settled by arbitration failing agreement. In 1909 the West Kent Electric Power Act was passed, transferring the powers and obligations of the Kent Electric Power Co. to the West Kent Electric Co. In the latter company's area for bulk supplies and for supply to railway companies were Dartford, Bexley, Beckenham, Penge, Chislehurst, Erith, Woolwich and other districts in which there were already authorised undertakers. The company could only supply for power within the limits of authorised distributors with the consent of the authorised distributors, or, if such consent be unreasonably withheld, with the consent of the Ministry of Transport. The company could, however, supply for railway traction purposes without the consent of any authorised distributor, and the energy could be used by a railway company anywhere on its system, with the consent of the Minister of Transport. Provisions in the company's 1917 Act removed all restrictions with regard to capital. They had expended over £155 000 on capital account. The company was promoted by the South Metropolitan Electric Light and Power Co. In 1917 it was determined to ask Parliament to remove the restrictions upon the development of the West Kent Co. as a generating company, and to enable it to perform the functions of a power company on a large scale. The money spent so far was found by the South Metropolitan Co. The bulk of the ordinary shares in the South Metropolitan Co. were acquired in 1918 by a group of companies including Vickers Ltd., and the Metropolitan Carriage, Wagon and Finance Co. The total issued and paid up capital of the South Metropolitan Co. (ordinary and preference) was £404 834.

Mr. P. C. Tempest, general manager of the S.E. and C. Railways, said he preferred that the railway companies should have their own generating station, as there would be less risk of failing to comply with the terms of the Government guarantee on the 6½ millions capital, viz. that the station should be completed in three years.

Financiers' Evidence.

Mr. R. McKenna, chairman of the City and Midland Bank, gave evidence as to the ability of the Metropolitan Carriage, Wagon and Finance Co. to finance the West Kent Co.'s project.

Sir E. Wyldbore Smith, chairman of the Metropolitan Carriage, Wagon and Finance Co., and a director of the West Kent Electric Co., said the former company were prepared to advance forthwith to the latter company, as a permanent investment, 3½ millions for the construction of the proposed station, laying mains, etc., and would be satisfied with a general return of 7 per cent. on the capital spent. The West Kent Co. s application to the Commissioners would be dropped unless an agreement were arrived at with the S.E. and Chatham Companies to supply energy to them. He believed the L.B. and S.C. Co., which had a contract with the London Electric Supply Corporation until 1927, would at some time take current from the West Kent Co. When that time arrived he believed the West Kent Co. would be able to supply more cheaply than the London Co.

Engineering Details.

Sir Philip Dawson, M.P., consulting electrical engineer, said he prepared the estimates for the West Kent Co.'s proposed station at Belvedere. In the first stage of the scheme there would be 100 000 kW of plant (in units of 25 000 kW each) running, and 50 000 kW of spare plant. The cost of the first stage would be £840 000. The West Kent Co. would be prepared to supply the S.E. and C. Companies three years hence at 0·575d. per unit, after transmitting the current 10 miles, assuming coal cost 15s. per ton. This charge for current would be varied as follows: The charge per kW per annum would be £4 5s. up to and including a maximum demand of 25 000 kW, and £3 5s. per kW for any excess above 25 000 kW, and then an amount equal to 0·252d. per kWh. As soon as all other demands outside the S.E. and C. Companies became equal to their demand, a rebate would be given them of 1 per cent., when other demands were double that of the railway companies they would be given a rebate of 2 per cent., and when the other demands were three times that of the companies they would be allowed 3 per cent. There must also be a sliding scale according to changes in cost of coal, rates of wages and improvements in machinery, which might justify renewals. Mr. Sparks's figure of 0·5d. for energy supplied at Lewisham was based on a thermal efficiency of 17·1 per cent. That was nearly 1 per cent. higher than he (witness) allowed for in a larger station with larger units and boilers. He allowed 16·2 per cent. The efficiency of his station should be 2 per cent. better than that of Mr. Sparks, according to his calculations, and assuming 15 per cent. efficiency for the Angerstein's Wharf station, that would increase the coal bill by 1·4 per cent. Assuming, also, 5 per cent. interest on the capital for the Angerstein station, instead of 4 per cent., and an addition of £0·31 to the £17·8 estimated as capital cost per kW of plant, an addition of £8 750 for cost of pilot and telephone cables, and £70 000 as the value of the generating station site, it brought the cost of current to 0·588d. At the 90 000 kW stage he estimated that Mr. Sparks's station would cost £18·2 per kW (compared with the estimate of £17·8), at the first stage—60 000 kW—the figure would be £18·45. A 150 000 kW station with 10 units of 15 000 kW must cost more per kW than his proposed station with 25 000 kW units. The greater the number of units the greater the cost per kW, and the smaller the units the more rapidly the cost increased. If Mr. Sparks' figure was correct for 150 000 kW, his figure for 60 000 kW was too small. On the debenture for £6 500 000 to be created by the Construction Co., it was agreed to pay interest not exceeding 6 per cent., so it was clear that 4 per cent., or even 5 per cent., was not the rate at which capital was expected to be obtained. He did not think many modern designers would plan a station with 10 units, particularly units as low as 15 000 kW. He had had information from all the railway power stations that were running. Higher steam pressures and higher temperatures were now being dealt with, but there were no stations running which enabled one to know the resulting increase in efficiency. The thermal efficiencies of some of the largest railway generating stations to-day were 9, 10, 11 and 12.

Advantages of Diversity.

Replying to Mr. Miller (for the S.E. and C. Companies), witness said he thought it could not be assumed that the efficiency at Angerstein's Wharf would be 17·5 compared with 14·2 at the South-Western power station at Wimbledon. The West Kent load, assuming they got the L.B. and S.C. demand, the S.E. and C. demand and a big industrial load, would give them an advantage over the S.E. and C. Companies' proposed station, because of the better diversity. It was not always a disadvantage to produce energy at two sites. It was an advantage if they had a big and a varied business and a high density factor, and could work their boilers at a high efficiency. It was a disadvantage to produce at two periodicities 50 and 25, but the S.E. and C. Companies had the disadvantage of a smaller demand and lower diversity factor.

Replying to the Commissioners, he said the West Kent Company would supply at the price which he suggested for the railway load (£4 5s. per kW per annum plus 0·252d. per unit, with reductions at certain stages) if the conditions as to power factor, etc., were similar. He did not think it followed that even if the price quoted to the railway companies proved unprofitable the general consumers would have to bear the extra cost. Four of the generators would be 25 cycle machines because that was the L.B. and S.C. periodicity, and two would be on 50 cycles, plus two converters to enable the higher efficiency to be obtained. The cost would be less for the same kW capacity if the plant were all 50 cycles. The extra cost was incurred because of the desirability of catering for the railway load, which would cheapen the general supply. If the S.E. and C. scheme were passed the general consumer would have to wait.

To Mr. Turner (for the Joint Conference of Local Authorities), Sir Philip said a Joint Electricity Authority, which included delegates of local authorities, could not compete with the railway companies as to price of energy. A private undertaking had to give its word to supply at a reasonable rate, but the Joint Electricity Authority would be able to charge what it liked to cover interest and sinking fund.

Re-examined by Mr. Tyldesley-Jones: The advantage the S.E. and C. had by having their generating station nearer Lewisham would be counterbalanced by the West Kent Company having increased generating facilities at Belvedere. The disadvantage in regard to transmission would tend to disappear as the load shifted eastward. The West Kent Company's charge to the railway companies would be 0·584d. with coal at 17s. 6d. Anybody else could be supplied at the same price under similar conditions. The price to the railway companies would come down to 0·55d. when other loads – the L.B. and S.C. and the industrial loads—were approximately equal to three times the S.E. and C. Companies' demand.

Replying to the Commissioners, Sir Philip said Mr. Sparks estimated a cost of £65 000 for cables from Angerstein Wharf to Lewisham. He (Sir Philip) suggested that with spares and pilot and telephone cables the total would be £200 000. He thought the 60 000 kW station could not be carried out for anything like the amount Mr. Sparks estimated. If the Commissioners assented to the West Kent Company's scheme orders for boiler plant and turbines could be placed within two or three weeks, and operations on the site could start at once.

Further Evidence for the Railways.

Mr. C. P. Sparks was recalled (for the S.E and C. Companies) and said 17·1 per cent. thermal efficiency had been obtained in stations with units the same size as those he proposed, and with a slightly lower load factor. Sir Philip Dawson had worked out the thermal efficiency on the basis of units delivered at Lewisham. He (witness) had calculated it on units sent out. About 18·1 might be assumed

for the larger station. The efficiency at the power station might be 1 per cent. higher than that at Lewisham. He did not think it could be substantiated that the power company were in a better position to give this supply than the railway company. Out of a demand of 57 000 kW the main load—43 000 kW—would be given at Lewisham, and the centre of gravity was in that neighbourhood. The railway companies started with an advantage of £155 000 as regarded expenditure in the first stage and at stage 1D that figure would rise to £310 000.

Trade Facilities Committee's Views.

Mr. W. J. SAINSBURY, secretary of the Trades' Facilities Advisory Committee, said, in reply to Sir John Snell, when the S.E. and C. Railway Companies first approached the Committee with regard to a guarantee they did not propose to generate their own power. The Committee said they would require to be satisfied that the power would be available when the line was ready for it. Later, when the railway companies proposed to generate the energy themselves, the amount was increased from 5 million to 6½ millions, but the guarantee was not to be given unless a satisfactory arrangement had been entered into for the supply of the power required. The Committee would be prepared to recommend a guarantee provided the Commissioners were satisfied that the power would be available when required, and that the price was acceptable to the railways.

In reply to the Hon. EVAN CHARTERIS (for the County of London Electric Supply Company) witness said he did not think the reduction of the 6½ million to 5 million would entail any delay.

To Sir HARRY HAWARD, he said a condition of the guarantee was that contracts for plant and equipment must be let to British firms, with the exception of small amounts for which sanction would be given for expenditure abroad. If the Commissioners decided in favour of the West Kent Company the Committee would instruct the consulting engineers that the contracts must be all placed on competitive prices, and that the Committee's sanction must be obtained for any purchase outside this country. These would be the conditions to whomsoever the guarantee were given.

Mr. TYLDESLEY JONES said it had been pointed out to him that the West Kent Company had not stated the load factor at which the 89 million units were to be taken by the S.E. and C. Companies. It was meant that they should take them with a load factor not less than 35 per cent. The maximum demand that had been specified was to be taken over half an hour or an hour. Coal cost was taken on a basis of 15s. and the wages were based on the present rates. He wished to explain more definitely the arrangement for reduction of the charge to the S.E. and C. Companies with the growth of the general demand. When the S.E. and C. Companies took 89 million units per annum, and the L.B. and S.C. and the industrial loads amounted to 216 million units the S.E. and C. would get the full benefit of the 3 per cent. rebate. The 1 per cent. and 2 per cent. rebates would apply when the S.E. and C. consumption was below 89 millions under the conditions stated. It was proposed that the agreement should be for 60 years and the terms of purchase were suggested to be 20 years' purchase on the average production for 5 years, subject to the parties being safeguarded if one or more of the five years were abnormal.

County of London Company's Case.

The Hon. EVAN CHARTERIS, opening the case of the County of London Electric Supply Company, said his clients had always taken the view that the capital station was the correct solution of the electric supply problem, would be able to give a supply at a price not higher than the railway companies could generate it themselves. The erection of a station for a specialised purpose was a proposition opposed to the interests of electrical development. The County of London Company were prepared to begin the construction on their Barking site of a 100 000 kW station.

Mr. CRAIG HENDERSON (for London County Council) pointed out that the Commissioners had issued a Memorandum last month stating that the consent given to the County of London Company for the Barking station was for the company's own needs. Notice ought to have been given of the company's intention to apply for sanction to supply the railway companies.

Sir JOHN SNELL said they must put in a formal application.

Mr. CHARTERIS said the Company were entitled to supply within their area, and the terms of their proposal would in due course be laid before the Commissioners. Cheap capital had to be considered in relation to the purposes for which the capital was to be used. Was it to be devoted to an economical purpose or squandered on a system which all the evidence of the last 10 years showed did not produce the best results and which was only to be justified in the event of there being no alternative which could commend itself to the Commissioners? Was the smallness of the cost of money commensurate with the capital saving which it would be shown could be effected by the County of London Company? Mr. Sparks said he started with a predilection for 50 cycles, which was used by the majority of authorities in the London district. He submitted that there would be no advantage in the adoption of 25 cycles. It was hoped that 50 would be the standard periodicity for London, and therefore it was a mistake to adopt 25.

Sir JOHN SNELL said if Mr. Charteris could show that the railway companies could still adopt the system they proposed to adopt if they used 50 cycles that was a matter the Commissioners must consider. His clients were not there to oppose the West Kent Company's application, except so far as putting forward an alternative involved criticism. It was estimated that there would be a capital saving of £483 000 by taking a supply from the Barking site, after allowing for transmission mains. £624 800 was the difference between (*a*) the station being erected for the purposes of the railway, and (*b*) the provision for the railway being part of the combined load, and the cost of the transmission mains being taken from the £624 000 brought it to £483 000, which was the saving in capital cost by combining the load compared with that at Angerstein's Wharf.

In reply to Sir JOHN SNELL, Mr. Charteris said if his company had the S.E. and C. load and constructed a tunnel under the river to contain the cables it was not suggested that it would necessarily take the place of the West Kent Company's proposed station. The cables through the tunnel would supply the County of London Company's area south of the river—which was the largest portion of its area. The question was whether the railway companies' load should be added to the County Company's load south of the river, thereby cheapening the whole supply north and south of the river. They had 30 000 kW industrial load, and were turning down demands for further supply owing to want of facilities.

Sir JOHN SNELL said that sanction was given on the Company's representations that it wanted the plant to comply with its statutory obligations. He understood that they wanted to shut down one or two of their existing stations on account of the risky condition of condensing water facilities.

On Tuesday, Mr. C. H. MERZ gave evidence on behalf of the County of London Company, and Mr. R. H. HOUGHTON was called for the railway companies.

Mr. W. F. FLADGATE went into the witness-box on Wednesday, after which counsel addressed the Commissioners.

Shanghai Electricity Undertaking.

The annual report and accounts of the SHANGHAI MUNICIPAL ELECTRICITY DEPARTMENT for the year 1921 have come to hand, and show the undertaking to be in a prosperous condition, further progress having been made during the year. The total capital outlay is now 20 771 469 taels (about £3 461 911) and on plant in operation 17 654 556 taels (£2 942 426), the return on the latter being 10·56 per cent., against 10·34 per cent. in 1920.

Year's Profits and Plant Extensions.

The gross profit on the year's working was 1 863 810 taels (£310 602) and the net profit, after meeting interest, providing for depreciation, etc., was 1 047 608 taels (£174 641), against an estimated amount of £171 636, and of £191 970 in the current year. From 1916 to 1921 a sum of 2 170 000 taels (£361 667) has been handed over to the general funds of the Council out of the profit of the electricity department, including £104 167 from the past year's revenue. The generating plant at the Riverside power station was increased by 46 000 kW (two 18 000 kW and one 10 000 kW sets), making the total capacity of the generating plant at that station 79 000 kW. Two 20 000 kW turbine sets and two 3 000 kW machines (the latter for providing independent supply for operating the auxiliary plant) are on order and will be available during next year. When these have been installed two 2 000 kW sets will be discarded, leaving plant of 121 000 kW at the station. The old Fearon-road generating station will also be shut down.

Cable Extensions and Sub-Station Development.

During the year 168 miles of overhead cable were erected and 66 miles of underground cable laid by the staff of the Department. The average capacity of the modern sub-stations is about 2 000 kW, though for supplying large mills and other purposes larger sub-stations have been equipped. The Tonquin-road "super sub-station" is already supplying 20 000 kW, and is being equipped to deal with 50 000 kW. At Robinson-road a large switch-house has been completed and is designed for ultimately handling 28 000 kW. The Department is now supplying electricity to 33 334 premises, an increase of 2 692 over 1920. The highest maximum load was 43 554 kW (Riverside 42 000 kW, and Fearon-road 1 554 kW), and the estimated maximum for 1922 is 64 000 kW. The load delivered to feeders was 41 074 kW, an increase of 16 per cent. Eight of the boilers have been equipped for burning oil fuel, experiments having shown that by supplementing coal-fired boilers with oil burners the steam capacity could be raised by about 25 per cent. The load factor has improved from 46·7 to 51·5 per cent.

The total units generated were 226 418 958, of which the Riverside station accounted for 219 251 888. The total units sold were 185 364 746, an increase of 28·24 per cent. over 1920. The largest increases were for power (over 38 million) and private lighting (over two million units), though the sales for public lighting, traction and heating and cooking were also larger. The new industrial power demands were not, however, as high as anticipated, but the existing consumers' requirements were higher. Owing to post-war conditions, delay in delivery of plant and other causes, the motors connected only amounted to 9 900 H.P., compared with 12 242 H.P. in 1920, which was a record year. The motor installations increase, but the number on hire shows a steady decrease, proving the popularity and established position of electric power. At present there are only 927 motors (of 15 888·5 H.P.) on hire.

Progress on the extensions at the Riverside station have not, it is stated, progressed as rapidly as might be desired owing to the amount of constructional plans required and to labour shortage.

Conference of Employers and Employed.

The first of a series of week-end conferences of employers and employed, which have been organised by the INDUSTRIAL LEAGUE and COUNCIL, was held on Saturday and Sunday last at the house of Sir Ernest Benn, at Oxted, Surrey. Among those present were: Mr. John Ames (general secretary Industrial League and Council), Sir Ernest J. P. Benn, Bart., C.B.E., Mr. W. Vincent Boby (W. Boby and Sons), Mr. H. J. Cash (National Federated Electrical Association), Major A. G. Church, D.S.O., M.C. (general secretary National Union of Scientific Workers), Sir Ernest Clarke, Mr. W. F. Dawtry (A.E.U.), Mr. H. H. Elvin (general secretary, National Union of Clerks), Sir Alfred Herbert (chairman, Machine Tool Trades Association), Mr. H. Wilson Howes (general secretary, Printing Machine Managers' Trade Society), Mr. K. A. Scott-Moncrieff (J.I.C. Electrical Supply Industry), and Mr. H. G. Williams.

Paper on Unemployment.

The Conference was divided into four sessions, presided over respectively by Sir Ernest Benn, Bart., C.B.E., Mr. H. Elvin, Sir Alfred Herbert and Mr. H. Wilson Howes. The subject for discussion was "The Fundamental Causes of Unemployment," and the case was presented by Mr. H. G. Williams, M.Sc., A.M.I.C.E.

Mr. WILLIAMS said that many excuses were given for unemployment, but in his view unemployment was due to bad trade. That was too often overlooked, and in consequence people sought to solve the problem of unemployment, instead of the problem of trade fluctuation which caused it. The immediate general causes of trade fluctuation were changes either in the volume or the direction of expenditure, or both combined. The Governments or large corporations had spent unwisely large sums of money. That had its present reflection on the unemployment in this country. The three causes of the changes in the volume of expenditure were :—(1) Economic disasters, (2) abstention from buying, and (3) inflation or deflation of currency or credit. Numerous disasters—*e.g.*, failure of harvests, war, revolution, industrial disputes—each deprived the people directly affected of their buying power, and that caused bad trade in other countries or industries. War, after its first stage, had the reverse effect when future production was mortgaged to raise loans. Abstention from buying might be caused by fear of war, revolution, abnormal legislation, bad trade, or resentment at high prices and the desire to reduce them.

Inflation and Deflation.

With regard to the inflation or deflation of currency and credit, the State or the banks, by the creation or destruction of credit in any way, *e.g.*, the printing of paper money or its withdrawal, the creation of book credits or their cancellation, could increase or diminish the amount of purchasing power available and thus raise or decrease the demand for commodities. Experience had shown that inflation or deflation produced appropriate reactions. Wherever deliberate inflation had taken place, disaster followed.

Unemployment was caused by changes in the direction of expenditure and changes which were partly changes in volume and partly changes in the direction of expenditure. Goods manufactured in anticipation of a demand which failed to materialise owing to a change of fashion become unsaleable, and persons who would have continued to produce such goods had to find fresh employment. Capital sunk in such products would be lost wholly or in part. In changing production the employer had a tremendous responsibility placed upon him, and should endeavour to make arrangements for displacing as little labour as possible.

Changes of State policy also tended to cause unemployment. Extravagance in spending an undue proportion of individual or national income on goods of immediate consumption and not enough on capital goods, *e.g.*, factories, machinery, railways, etc., would render idle both plant and people in constructive industries, and had its influence on the future efficiency of other industries.

Improved Methods.

Increase in the efficiency of firms in one part of the country might throw temporarily out of employment numbers in the same trade in another part of the country, and the same applied to firms producing goods in another country of the same quality, but at a cheaper rate. Improved methods resulted in cheaper production because each person's output was increased. The ultimate effect was to increase the demand through lowering prices. The immediate effect of it might be the temporary unemployment of some of the men. Those, however, were much more readily taken up when an increase of output was increasingly distributed.

It was possible for bad trade to be avoided, but only if all the causes which led to it were removed. Some of the causes were beyond human control, while others could be completely avoided if everyone was not only good but also wise. Better understanding of the consequences of the unwise acts on the part of Governments and employers and of workpeople which led to trade dislocation, and the more we could educate people on those lines the less bad trade we should endure in future.

There was a considerable need for an economic fly-wheel, which, like the fly-wheel of an engine, would take up undue speed and assist to regulate action when energy was reduced. In that way, during periods of prosperity, the State, municipalities and Governments should accumulate the funds needed for capital expenditure and use them when trade was slack.

Resolution of Conference.

There was considerable discussion, in which all those present took part. The conference, at the last session, unanimously passed the following resolution :—

"That this week-end conference of employers and employed after considering 'The Fundamental Causes of Unemployment,' find that discussion discloses varied and complex causes of unemployment which are unknown to the great majority of the people; they are of opinion that the incidence of unemployment should be fully inquired into and they respectfully recommend to the Joint Industrial Councils and Joint Interim Reconstruction Committees that each Council should appoint a special committee of inquiry who shall make a full investigation into the whole question of unemployment as it affects each industry and that each Council be requested to issue individual reports of each inquiry."

Efficiency of Wireless Watchers.

The report of the MERCHANT SHIPPING ADVISORY COMMITTEE, which was appointed in December last to inquire into the efficiency of wireless watchers, has been issued. The committee (of 12 members) state that they have had the advantage of hearing the views of representatives of the Association of Wireless Telegraphists, of witnesses nominated by the Shipowners' Parliamentary Committee, the Institute of Marine Engineers and the Imperial Merchant Service Guild, and of Commander F. G. Loring, R.N., of the General Post Office. The time at the disposal of the Committee was, however, not sufficient to enable the members thoroughly to investigate the cases submitted by the Board of Trade. As, however after examination of the cases it appeared that in only four of them was technical inefficiency on the part of watchers alleged, the committee consider that even if the allegations made should on further inquiry be sustained, they do not afford ground for advising any alteration in the present regulations.

At the same time, the evidence reveals in some cases a want of friendly co-operation between operators and the watchers, and the committee are of opinion that shipowners, masters and seamen's organisations should be impressed with the desirability of taking all steps open to them to encourage such co-operation in the interests of all on board. Further, watchers should not be removed from their duty during their period of watch.

In a reservation by Mr. J. Henson it is stated that if technical inefficiency is proved that justifies alteration in the regulations, and also that an alteration is required providing that before a certificate is issued by the Post Office to any person acting as a watcher, more technical knowledge should be required.

"Permoil" Lubrication.

LOCO AND AUTO ECONOMY ACCESSORIES, LTD., of 183, Westminster Bridge Road, London, S.E.1, have devised the "PERMOIL" system of greasing for axle boxes which, it is claimed, when once installed, requires no re-oiling until after 60 000 miles running on a railway coach or wagon and 90 000 miles on a tramcar. A special oversized pad, constructed of horsehair and wool, is used. This is strung together to keep its form, and is so arranged as to keep its tension like a collection of springs. This special construction prevents the usual rapid compression of the packing. The pad is soaked in a specially prepared oil which has a viscosity of from 15 to 16, and is without impurities or acid content. After 60 000 or 90 000 miles have been run a fresh supply of oil poured on the pad will enable another run of similar length to be made before the pad is discarded. The initial cost of filling an axle box is only 10s. to 12s. 6d., and the cost per mile on a life of 90 000 miles is about 0·01d. compared with 0·24d., which is said to be the lowest figure reached under the old system. The old method of using a wick to conduct oil from a container to the pad is entirely dispensed with. The thin layer of the "Permoil" lubricant between the bearing and the axle gives the lowest possible coefficient of friction without loss of permanence of the film, and a dry or semi-dry condition of the bearing does not occur, even under the greatest pressure. The "Permoil" E.B.5 lubricant, which is used for railway and tramway axles, is said to act perfectly in the hottest climate without getting thin and down to 30 degs. without congealing. It is not necessary to change the construction of axle boxes in order to instal the system.

A table prepared by the company shows comparative results of tests with the "Permoil" system and with ordinary oil lubrication. On a G.E. 52 motor one charge of ordinary lubricant in summer gave three days' running on an axle bearing and two days on an armature bearing, compared with 120 days and 160 days respectively with the "Permoil" system. With a G.E. 800 motor the figures were three days and one day with ordinary lubricant and 100 days and 80 days with "Permoil." In winter the figures were with ordinary lubricant four days (axle) and three days (armature) on a G.E. 52 motor, and six days and four days on a G.E. 800, while with the "Permoil" 160 and 140 days were run on the G.E. 52 and 150 and 130 days on the G.E. 800.

The "Permoil" system is now being used on the Great Western Railway, amongst other traction undertakings, and it is said to be regarded with favour by the managers of many railways and tramways. Tests will be made shortly on the L.C.C. Tramways.

Association of Consulting Engineers.

The annual general meeting of this association was held on the 29th ult., Mr. W. Vaux Graham, M.I.C.E., presiding.

The report of the committee stated that nine new members (including one from Cape Town and one from Calcutta) were elected during the year, the total membership being now 84. A letter was received last summer from the Belgian Association of Consulting Engineers inviting the association to attend a meeting in Paris in connection with a proposed International Federation of Consulting Engineers, but after consideration it was decided that no useful action could be taken at present. Owing to the coal strike, the annual dinner was postponed until November. The result showed that this period of the year was more convenient than the spring and it is proposed this year to adopt the same course.

Conditions of Contract.

The association had a representative on the Committee of the I.E.E. to revise the model general conditions of contract, but during the year it became evident that the association could not accept the conditions in the form in which they appeared likely finally to take, and the representative was withdrawn. After discussion with representatives of the B.E.A.M.A. it was decided that the association should itself draft a set of conditions for use where members of the association and members of the B.E.A.M.A. were jointly concerned. A draft was accordingly prepared by a sub-committee. One principle underlying these conditions was that the responsibility for the design of the works should rest with the engineer, and that the work should be carried out to his instructions and satisfaction, but that in the event of the contractors being dissatisfied with any of his decisions they should have the right to refer the matter to an independent arbitrator, who should hold a single arbitration on the completion of the work to decide whether such decision of the engineer had entailed additional expense to the contractor. This principle was mutually approved, and the conditions were agreed, except clauses 27 and 34. These were held over for further discussion at the end, as the committee found themselves unable to accept the limitations of the B.E.A.M.A.

Limiting Contractor's Liability.

The first was an addition to clause 27, limiting the liability of the contractor for damage or loss caused to the purchaser, owing to neglect by the contractor or to improper workmanship or design of the plant, to a sum not exceeding the value of the contract. The B.E.A.M.A. claimed that such a clause had already been included in the draft agreed by the representatives of the I.M.E.A. on the Committee of the I.E.E. The committee of the A.C.E., however, felt that as the liability of contractors to make good such damage was not limited under Common Law, they could not agree to recommend the members to put before their clients a set of conditions by which the contractor was relieved of this legal obligation. The addition to clause 34 limited the penalty of 1 per cent. of the contract value of any portion of the plant for every week by which the "Time of Completion" was exceeded, to 25 per cent. of such contract value. Unfortunately the B.E.A.M.A. finally decided that without the inclusion of these two additions the conditions could not be issued as agreed, but as so large a measure of agreement had been arrived at, the committee issued them in the name of the association and recommended its members to make use of them, leaving the B.E.A.M.A. to raise those questions in any particular case.

The report and accounts were adopted, and the following members were elected to serve on the committee:—*London:* Mr. A. T. Cooper, Mr. J. Mitchell Moncrieff, C.B.E., Mr. Arthur Henry Preece, Mr. Henry John Rofe. *Country:* Mr. Harry Prescot Hill (Manchester) and Mr. John Alex. Warren (Glasgow).

Electricity Companies Officers' Association.

In the 1921 report of the Executive Committee of the Association of Officers and Staff Members of Electricity Companies of Great Britain it is stated that Sir Alex. B. W. Kennedy, F.R.S., has again kindly consented to accept the Presidency of the Association. Mr. F. Wood has resigned his seat on the Committee and the hon. treasurership of the Association, and Mr. A. C. Tappenden (of the City of London Company) has undertaken the duties of hon. treasurer. The Committee have watched the proceedings at the local inquiries of the Electricity Commissioners with the view of keeping before the Commissioners the desirability of the foundation of superannuation schemes by any new authorities.

In regard to the Morley award, the Committee are of opinion that all questions as to the detriment suffered by officers and servants of an undertaking by operations under the 1919 Act would best be dealt with by referees fully acquainted with the nature of the industry; and they have (in conjunction with other Associations) submitted this opinion to the Electricity Commissioners. Many of the powers of combination conferred on undertakers by the Act of 1919 are similar to those given by the Acts of 1908 and 1909, but any such combination as may take place in future will be in consequence of the Act of 1919, and the Committee think that any member who may suffer detriment should be entitled to the protection given by Sec. 16 of that Act. They were afforded an opportunity of laying their views before Sir John Snell and Sir Harry Haward, with the result that a new section has been inserted in the Bill now before Parliament favourably amending the section.

The accounts shows a credit balance of £517 12s., which sum, except for the amount which it is necessary to keep on current account, has been placed on deposit at the bank. The members of the Executive Committee who retire are Messrs. V. A. Hitchman, W. A. Mackenzie, A. W. Seabright, and J. H. Willis. Mr. Mackenzie has resigned his seat, but the other gentlemen offer themselves for re-election. The hon. secretary (Mr. O. M. Andrews) having found it impossible, owing to other engagements, to devote the necessary time to the business of the Association, an assistant hon. secretary (Mr. R. Litt, of the Westminster Company) has been appointed.

Small Ironclad Cut-outs.

In Henley's new pamphlet dealing with CUT-OUTS we notice that the company have made a departure which will be appreciated by many engineers. Extracts are given of tests carried out at the National Physical Laboratory, part of which we produce below. With this information confidence can be reposed in a cut-out, whereas previously the performance of a cut-out depended too much upon theoretical assumption. In many cases engineers, for the sake of safety, install a higher capacity cut-out than is necessary. Obviously this is an expense which could be reduced considerably.

The Henley "Isco C" cut-out, dealt with in this pamphlet, is rated for a working current of 10 A and a fusing current of 30 A, and the test certificate of the National Physical Laboratory states that:—"The cut-outs are rated for 10 A 250 V, fitted with fuse wire of 0·018 in. dia. tinned copper. A battery of 1 000 Ah. cells giving 240 V was used for the test. The resistance was adjusted to give a short circuit current of 1 000 A. The positive pole of battery was connected to the top terminal and also with a resistance of 0·100 ohm, to the earthing screw of the metal box, the negative

FIG. 1.

pole being connected to the bottom terminal. The result of five tests was as follows: The fuse opened the circuit clearly without arcing. The blowing of the fuse blackened the asbestos lining in the lid, but this was purely superficial."

There are a number of other interesting features in this Henley cut-out, including a patent slam catch and sealing device (shown in Fig. 1) so that there is no loose sealing pin to wrestle with; the

FIG. 2.

carrier is fitted with self-aligning contacts, and solid brass terminals fitted with a pair of brass cheesehead pinching screws. These cut-outs are specified for a *working current* of 10 A, and Messrs. Henley inform us that although the fusing current of this new cut-out is 30 A they consider it is more important that engineers should know the actual working current. This is, or should be, standard practice. We also illustrate a Home Office type of fuse carrier, showing the method of wiring and the patent self-aligning contacts. A copy of pamphlet W.L.3 may be obtained from W. T. Henley's Telegraph Works Co., Blomfield Street, London, E.C.2.

Legal Intelligence.

Re Corona Lamp Works, Ltd.

A petition by the British Thomson-Houston Co. for an order to wind up the Corona Lamp Works, Ltd., came before Mr. Justice Astbury on Tuesday.

Counsel for the company asked for an adjournment. He said the petition was the result of an appeal to the House of Lords for a decision of the Court of Appeal. There was a sum of £5 529 from costs which were ordered by the House of Lords to be repaid to his clients. There was also a subsequent action, tried by Mr. Justice Astbury, between the same plaintiffs and defendants, and that resulted in judgment against defendants. It was alleged in the petition that negotiations had taken place for a compromise on the different matters between the parties, and the matter was allowed to stand over for some scheme to be carried through. Unfortunately, while the negotiations were pending the petitioning creditors put in an execution on the goods of the company. A receiver was appointed by the debenture holders, and the sheriff came out. Then the petition was launched. If the negotiations had been allowed to proceed the Corona Co. had every reason to believe that there would have been no necessity for the petition, and a scheme would have been brought forward to satisfy everybody. The nominal capital of the company was £2 000, but there were debentures in three classes for £32 000; and the receiver was in possession. He asked that the petition should stand over for a month to allow of the negotiations between the petitioners and the company to be continued.

Mr. Turner (for the petitioners) said his instructions prevented him making any concessions.

His lordship then made a compulsory winding-up order.

Is a Motor Repairing Waggon a Tractor?

Sheriff Robertson, of Falkirk, has given his considered judgment in the case against the Falkirk and District Tramways Company for having used, on February 26 last, a motor tower repair waggon for which a licence under the Finance Act, 1920 (as amended by the Roads Act, 1920), was not in force. The company had applied to the Stirling County Council for a licence, for which a postal order for 5s. was enclosed, but the Council, not being satisfied that that was the appropriate duty, declined the 5s. and communicated with the Ministry of Transport, who expressed the opinion that the correct duty payable on the vehicle was £25. The company maintained that the waggon, which was not used solely in the course of trade or agriculture or in carrying goods from one place to another, was a tractor, and should be licensed as such at 5s.

In the course of his judgment, the Sheriff said that for effecting the repair of the overhead wires the company used a motor tower repair waggon, which was an ordinary four-wheeled lorry propelled by an internal combustion engine capable of developing 24 to 25 H.P. On the front part of the lorry there was a telescopic tower, by means of which a platform could be raised to enable workmen to carry out repairs to the wires. The rear part of the lorry contained a box, in which tools, pieces of spare wire and other fitments necessary for the repairs were carried. The Finance Act of 1920 provided that on mechanically propelled vehicles used on public roads duties should be paid at the rate specified in the second schedule of the Act, but for vehicles used solely in the course of trade or in agriculture (locomotive ploughing engines, tractors, and other agricultural engines) the duty was to be 5s. If the vehicle was not a "tractor," the company's argument failed. He could not conceive any definition which would be wide enough to include the vehicle in question that would not also include every motor lorry used to carry any kind of burden. The general feature of all "tractors" must be that they draw their burden behind them and do not carry it. He had no doubt but that the company when they asked for a licence failed to tender the appropriate amount of the duty payable by them. Therefore he imposed a fine of £10, three guineas of which he allocated to the County Council.

Parliamentary Intelligence.

Key Industries.

In the House of Commons on Monday, Mr. S. BALDWIN stated, in reply to Major Mackenzie Wood, that he was aware of Sir J. J. Thomson's general attitude on the Safeguarding of Industries Act and on the alleged difficulties in getting apparatus for research. He would point out, however, that the inferiority of apparatus and materials could not be ascribed to that Act, since there was no prohibition of importation, and the duty was not of sufficient magnitude to deter an investigator from obtaining foreign goods if their quality was appreciably higher than that of domestic products. There was conclusive evidence that Germany was far from maintaining her pre-war standard of quality. He could not consider Sir J. J. Thomson's suggestion that a system of licences under the Act for research institutions should be set up.

Supply Companies Charges.

Answering Viscount Curzon in the House of Commons on Monday, Mr. A. NEAL stated that the increases in the maximum charges authorised to be made by electricity authorities had sometimes been made under the terms of their provisional orders, which incorporated Sec. 32 of the Schedule of the Electric Lighting (Clauses) Act, 1899, but in the majority of cases under the Statutory Undertakings (Temporary Increase of Charges) Act, 1918. In each case the Minister had considered a report by the Electricity Commissioners, and under these circumstances he did not think that the appointment of a Committee to deal with the matter would be useful.

Suburban Railway Electrification.

On Monday, Mr. J. D. Gilbert put a long question to the Minister of Transport on the subject of the electrification of the suburban lines of the S.E. and C. Railway Companies. Mr. Gilbert asked whether, seeing that the Government had undertaken to guarantee capital expenditure of six and a half millions by the companies for their electrification scheme; that it was a condition of the guarantee that the work should be started at an early date and be carried out within three years, and that the generation of the necessary power should be done at cost price; that the formal application of the railways for consent to erect a generating station was opposed by the West Kent Co.; that the latter company were themselves promoting a scheme for putting up a station at Erith; that practically all the shares in the West Kent Co. were owned by the South Metropolitan Co., who had recently joined a large group of London electricity companies; that the opposition of the West Kent Co., if successful, was likely to delay the electrification of the railway lines and to increase the cost of power supply for the lines; and that the erection of a non-purchasable capital station at Erith would seriously affect the purchase rights of the London County Council, he would state whether the Advisory Committee under the Trade Facilities Act were aware, when they came to the agreement to assist the railway companies, that the consent of the Commissioners would be necessary for putting up the station; and whether there was any consultation between the Treasury and the Ministry of Transport on the subject?

In reply, Sir R. HORNE said the answer to both parts of the question was in the affirmative. He must not, however, be taken to concur in all the statements of the preamble, many of which were matters for argument.

Motor Transport by Railways.

On Monday it was announced that, owing to the opposition, it had been decided to withdraw the L. AND N.W. AND MIDLAND RAILWAY BILL for road transport powers.

Overhead Transmission Line Material.

B.S. specification No. 137 for PORCELAIN INSULATORS FOR OVERHEAD POWER Lines, the first of a series covering overhead transmission line material, has been issued by the British Engineering Standards Association, and copies may be obtained (at 1s. 2d. each) from the Secretary.

In preparing the Specification the Committee considered that, in view of the number of designs available at present, none of which could be said to represent finality, it was not desirable to standardise the shape or dimensions of the insulators. The Specification is, therefore, confined to the conditions of test and performance of two types of insulators. Considerable difficulty was experienced in finding suitable terms for these types, and finally the terms "Supporting" and "Tensioning" were adopted. They are defined as follows:—

"Supporting Insulator" denotes one which supports the conductor but is not intended to withstand the load due to the full tensile stress in the conductor. Pin type supporting insulators are generally used for declared pressures up to about 60 kV and suspension type are employed generally for declared pressures in excess of 60 kV.

"Tensioning Insulator" denotes one which is designed to withstand the load due to the full tensile stress in the conductor. Tensioning insulators are of the disc and shackle type, but the latter are practically obsolete. Disc type insulators are divided into interlinked and metal hooded types.

I.E.E. War Memorial.

The unveiling and dedication of the WAR MEMORIAL in memory of the members of the Institution of Electrical Engineers who fell in the Great War will take place at the Institution building on Wednesday, the 28th inst., at 4.30 p.m. The Memorial will be dedicated by the Rt. Rev. Bishop Ryle, K.C.V.O., D.D., Dean of Westminster, and unveiled by Air Chief Marshal Sir H. M. Trenchard, Bart., K.C.B., D.S.O., assisted by the President of the Institution, Mr. J. S. Highfield, and the Senior Vice-President Dr. W. H. Eccles, F.R.S.

The Entrance Hall, where the Memorial will be erected, will be reserved for nearest relatives, and special tickets will be issued to them for this purpose. Members (other than relatives) and their ladies will take their places in the lecture theatre, for which no tickets will be required. It is requested that those attending should arrive not later than 4.15 p.m., and it is desired that officers who have uniforms should attend in service dress with decorations.

Electricity Supply.

For the year ended March 31 the Bacup Electricity Department made a profit of about £29.

KENDAL Town Council have decided to spend £11 685 on extensions and plant in connection with the electricity undertaking.

CANTERBURY City Council has applied to the Electricity Commissioners for a loan of £4 650 excess expenditure in respect of new generating plant.

DUMFRIES Town Council has now received the terms upon which the undertaking of the Electricity Company can be acquired, and the offer is to be investigated.

BLACKROCK (Dublin) Urban Council have applied to the Provisional Government for a Special Order to authorise the supply of electricity in the township.

GLASGOW Electricity Committee have decided to purchase 240 000 tons of coal during the next twelve weeks at a price which is about 10s. a ton less than last year.

BLACKPOOL Tramways and Electricity Committee have decided to allocate £4 000 of their balance of £6 286 to reserve fund, and £1 000 to third-party insurance, carrying forward £1 236.

A meeting of residents of ABBEYFEALE (co. Limerick) was recently held in support of a scheme for the formation of a company to establish electricity works. Canon Cregan presided over a representative gathering.

WORKSOP Urban Council is being sued by the Grafton Angling Association for damage caused by alleged negligence in permitting heated water to enter the Chesterfield Canal from the condensing plant at the electricity works.

BLACKPOOL Electricity Committee will support the scheme for the improvement of the existing organisation for the supply of electricity in MID-LANCASHIRE ELECTRICITY DISTRICT, and for setting up a Joint Advisory Board.

The large power consumers having complained of the high charges for electricity, the Corporations of both Bacup and the adjoining Borough of Rawtenstall are in negotiation with a view to a new scale of charges being adopted in the two towns.

Mr. A. Ellis, of Cardiff, who was appointed to report on HULL electricity undertaking, states in his report that if it was a case of wishing to find work for the unemployed he would say the Committee had succeeded beyond the limits of anticipation.

The institutions under the control of the BLACKBURN Guardians are apparently quite up to date, for Mr. P. P. Wheelwright, who is acting as electrical adviser to the Board, has been instructed to instal six electric irons at the laundry, and also to lay a cable to the Sanatorium.

Owing to the delay in making known the proposals for dealing with electricity supply in the area which includes BURLEY-IN-WHARFEDALE, the Urban Council find themselves unable to proceed with their scheme for providing public and private electric lighting in the village.

On February 23, STEPNEY Borough Council applied to the Electricity Commissioners for sanction to a loan of £492 140 for extensions to the electricity undertaking. They have now received permission to borrow £268 000 on account, a former sanction to £125 000 for the same purpose given in May, 1921, being cancelled.

The Bursar of MARLBOROUGH College has applied to the Town Council for permission to carry cables under and above roads in connection with an electric lighting scheme for the college buildings and boarding-houses. It is suggested that the Council should take advantage of the scheme by endeavouring to obtain a supply of electricity for the town.

CROOK (co. Durham) Urban Council are applying for a Special Order to authorise the Council to purchase, and the County of Durham Electrical Power Distribution Company to sell, so much of the company's undertaking as is situate in the Council's district, to authorise the Council to take a supply of electricity from the said company or any other body or person, etc. Objections to the Electricity Commissioners by July 10.

HACKNEY Borough Council have passed a resolution asking the Electricity Committee to consider and report on the question of initiating a scheme whereby electricity for all domestic purposes may be made available to families of limited means without the necessity of appreciable initial expenditure; and requesting the borough electrical engineer to prepare a report on the matter for submission to the Electricity Committee.

The Electricity Commissioners have informed BACUP Corporation that although the town has not been included in the S.E. Lancashire Electricity District, that fact does not preclude the possibility of Bacup obtaining a supply or giving a supply of electricity to an authorised undertaking or to a consumer in that district if it be established that such a course is the most economical and is in the best interests of the parties concerned.

Colonel Ekin held an inquiry last week into the application of LYME REGIS Town Council for a Special Order to enable them to purchase the undertaking of the Lyme Regis Electric Light and Power Co. It was stated that the purchase price agreed upon was £3 750, and it was proposed to expend an additional £8 000 on extensions and improvements. The price charged by the Company was 1s. per unit, and it was proposed to increase this to 1s. 2d., with a maximum charge of 1s. 6d.

ST. PANCRAS Electricity Committee, in a report on the Council's scheme for supplying electricity to small dwellings, states that at present there are 285 consumers, and that Flaxman Terrace and Prospect Terrace Dwellings have been wired for 488 lights, but the supply to these houses has been delayed pending a decision of the Special (Housing) Committee as to the wiring of the staircases, the caretaker's residence, etc., as the tubing for the rising mains can be utilised for both schemes. Instructions have now been given for the work to be proceeded with.

The fourth and last of the new gas-driven sets for BUXTON electricity undertaking has been installed, and it is confidently anticipated that the works, which have shown a loss since 1918, will now show a substantial profit. The loss for 1918 was £1 863; for 1919, £2 057; and for 1920, £3 378. But when the first portion of the new plant was installed matters began to improve. In 1921 the loss was reduced by £2 000, by a further £400 in March, 1922, and would have been wiped out if the coal strike had not occurred. It is hoped soon to reduce the charges to consumers.

New Schemes and Mains Extensions.

The NAVAN (Ireland) Urban Council have started work in connection with the erection of the new electricity works.

YORK City Council have applied for sanction to loans of £1 200 for two air filters, £2 000 for transformers, and £3 000 for services.

CHEADLE (Lancs) Council has decided to canvass the residents in Cheadle Road in order to ascertain the demand for electricity supply.

FORMBY (Lancs) Council have received offers of electricity supply from Liverpool and Southport Corporations and the L. & N. W. Railway Company.

WARRINGTON Rural Council will consider at their next meeting the application of the Corporation for authority to lay an extra cable along Padgate Lane.

HASTINGS Corporation Council has applied for authority to borrow £7 000 for mains, including £1 113 over-spent, and £5 418, excess expenditure on various loans.

The Electricity Commissioners have sanctioned the borrowing of £26 050 for electricity extensions at LYTHAM and ST. ANNES, where there are now 3 222 electricity consumers, against 2 553 last year.

The talk of utilising IRISH WATER POWER for generating electrical energy is still going on, but it is obvious that no real progress in that direction can be achieved till a calmer political atmosphere prevails.

ELGIN Town Council are supporting an application by Edmundson's Electricity Corporation for a Special Order authorising the supply of electricity in the burgh. A limited company is to be formed with a capital of £20 000.

HENLEY-ON-THAMES Council have before them two schemes of electricity supply, one being by means of overhead cables from Reading, which would also link up other parishes, and the other by utilising the water-power of the river.

Messrs. Armstrong, Whitworth and Co. have obtained an extension of time from INVERNESS Town Council in regard to the Loch Luichart hydro-electric scheme. The firm have alternative proposals for utilising the water-power of the Caledonian Canal.

BURY (Lancs) Corporation has applied to the Electricity Commission for sanction to borrow £2 700 for laying a third main between Chamber Hall and Rochdale Road power stations, and the permanent laying of the two existing trunk mains along Tanpits Road.

HAWARDEN Rural Council has applied for a Special Order to authorise the supply of electricity in Connahs Quay Council area, but the application is opposed by Chester Corporation, who have applied for an order to distribute electricity within a radius of five miles of Chester, and also by Wrexham Corporation

The question of providing additional generating plant is being considered by CARNARVON Corporation. Ald. J. Pritchard, chairman of the Electricity Committee, explained at last week's meeting that the proposed plant would cost about £8 000, while the cost of providing bulk supply from the North Wales Power and Traction Company would be about £12 000. The arrangement with the National Construction Company would end in three years, but there was an understanding by which the period might be extended to eight years.

An inquiry was held at LIVERPOOL on Tuesday into the application of the Corporation for a special Order to authorise the purchase of the Bootle Municipal Electricity Works and to extend the Liverpool area of supply to Bootle, Litherland, Waterloo, Seaforth and Great Crosby. The inquiry was conducted by Col. Ekin, and there was no opposition, save from a section of Bootle ratepayers, who demanded an annual payment of £12 500 to Bootle, instead of the £7 500 agreed upon by the two corporations, and for a periodical review of the price per unit to be charged to Bootle consumers.

Electric Traction.

BLACKPOOL Tramways Committee has declined an offer to rent the electric standards for advertising purposes.

BURNLEY Tramways Committee has applied for sanction to borrow £4 950 for relaying the double line between Park Lane and Padiham, and a single line in Manchester-road to Towneley, and Rosegrove.

Work was started on Monday last on the schemes for the improvement and extension of the railways of the UNDERGROUND ELECTRIC RAILWAYS CO. OF LONDON. Part of the City and South London line will be closed on August 8, when the widening of the tube will be commenced. The first sod of the ground for the Edgware extension was cut on Monday.

GLASGOW Tramways Sub-Committee are to consider and report on the revision of fares and the improvement of the services.

The wages of the tramway employees were reduced by 3s. a week on June 1, and by a further 2s. on the 1st prox.

The shareholders of the GLASGOW SUBWAY CO. have now authorised the sale of the undertaking to the Corporation for £385 000. It is probable that electric traction will be adopted when the transfer has taken place.

For some time the tramways department has been employing men each alternate week on relief work, and under arrangements with the Employment Exchange these men received an out-of-work donation for the week of enforced idleness. The Ministry of Labour has decided that this practice must be discontinued, and men employed on such terms are not to get the out-of-work donation in future. The Tramways Committee are endeavouring to secure the continuance of the practice.

It is reported that satisfactory trials have taken place of the NORTH EASTERN RAILWAY CO.'s new electric passenger locomotive. It is intended to haul a 450-ton express train at an average speed of 65 m.p.h., but the running gear is designed for a maximum safe speed of 90 m.p.h. The trials are stated to have clearly indicated that the full h.p. for which the engine was designed—1 800 h.p. one-hour rating, or 1 260 h.p. continuous rating—could be developed, and that the heavy gradients could be dealt with in the manner anticipated.

The demand for a reversion to penny tram fares was renewed at last week's meeting of LIVERPOOL City Council. It was stated that since the minimum twopenny fare was introduced about eighteen months ago there had been a falling off of passengers amounting to 40 000 000 per annum. Councillor Wilson, chairman of the Committee, said an effort would be made to cheapen fares towards the end of the present year, but the department must first get out of debt. Liverpool was paying higher wages to its tramway employees than any other municipality in the country, and nowhere were there better cars or better tracks.

The inauguration of the electric train service between Goldau and Lucerne on the 28th ult. completed the ELECTRIFICATION OF THE GOTTHARD RAILWAY, about 140 miles in length. The steam line was opened in 1882 and work on its electrification began in 1913. The scheme, which was delayed by the war, also involved strengthening some bridges and viaducts. Electrical energy is supplied by Lake Ritom hydro-electric station but as soon as the Amstey power station is capable of furnishing a supply the electric service will be extended to the Lucerne-Basle line. Some particulars of the electrical equipment have already appeared in THE ELECTRICIAN.

The proposal of GLASGOW Corporation to purchase the Airdrie and Coatbridge Tramways is severely criticised in the report issued by the Ratepayers' Federation. It is thought that the present is an inopportune time to purchase the tramways. The Federation are, apparently, reconciled to a railway monopoly but a tramway monopoly is to be opposed, for the report states: "Were it proposed simply to link up Glasgow tramways with those of another burgh no objection could be offered, but it was a different matter for municipalities to borrow money in order to create great tramway and omnibus monopolies, which in turn were to become destructive of the capital supplied by the same public to run the railway companies." It is also objected that though the Corporation are now promoting a Provisional Order to purchase the tramways they paid the purchase price of £82 250 in December last. The purchase scheme has been before the ratepayers for a long time and the promotion of the Order was approved. In fact as no petitions have been lodged against the Provisional Order it is now proceeding as an unopposed measure.

A large installation of ELECTRICALLY OPERATED SUGAR PLANT, consisting of centrifugals, has been sent to JAVA by Pott, Cassels & Williamson, of Motherwell. The centrifugals have been delivered to the Tjomal sugar factory, and comprise 73 electrically driven units, arranged in two double rows, batteries of 42 and 33 machines respectively, with steel baskets, 36 in. dia., 18 in. deep. Each machine has its own 3-phase overhead motor, running at 1 200 revs. per min. The centrifugals are driven by the motors through a special form of friction clutch which also acts as a flexible coupling between the motor and centrifugal. The switches are also of special design and are interlocked with the brakes of the centrifugals. Each of the four distributing mixers has its own motor, operating through suitable bevel and worm gear. There are altogether 83 electric motors.

Municipal Accounts.

WALSALL MUNICIPAL ELECTRIC TRAMWAYS DEPARTMENT shows a net profit in the year ended March of £3 987, compared with £3 107 in the preceding year.

The profits of the WALSALL ELECTRICITY SUPPLY DEPARTMENT for the past year amounted to £1 110, compared with £1 613 in 1921. Receipts from the sale of current fell from £94 658 to £85 117, but generating expenses dropped from £10 458 to £7 935, and management expenses from £6 556 to £5 944.

ABERDEEN Corporation Tramways department has completed a record year. The total revenue of the tramways and motor omnibuses was £196 119, against £195 312 last year. There was a decrease of £6 968 on the tramways, but an increase on the 'buses of £7 775, or a net increase of £807. The estimated net profit will be about £2 248.

The net profit on the past year's working of the SWANSEA electricity department was over £3 400, although there was a large drop in consumption owing to trade depression. In 1920–21 the profit was £3,878. Arrangements have been made for the construction of a railway siding at the electricity station which will effect a saving of 2s. 6d. per ton on coal delivered, or £2 000 a year.

The accounts of TYNEMOUTH ELECTRICITY Department for the year ended March 31, 1921, have only recently been issued and show a surplus of £2 895, compared with a loss of £293 on the previous year. The capital expenditure during the year amounted to £23 623, against £5 578 in 1920, bringing the total capital expenditure up to £127 761, less £67 408 repaid. The units sold numbered 7 516 571, an increase of 1 704 687. The total works cost per unit sold was 0·892d. against 0·868d. the previous year.

At LINCOLN City Council meeting last week, Alderman W. S. White (chairman of the Electricity Committee, said the accounts of the ELECTRICITY UNDERTAKING showed a loss on the year's working of £12 833, making, with the deficit of £6 833 brought forward, a total of £19 666. The Ministry of Health had granted permission to spread the repayment of this deficiency over a period of five years. The balance standing to the credit of the depreciation account at the close of the year was £5 166, and in addition works of replacement and renewal to the value of £27 213 had been met by that account.

With regard to the TRAMWAYS UNDERTAKINGS, the year began with a deficiency of £410, and the loss on the year's working was £644, leaving a deficit of £1 054. A reduction of £1 368 in the working expenses was more than counter-balanced by a fall of £1,403 in the revenue.

The gross profit of WORCESTER ELECTRICITY UNDERTAKING for the year ending March 31 last amounted to £13 758. After allowing for interest (£5 845), repayment of capital (£5 418), and income tax (£1 149), there remains a net profit of £1 346, which is carried forward to the appropriation account, bringing the balance up to £5 018 10s. Of this sum a contribution of £1 500 has been made to the relief of rates, leaving £3 185 to be carried forward. In several previous reports, special reference has been made to the desirability of building up an adequate reserve fund. About two years ago the Council approved of this policy, but up to the present no contributions have been made for this purpose, all surpluses being appropriated for the relief of rates. In addition, the accounts have been further burdened by increased charges for rates and taxes. To meet increased demands it has been decided to extend the power station and generating plant at an estimated cost of £53 950. £157 048 of the capital expenditure has been repaid, leaving the outstanding debt at the end of March, £104 176.

The units sold during the year were 4 583 621, compared with 3 663 349 last year; 25 new motors and 27 heating devices of a capacity aggregating 630 H.P. were connected; 3 599 653 units were sold for industrial service, heating and traction; and 742 108 units for lighting and domestic heating, compared with 589 204 units last year.

The annual report of LIVERPOOL CORPORATION TRAMWAYS Undertaking for 1921 shows a decrease of 47 989 531 passengers carried compared with 1920, but an increase of £105 006 in the receipts. The average earnings per car mile amounted to 27·48d. against 22·82d., or an increase of 4·66d. The gross profit was £258 122. Interest, however, required £54 787, and sinking fund and repayment of loans £46,650, leaving a surplus of £156 685. The sum of £205 261 was spent on renewals. The reserve, renewal and depreciation fund was practically exhausted at the end of 1920 so that the whole of the surplus (£156 685), together with an additional sum of £48 576, was spent on renewals. This latter amount has been carried forward to next year's accounts. The committee approved of the introduction of an improved type of car designed by the general manager (Mr. P. Priestley), and certain new cars of this type were placed in service, and 16 of the older type were re-built and re-modelled. Progress was made in the installation of the new type of route indicator boxes and side screens. Some of the old motor equipments, which were in the works, were converted into an electric welding plant, and the saving effected by being able to carry out repairs with this plant instead of buying new material considerably lessened the cost of repairs and maintenance.

Imperial Notes.

Electricity supply was commenced in BELGRAVE (Victoria) early in April from a power house at Upwey.

The Corporation of JOHANNESBURG have decided to spend £35 000 on extensions of the electric supply mains to the suburbs.

The Municipal Council of SALISBURY (South Africa) recently raised a loan of £70 000, of which £30 000 is to be expended on electricity generating plant.

The Provincial Government of QUEBEC have now decided to, enforce an Act passed in 1921, and commonly known as the "Electricity Licensing and Inspection Act," for the licensing of electricians, for the inspection of wiring installations in public buildings, etc. At first it is proposed to enforce it in Montreal, Quebec and a few of the larger towns.

According to the Toronto correspondent of "The Times" agreements have been completed for the purchase of the radial railways and electric power companies by the Province of ONTARIO and the city of TORONTO, which will require Toronto to assume obligations amounting to $30 000 000 (£6 000 000) and the Provincial Government $18 000 000 (£3 600 000).

A correspondent of the "Times Trade Supplement" states that reports are current that the Government of Ceylon are going to raise fifteen million rupees to start work in connection with a HYDRO-ELECTRIC SCHEME and other important public works, by imposing the Indian Tariff Scale. This will mean a large increase on the existing Customs tariff. It is also stated that preparations are being made to raise another loan in London shortly to finance the hydro-electric scheme as a whole.

The Dominion Steel Corporation has recently been organised for the manufacture of ALLOY STEEL IN CANADA. Works are to be erected at Sarnia (Ontario), and the plant will contain two 75-ton open hearth furnaces, together with two electric furnaces (one 20-ton and one 6-ton), rolling, blooming and sheet mills, etc. The capacity of the works will be 100 000 tons of alloy steel a year, and the initial demand for power, to be supplied by the Hydro-Electric Commission, will be about 15 000 H.P.

A deputation from the KURANDA (Queensland) Progress Association recently received an assurance from the Home Secretary that he would give all the assistance in his power to the scheme for utilising the Barron Falls in the generation of electrical energy. The State Government have agreed to support the scheme provided a load (apart from the Cairns lighting) sufficient to justify the expense can be relied upon. A committee has been formed to endeavour to secure the establishment of power-using industries in the district.

The Johannesburg correspondent of the "Financial Times" states that Mr. Bernard Price, chief engineer in South Africa of the VICTORIA FALLS AND TRANSVAAL POWER CO., in the course of his evidence before the Rand Mining Board, said that the unions seemed under the impression that by the company's refusal to meet them in conference they had been unfairly treated. His view was that when it was impossible to acquiesce in a request it was insincere and useless to engage in a conference. Shareholders in the company had been paid out of reserve funds ever since the establishment of improved conditions after the strike. Certain men had not been reinstated because the company recognised that it was better without them. Such action did not constitute victimisation. He did not agree that it was incumbent upon the companies to re-engage everybody. The machinery created for the purpose of securing the settlement of disputes had been rendered valueless by the extreme action of certain sections, who were always active. His company had been compelled to sell current at the fixed rate prevailing in 1914, being unable to pass the increased charges on to the consumers.

Mr. Forbes Mackay, general manager of the SYDNEY (N.S.W.) Electrical Department, who, returned recently from a visit to Great Britain and Europe, has submitted his report to the Municipality. The report deals with boiler pressures, stokers, ash handling, pulverised coual, ad the automatic protection on the h.t. distributing system. Mr. Mackay thinks it is not desirable in the case of Sydney to go beyond a gauge pressure of 350 lb. to the square inch. With this pressure, and a steam temperature of about 700 degrees F., the steam consumption of turbo-alternators could be brought down to slightly over 11 lb. per kWh. The reduction which might be obtained by going as high as 450 lb. or 500 lb. to the square inch would not justify the extra first cost and probable extra cost of maintenance of boilers, pipework, etc. Provided prices quoted were suitable, the Council should consider the installation of retort automatic stokers. The best method of dealing with ashes which he had seen was that of allowing the ashes to fall continuously from the back of the grate into a trough kept automatically full of water, in which trough there was travelling under the water an endless chain conveyor. The use of pulverised coal under the boilers should not be adopted yet. It is not advisable to provide full automatic differential protection for the whole high tension distributing system. Under Sydney conditions of high temperature of circulating water and therefore comparatively low vacuum, there is no reason why a turbo-alternator to run at 3 000 revs. per min., and rated at from 14 to 16 000 kW, should not be ordered. The armour-clad type of switchgear would be better for Sydney Council's purpose if it was decided to establish a new power house. At present the use of the mercury arc rectifier was not advisable.

Foreign Notes.

From June 17 to June 26 an INDUSTRIAL GOODS FAIR will be arranged by the BUDAPEST Chambers of Commerce and Industry.

The first 100 000 V transmission system in AMERICA dates from the year 1909, and since then about 20 electric supply companies in the UNITED STATES have adopted a transmission voltage of 100 000 or over. Four companies use 100 000 V, two 102 000 V, two 104 000 V, and seven 110 000 V lines, the remainder employing 120 000 to 150 000 V. On the Pacific coast one company is making preparations to introduce 220 000 V in a portion of its area.

The "Times" correspondent at Cairo states that the RUTENBERG CONCESSION has caused considerable indignation in Palestinian and Syrian circles there. The opinion, he says, is freely expressed that the concession, if allowed to stand, would give Mr. Rutenberg and his backers a position of control which would be intolerable; and the Government of Palestine is blamed for its action, which is regarded as being in every respect an abuse of the mandatory powers.

Mr. W. F. Vaughan Scott, who has been Commercial Secretary to H.M. Legation in Santiago, Chile, is in the United Kingdom pending transfer to another post, and will be in attendance at the Department of Overseas Trade (35, Old Queen Street, S.W.1) until June 24. He can be interviewed by firms interested in TRADE WITH CHILE, and he will also (if desired) furnish information concerning trade with Bolivia. After the 24th inst. Mr. Vaughan Scott will visit important industrial centres in the provinces. Applications for interviews should be addressed to the Department (reference 3808/TG/GP).

H.M. Consul-General at New York (Mr. H. Gloster Armstrong) has written to the Department of Overseas Trade calling attention to the facilities now available to representatives of U.K. firms visiting NEW YORK, at the offices of the British Empire Chamber of Commerce (Cunard Building, 25, Broadway). The Chamber has arranged for the formation of a sample room where British commercial travellers can, for a moderate charge, exhibit their goods, take orders, obtain office facilities and clerical assistance, and generally make it their headquarters during their stay in New York. Firms requiring the use of the sample room for their representatives should communicate with the Chamber well in advance. Further particulars can be obtained from the secretary.

Institution Notes.

The annual meeting of the ASSOCIATION OF OFFICERS AND STAFF MEMBERS OF ELECTRICITY (POWER AND SUPPLY) COMPANIES OF GREAT BRITAIN will take place at 8 p.m. on Tuesday next, at Caxton Hall, Westminster.

The Swansea meeting of THE INSTITUTE OF METALS will be held on September 20 to 22 next. Swansea is a metallurgical centre of great importance. Those who are desirous of attending the meeting can obtain membership particulars from the Secretary. An election of members will take place on the 13th prox.

At the last meeting of the DIESEL ENGINE USERS' ASSOCIATION Mr. H. F. P. Purday, B.Sc., A.C.G.I., read a paper on "Marine Diesel Engines." He referred to the main points of difference in the design of marine Diesel engines compared with land engines, and after dealing with the principal types of marine Diesel engines the author dealt with the four-stroke and two-stroke engine and referred to opposed piston two-stroke engines using solid injection and air injection of fuel. He discussed the thermal difficulties of large Diesel engines and pointed out that the trend of modern design seemed to be to eliminate extensive temperature stresses by dividing the castings into smaller pieces having considerable freedom from expansion. He favoured the provision of concave crowns to pistons, as the further the centre of the crown was away from the fuel valve the less heat it would presumably receive. He considered that the Diesel engine must be seriously considered in the near future for propelling large ships.

In the ensuing discussion the view was expressed that further development of the marine Diesel engine was likely to follow along the lines of the double acting two-stroke engine. Further interesting information was given concerning the cylinder construction of the "Still" engine.

A.C. House Meters.

A well designed series of watt-hour meters for alternating current domestic circuits has been put on the market by MEASUREMENT, LTD. These are made in two types, for two and three wire single phase circuits respectively. Both meters are manufactured in sizes up to and including 30 A, and are made throughout in accordance with the B.E.S.A. specification. In addition, the makers call attention to the simplicity of their design and their easy accessibility, while another important point is the light weight of the moving element. Electrically the meter follows the usual lines, and an accuracy within 2½ per cent. from 25 per cent. overload to $\frac{1}{10}$th load at any power factor from unity to 0·5 is claimed. These claims are borne out by test curves.

Telephone and Telegraph Notes.

The BELGIAN TELEPHONE SERVICE, which was of course very much disorganised by the war, last year exceeded the number of subscribers (54 700) existing in 1914 by over 4 000.

Mr. J. Milward, the manager in Australia of the Pacific Cable Board, is at present in London in connection with the proposed scheme for the DUPLICATION OF THE PACIFIC CABLE, and a decision is expected in a few days.

An important fusion of telephone interests has been recently arranged between the L.M. Ericsson General Telephone Co. and the H.T. Cedergren General Industrial Company, manufacturers of telephone wires and cables. This amalgamation has been brought about for the purpose of effecting economies and to increase the competitive value of the Swedish telephone industry.

The telephone and telegraph lines connecting LUNGCHINGTSUN with the neighbouring marts of YENKI and TOWTAOKOW, erected last year by the Japanese military authorities, are now being operated by the Japanese post office. A telephone system is to be established in KAIFENG, Honan; the PEKING Telephone Administration will shortly establish a new south office with facilities for 2 000 additional subscribers. The equipment is being obtained from America.

According to a return which has been prepared for the Postmaster-General, during April last the number of telegrams which passed through the Central Telegraph Office was 3 600 000, the highest figure since July, 1921, when 3 625 143 messages were dealt with, and 660 000 more than in April, 1921. The instances of complaints of delay from all causes during April, 1922, were only eight. The number of telegrams received from subscribers to the telephone system during the financial year was 785 622, an increase of 49 859 over the corresponding period of 1920–21. The number of telegrams delivered by telephone was 663 754, or 2 per cent. less than in the previous year. The number of telegrams which passed through the cable room of the Central Telegraph Office was 9 324 825, as compared with 9 408 297 in 1920–21. This small variation is regarded as not unsatisfactory in view of the trade depression which affects Europe generally. Direct wires are now worked from the London Stock Exchange to Paris and Amsterdam, and have fully justified themselves. There was an increase of 11 per cent., or 1 116 218 words, in the traffic sent by the Imperial Cable, the respective figures for 1920–21 and 1921–22 being 9 885 640 and 10 999 858.

Wireless Notes.

A reduction from 4½d. to 4d. a word is announced in the rate for DEFERRED WIRELESS MESSAGES via Marconi from Great Britain to the Eastern zone of Canada.

The BELGIAN merchant service, which before the war included ten wireless units, now possesses more than 120, which are controlled by the Administration des Télégraphes.

Messrs. Cross Bros., Ltd., have installed a WIRELESS RECEIVING STATION at their premises in St. Mary Street, Cardiff, engaged a wireless engineer and announce daily demonstrations to which the public are invited.

The Central Telegraph Office is now carrying on wireless services to Berlin, Cologne, Posen, Rome, and Egypt. News handed in at that office is broadcasted from the Post Office wireless station at Leafield, near Oxford, and is picked up in India and Australia, except when atmospheric conditions are unfavourable; while a regular wireless news service is carried on with Halifax, Canada.

In his report for 1921 on the economic, commercial and industrial situation of SWEDEN, Mr. H. Kershaw H.M. Commercial Secretary at Stockholm, states that serious attention is being paid to the possibilities of the practical use of the wireless telephone, and during the summer exhibition in Lulea wireless telephone communication was carried on largely between that city and Boden. Experiments were also carried out during the early part of the year with the object of examining the possibilities of the use of high frequency power cables.

Personal and Appointments.

The Albert Medal of the Society of Arts for 1922 has been awarded to SIR DUGALD CLERK, K.B.E., for his important contributions to the development of the internal combustion engine

The marriage took place on June 1, at St. Paul's Church, Halifax, of Mr. Eric N. Johnson, A.M.I.E.E., elder son of Mr. S. C. Johnson, of Manchester, and Miss Lena Barnes, third daughter of Mr. F. J. Barnes, of Luddenden Foot.

The ENGAGEMENT is announced between Norman Felix Herbert Freudenthal, late Grenadier Guards, only son of Mr. and Mrs. J. Freudenthal, Eton Avenue, London, N.W., and Iris Hilda, elder daughter of Mr. and Mrs. M. J. Railing, of "Whiteknights," Reading, and Duke Street, W.

MR. J. H. TAYLOR, assistant engineer, Central Argentine Railway, has been awarded the "George Stephenson" Gold Medal of the Institution of Civil Engineers for his paper on "The Application of Electric Traction to the Suburban Lines of the Central Argentine Railway." Mr. Taylor is also a Miller Prizeman of the Institution.

Miscellaneous.

Cambridge University have gratefully accepted the offer of Sir Ernest Moir, Bt., to endow a PRIZE IN THE ENGINEERING DEPARTMENT in memory of his son Reginald, an engineering student, who was killed in the war.

A Berlin special message to the "Temps" says that following the example of Herr Hugo Stinnes, his rival, DR. RATHENAU, is buying up big industrial concerns in Austria, and has just acquired the large establishments of Woellersdorf.

The 12-cylinder Sunbeam Racer, on which Mr. K. Lee-Guinness surpassed many previous WORLD'S RECORDS AT BROOKLANDS on May 17 and 20, was equipped with B.T.-H. magnetos. A B.T.-H. magneto was also fitted to the Triumph machine on which Mr. W. W. Brandish secured second place in the Senior T.T. race.

We regret that in the Editorial Notes referring to Mr. Mitchell's paper in last week's issue we said that the COAL CONSUMPTION AT THE DALMARNOCK GENERATING STATION was 10.65 lbs. per unit generated. This, of course, should be the steam consumption, the coal consumption given by Mr. Mitchell being 1.98 lbs. per unit delivered.

The result of the ENGINEERS' BALLOT is a majority of 36 000 (nearly two to one) in favour of returning to work at once. Only about one-third of the members voted. The lock-out, which has now been lifted, occurred on March 11. Arrangements have been made for resuming work at once, and some returned on Wednesday. As the Foundry Workers' Union have also accepted the masters' terms, only the Boilermakers remain to be settled with.

During the year 1921 there were 35 132 APPLICATIONS FOR PATENTS, or 1 540 fewer than in 1920, and the complete specifications filed numbered 19 159, (2 637.). The applications from women inventors were 297 (against 311) and those made by way of communication from abroad 1 339 (compared with 1 265). The total receipts were £525 500 (against £487 542), including £445 947 from patent fees, £9 648 from designs, and £47 803 from trade marks fees.

The new WHITE STAR LINER "PITTSBURGH," is interesting because she is propelled by steam generated by oil fuel, but apart from that nearly every other service on the ship is performed by electricity. The electric generating plant is capable of supplying over 1 000 h.p., and upwards of 80 miles of electric cable are used. The steering is by the Wilson-Pirrie electric gear, the boats are lowered electrically; there are seventeen electric winches for cargo handling; the lifts, sounding machines, printing press, bilge pumps, etc., are all operated by electricity. Moreover, the "Pittsburgh" has a very complete electric cooking outfit. Mr. W. J. Willett Bruce, superintendent engineer of the White Star Line, is making the voyage for the purpose of observing the way in which the electrical installation operates.

Business Items, etc.

Mr. W. M. Selvey, consulting engineer, of Sheffield, is opening a London office at 23, Old Queen Street, Westminster, S.W.1, and from July 1 he will reside in London.

An agreement has been concluded between the MINERALS SEPARATION, LTD., of London, and the Electro-Osmose Aktien-Gesellschaft, of Berlin, which includes a mutual exchange of patents.

Messrs. Owen & Palmer have taken over the business of Messrs. H. D. Carter, Ltd. (Bangor), carried on at Faraday House, High Street, Bangor. Mr. Owen was manager for Messrs. Carter and Mr. Palmer has been with Vickers, Ltd., and the General Electric Co.

The board of the INDUSTRIAL PUBLICITY SERVICE has been reconstituted and the following have been appointed directors: W. Rutherford (Chairman), Major J. Proctor Humphris (appointed by the F.B.I.), T. C. Elder (appointed by the B.E.A.M.A.), R. H. W. Hope, M.C. (C.M.A.), and C. J. de B. Sheringham, D.S.O., M.C. (British Engineers' Association).

The SOCIÉTÉ ANONYME FAMA, of Paris, has the exclusive licence under the Riley patents to construct and instal Riley stokers for Great Britain and its Dominions, as well as for France, and a British company will shortly be formed, but meanwhile inquiries for the stokers should be addressed to 64, Mark Lane, London, E.C.3. The company has recently installed the stokers at the Gennevilliers power station of the Union d'Electricité, Paris.

Catalogues, Price Lists, &c.

The monthly magazine and price list of HIGGS BROTHERS for June is, as usual, full of both entertaining and useful information.

The June price list of motors and dynamos manufactured by the A.C.E.C. (ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI) is to hand.

The SWEDISH GENERAL ELECTRIC, LTD., have issued the following new stock lists:—No. 42 F, single-phase a.c. fans; No. 111 d.c. "K" motors, and s.p. Century motors; No. 111a, 3-phase and 2-phase motors, s.p. commutator motors, transformers, etc.

An illustrated leaflet (Supplement 1 to Catalogue 600) is to hand from SIEMENS BROTHERS AND CO., and contains detailed information regarding the primary cells and batteries (dry and fluid) manufactured by the firm for the h.t. circuit of wireless apparatus using thermionic valves.

Tenders Invited and Accepted.

UNITED KINGDOM.

BRIGHTON Guardians. June 20.—Electrical fittings, etc. Tender forms from the Clerk, Mr. H. Burfield, Prince's Street.

WEST DERBY (LIVERPOOL) Guardians. June 20.—Electric lamps. Tender forms from the Clerk, Mr. H. P. Cleaver, Brougham Terrace, Liverpool.

WARRINGTON Guardians. June 20.—Electrical goods for three months. Tender forms from the Clerk, Mr. A. Bottomley, Bewsey Chambers.

SALFORD CORPORATION, July 3.—E.h.t. and l.t. switchgear and transformers. Specifications from Borough Electrical Engineer (Frederick Road), and tenders to Town Clerk, Town Hall, Salford.

KIRKCALDY CORPORATION.—July 10.—Converting plant specifications from Kennedy and Donkin, consulting engineers, 17, Victoria Street, Westminster, S.W.1.

INDIA.

EAST INDIAN RAILWAY. June 21.—Electric overhead travelling cranes. Tenders to the secretary of the company, 28/30, Nicholas Lane, London, E.C.4. Particulars from the Department of Overseas Trade.

EAST INDIAN RAILWAY Co., June 21.—Electric overhead travelling crane. Specification at company's offices, 28-30, Nicholas Lane, London, E.C.

SOUTH AFRICA.

MUNICIPALITY OF ROBERTSON. August 14*.—Supply, delivery and erection (optional) of *two 75 kW steam sets and equipment for power station (Contract No. 1); one 300 A.h. battery (Contract No. 2); material for the outside distribution system (Contract No. 3).

CHILE.

CHILEAN STATE RAILWAYS. July 11.—Structural steel for repairing bridges; insulated copper cable for welding purposes, 440 V.

CANTERBURY City Council has accepted the tender of Meldrum, Ltd., for a dust destructor at £1 395.

BRAY (Co. Wicklow) Urban Council have accepted the tender of Mirrlees, Bickerton and Day for a Diesel engine and alternator at £5 233.

YORK Corporation have accepted the tender of the British Thomson-Houston Co. for a rotary converter, switchgear, etc., at £2 753.

BLACKPOOL Gas Committee have accepted the tender of Mr. Thomas Barton for the supply of electricity controlling gear at the gas works.

BARROW Corporation have accepted the tender of Johnson and Phillips for e.h.t. and h.t. transmission lines to Rampside and Roa Island at £2 816 3s. 7d.

NAVAN Council have accepted the tenders of Hay, Maryon and Co. for turbines, at £2 983, plus £280 for erection; and British Mannesmann Tube Co. for 120 poles, £616.

HALIFAX Corporation are recommended to accept the tenders of the British Thomson-Houston Co. for feeder equipment and control panel, £945; and A. Reynolle and Co. for nine e.h.t. switch panels, £3 100.

LIVERPOOL Corporation have been recommended to accept the tender of R. Dempster and Sons for ash conveyor and accessories and coal-handling plant at Lister Drive, No. 2 power station; British Insulated and Helsby Cables, for 33 000 V main; and A. E. and T. H. Chesters for wiring 24 houses.

STEPNEY Borough Council have accepted the following tenders:—RANSOMES AND NAPIER (lowest tender received), a 50-ton electrically driven overhead travelling crane at Limehouse generating station; the provision of spare parts and accessories and the dismantling of the existing 20-ton hand-operated crane and its re-erection at Mile End sub-station, £3 455. Eighteen tenders were received, the highest being that of Isles, Ltd., £6 200. PERRY AND CO. (BOW), LTD., circulating water pipes at Limehouse, £2 134; GENERAL ELECTRIC CO., three motor converters, £10 114; E. AND F. WRIGHT, cast iron pavement boxes, frames and covers, £60 6s. 7d.; SUTTON AND CO. (OVERSEAL), LTD., troughs and covers, £452 9s. 8d.

The MADRAS GOVERNMENT have ordered from the Marconi Co. seven sets of wireless apparatus for erection in the MOPLAH country. One will be set up at the headquarters at Malapuram, and the others at the various auxiliary police posts.

H.M. Chargé d'Affaires at Havana has prepared a report on the market for wire and wire products in CUBA, which can be seen at the Department of Overseas Trade. A recent catalogue of an American wire company, who have secured a large proportion of the Cuban trade in wire and wire products, can also be inspected at the Department, as well as samples of certain goods referred to in the report.

Companies' Meetings, Reports, etc.

Great Northern Telegraph Company.

The report of the directors for the year 1921 states that the company succeeded in repairing two of the three cables (one Anglo-Danish and one Franco-Danish) which were difficult to repair on account of mines, but it has not yet been possible to repair the Petrograd-Libau cable. The Russian Government is, however, taking the necessary steps to clear the mines from the area where the cable is broken, and there are, consequently, good prospects of the cable being repaired this summer. Besides these repairs, the company has had to deal with 21 interruptions on 8 cables in Europe, and 12 interruptions on 5 cables in the Far East. The c.s. "H. C. Orsted" has been occupied in European waters for 253 days, of which 12 have been for the account of other administrations, whilst in the Far East the "Store Nordiske" and "Pacific" have been in commission for 191 days, including 120 days on charter by other administrations.

Communication with the Far East.

Both the Russian Government and the company have done everything in their power to re-establish telegraphic communication between Europe and the Far East *via* Siberia. Whilst the lines through Russia and Siberia are maintained in good condition by the Russian Government, it is impossible to establish communication between the Russian telegraph system and the cables and landlines in the Far East, either *via* Wladiwostock or *via* Kiachta, owing to the total interruption of both routes. The restoration of the Wladiwostock route is hindered by the state of war between the Governments of Tchita and Wladiwostock, whilst the restoration of the Kiachta route is dependent upon the Governments of Peking and Urga succeeding in arriving at an agreement. Under the circumstances, the company has had to fall back upon another scheme which became possible of realisation, thanks to the facilities granted by the Russian and Chinese Governments, resulting in the establishment of a quite new route by means of a wire placed at the exclusive disposal of the company by the two administrations between Irkutsk and Peking, *via* Blagowestschensk—Helampo—Harbin, and worked in connection with the company's direct wire between Petrograd and Irkutsk. A repeater station, equipped by the company and manned by Danish operators, has been established at Harbin. Communication was thus re-established on March 26 last after an interruption of nearly four years.

The company's negotiations with Russia, mentioned in last year's report, have been brought to a successful issue, and in the course of the summer an agreement, covering a long term of years, was signed whereby the company is enabled to renew its former activities in Russia. Although the preparations for reopening the company's telegraph office at Petrograd proved very difficult, as well as long and costly, the company was, nevertheless, able to re-establish telegraphic communication with Petrograd on January 18, 1922. The concession granted by the Government binds the company to open a telegraph station at Moscow, thereby placing the Russian capital in direct telegraphic communication with the company's European system. Various causes have, however, hitherto prevented the carrying into effect of this undertaking. The Russian terminal traffic exchanged with Western Europe and America is, so far, quite inconsiderable compared with the corresponding traffic in pre-war times.

Concessions and Year's Working.

Negotiations with England and Sweden in connection with a prolongation of the company's concessions have been carried on during the year, but have not yet been brought to a final conclusion. Preliminary discussions with the Chinese Government were commenced last year by the company, in conjunction with the Eastern Extension Australasia and China Telegraph Co., with the object of obtaining a prolongation of the existing agreements between China and the two companies. Owing, however, to the decision come to by the International Conference in Washington to include the question of telegraph communication in China amongst the items for discussion there, it became necessary to suspend temporarily the companies' own negotiations in Peking. A new cable steamer destined to replace the "Store Nordiske" is being built at a Danish shipyard. The company's new building at Shanghai and the dwellings for the staff at Peking were completed during the year. The directors record with regret the death of the honorary Chairman (Commodore E. Suenson), for so long associated with the company.

In spite of the fact that the net profit is about 32 per cent. less than the previous year, and that the traffic as a whole does not as yet show any tendency to increase, the directors consider themselves justified in recommending a total dividend and bonus of 22 per cent., a decrease of only 2 per cent. compared with last year. The reserve fund will be credited with the usual amount (£33 333), whilst it is proposed to contribute £55 555 to the pension fund of the staff, and to carry forward about the same amount as the previous year. The traffic receipts, etc., are about £533 670 less than the previous year, mainly due to the loss on exchange showing a drop of about £395 700. The decrease in traffic receipts is partly counterbalanced by a reduction under expenditure of about £331 625. The latter decrease is mainly accounted for by only £116 980 having been taken to meet the payment of taxes, against £416 666. The actual working expenses show a decrease of about £32 000 only.

Aluminium Corporation.

Addressing the shareholders at the annual meeting of the Aluminium Corporation, Ltd., last week, Mr. Kenneth M. Clark (the chairman), who presided, said that the accounts submitted covered a period of two years. The gross profit for the two years amounted to £87 434, or an average of just over £43 000 per annum. The net balance of profit and loss account, after paying the preference dividend for 1920, amounted to £25 150, and this enabled the directors to recommend payment of the 7 per cent. preference dividend for the past year, leaving a balance of £13 261 10s. to be carried forward to next year's accounts. A sum of £321 421 had been expended during the past two years on constructional work. The depreciation reserve now amounted to £26 000. Shares and loans in subsidiary companies stood at £102 957. Stocks of metal, raw material, etc., showed an increase of £43 775, which was not abnormal, and sundry debtors were up about £27 000. Cash at bank and in hand amounted to £7 443. The accounts did not include any returns from the very heavy expenditure incurred during the last five years in the construction of the dams at Cowlyd and Llugwy.

The great difficulty in the development of water power was the time required to make the necessary reservoirs and to negotiate the various rights. He was glad to say that the whole rights had now been acquired; the dams had been completed, and the work of constructing the canal connecting the two lakes was in active progress, and should be completed within three months. Once this was carried through they would have a greatly increased supply of electrical energy at their disposal, both for the supply to the power company and for the manufacture of aluminium. During the whole period of depression they had been able to obtain sufficient orders to keep the rolling mill in continuous operation. An extraordinary general meeting of the company had been called to follow this meeting for the purpose of increasing the directors' borrowing powers. If this resolution was agreed to the directors proposed to increase the capacity of the rolling mill, to instal a second and larger pipe line with pen stock reservoir, and to erect a new power house with the necessary machinery. This would enable them to utilise a considerable amount of water power at present partly developed, and was called for by the business they were able to do in aluminium sheet and by the demands that would be made upon them for energy by the North Wales Power Co.

At the meeting which was afterwards held, the directors were empowered to borrow for the purposes of the company (in addition to the amount authorised by clause 83 of the articles of association, and the extraordinary resolution passed December 13, 1920) sums not exceeding in the aggregate £500 000.

The directors of the Electrical Apparatus Co., Ltd., invite applications for 50 000 8 per cent. cumulative preference shares at par. The lists close on or before the 17th inst.

A petition for confirming the proposed reduction of the capital of the British Power Railway Signal Co., Ltd., and reduced from £50 000 to £25 000, will be heard by Mr. Justice Astbury on June 27.

The net profit of Doulton and Co. for 1921, after providing for depreciation, was £75 568, making available with £54 251 brought forward £129 820. A dividend of 5 per cent. has been declared, carrying £53 243 forward.

The transfer books of the Automatic Telephone Manufacturing Company will be closed from the 17th to the 24th inst. for preparing the dividend warrants on the preference shares for the half-year ending the 30th inst., when the warrants will be posted.

The directors of the Yorkshire (West Riding) Electric Tramways Company have decided to pay on July 1 an interim dividend of 3 per cent. (being at rate of 6 per cent. per annum) on the 6 per cent. cumulative preference shares for the half-year ending June 30.

The net profit of the British Electric Traction Co. for the past year amounted to £218 494, plus £177 319 brought forward. A dividend on the ordinary shares of 4 per cent. is proposed, placing £14 677 to reserve, and carrying forward £194 238, subject to corporation tax for three years.

The Stock Exchange have allowed dealings in £94 200 6½ per cent. cumulative "A" preference, and £177 100 7½ per cent. cumulative "B" preference shares of the General Electric Co. This represents the whole of the unissued balance of the "A" and "B" preference capital.

At the annual meeting of the Penarth Electric Lighting Company last week, the chairman, Mr. Geo. J. Somerville, presided. The report and the accounts were adopted, and dividends of 7 per cent. on the preference shares and of 7½ per cent. on the ordinary shares were agreed to, leaving £2 532 17s. 7d. to be carried forward.

At the ordinary general meeting of the Merthyr Electric Traction and Lighting Company on the 8th inst., it was reported that the available balance for the past year was £6 432. A sum of £1 200 was placed to reserve, and dividends of five per cent. on the preference and six per cent. on the ordinary shares were declared, £1 332 being carried forward.

The profit of the Chloride Electrical Storage Co. for the year to March 31, 1922, after providing for depreciation and taxation, was £73 968, plus £23 340 brought in. The directors recommend a further dividend of 5 per cent. on the ordinary shares, making 10 per cent. free of tax, placing £20 000 to employees' benefit fund, £20 000 to reserve (making it £60 000), carrying forward £31 613.

The directors of the Brazilian Traction Light and Power Company have decided that, although the exchange value of the milreis continues considerably lower than was generally anticipated, there are clear indications of such improvement in general conditions as to justify the resumption of the payment of dividends on the ordinary shares. The Board have accordingly declared a dividend of 1 per cent. on the ordinary capital, payable September 1 next. The last ordinary dividend was paid in 1917.

The net receipts of the Pernambuco Tramways and Power Co. for 1921 totalled £69 731, plus £18 373 brought in. After providing for interest, reserve, amortisation fund, etc., £1 107 remains to be carried forward. The directors regret it was not possible to pay any dividend on the preference or ordinary shares. The reduction in the net revenue was entirely due to the fall in Brazilian exchange. If exchange had remained the same as in the preceding year, net results would have shown an improvement over the previous year.

The accounts of Ransomes, Sims and Jefferies (associated with Ruston and Hornsby) for the year ended March 31, 1922, after making provision for depreciation and bad and doubtful debts, more particularly those debts affected by the war, also after deducting interest on debenture stock and deposits, show profit of £3 997, against £15 457 for the previous year. The dividend on the preference shares to June 30, 1921, absorbs £2 750, leaving with £40 811 brought forward, £42 058. Owing to the continued adverse trade conditions the fall in selling values and the necessity for conserving the resources, the directors regret that they are unable to recommend any dividend on the ordinary shares for the year or on the preference shares for the half-year to December 31, 1921.

The report of Ruston and Hornsby, Ltd., for the year ended March 31 last shows a balance on profit and loss account of £101 637, which, after allowing for depreciation £55 952, and interest on debentures £25 500, leaves a balance of £20 185. This, with the balance from last year of £43 920, makes a total of £64 105, from which is deducted the preference dividend paid last July, leaving a net balance of £58 230. The directors "regret that owing to the continued trade depression and the serious fall in stock values, it is essential that the whole of the above balance should be retained in the business, and in addition they thought it wise to transfer £100 000 from the general reserve to meet a possible further fall in the values of stock-in-trade. Under the circumstances they do not recommend the payment of the outstanding dividend on the preference shares, or a dividend on the ordinary shares for the past year." For the year ended March 31, 1921, there was a profit of £108 683, but no ordinary dividend was paid. For the previous year 5 per cent. was paid on a profit of £165 397.

The gross earnings of the United River Plate Telephone Company for the year 1921 were £1 161 848, and the maintenance and other charges in Argentina and London were £981 411, leaving a profit of £180 438. Deducting interest on debenture stock, dividend on preference shares to December 31, 1921, and the interim dividend on the ordinary shares (£72 100), and adding amount brought forward (£38 367), the available balance is £146 705. The directors recommend payment of a final dividend of 5 per cent. on 324 000 ordinary shares, making, with the interim dividend, a total of 8 per cent. for the year, tax free (£81 000), and a dividend of 5 per cent. on 108 000 ordinary shares, tax free (£27 000), the balance to be carried forward being £38 705. Progress has been made during the past year, but although a record number of subscribers have been connected, many thousands of applicants are still awaiting service. The automatic plant in course of erection will relieve the position somewhat, but it is hoped the Government will shortly realise that the large amount of capital needed to meet the additional telephonic requirements of the country cannot be raised until the increase in the tariffs petitioned for in 1919 is granted.

The net revenue of the Globe Telegraph and Trust Company for the year ended May 31, after deduction of expenses, amounts to £330 146, and, with £2 181 brought forward, the total is £332 327. From this amount £233 605 has been distributed in interim dividends, leaving £98 722. The directors now recommend payment of the following final dividends—viz., 3s. per share (less tax) on the preference shares, making, with previous distributions, a total dividend for the year on those shares at rate of 6 per cent. per annum (less tax); and 5s. per share net on the ordinary shares, making, with previous distributions, a total dividend on those shares at rate of 10 per cent. net for the year. These dividends will absorb £77 868, leaving £20 853 14s. 8d. to be carried forward. During the year under review fifty-three certificates of the Submarine Cables Trust belonging to the Globe Company were drawn and paid off at £120 per certificate. The proceeds have been reinvested in Eastern Telegraph Company's ordinary stock and Eastern Extension and Western Telegraph Companies' shares. The articles of association, which date back to the incorporation of the company in 1873, are now out of print, and, as they are in many respects obsolete, new articles will be submitted for approval at an extraordinary general meeting which will be held after the annual meeting.

New Companies.

Commercial Engineering Co.

COMMERCIAL ENGINEERING CO., LTD. (182 117.)—Private company. Reg. May 29. Capital, £2 000 in £1 shares. Electrical, automobile and general engineers, etc. Subscribers: J. McNaughton and F. C. Farthing. Solicitors: Nash, Field and Co., 12, Queen Street, Cheapside, E.C.

Summit Electrical Co.

SUMMIT ELECTRICAL CO., LTD. (182 383).—Private company. Reg. June 9. Capital, £100 in £1 shares. Electrical engineers, manufacturers of, dealers in and agents for all kinds of general electrical supplies, motor cars and parts, etc. Reg. office: 11, Bucknall Street, Bloomsbury, W.C.2.

John M. Boyd.

JOHN M. BOYD, LTD. (12 249).—Private company. Reg. in Edinburgh June 6. Capital, £5 000 in £1 shares. General, electrical, and motor engineers, etc. Directors are: J. M. Boyd and J. B. Andrews. Secretary: David R. Galloway. Reg. office: Ballochmill Road, Eastfield, Rutherglen.

Ledger Taylor & Co.

LEDGER TAYLOR AND CO., LTD. (182 263.)—Private company. Reg. June 2. Capital, £3 000 in £1 shares. Electrical, hydraulic engineers and contractors, etc. First directors: R. W. Taylor and Mary J. Taylor. Secretary: F. Boothby. Reg. office: Moorgate Ironworks, Moorgate, East Retford.

Building and Insulating Material Co.

BUILDING AND INSULATING MATERIAL CO., LTD. (182 210.) Private company. Reg. June 1. Capital, £5 000 in £1 shares. Builders and contractors, etc., electrical engineers and contractors, suppliers of electricity. Subscribers: S. G. Robinson and O. V. Monk. Reg. office: 20, Essex Street, Strand, W.C.

Arco Institute, Ltd.

ARCO INSTITUTE, LTD.—(182 285.)—Private company. Reg. June 6. Capital, £100 in £1 shares. To adopt an agreement with A. Rosenberg and to carry on the business of electro-therapy, electro-medical treatment, etc. Directors are: H. J. Munro and A. Rosenberg. Reg. office, 3, London Wall Buildings, E.C.2.

Abrey and Gerratt.

ABREY AND GERRATT, LTD. (182 355).—Private company. Reg. June 8. Capital, £2 000 in £1 shares. Mechanical, electrical heating and ventilating engineers, contractors, manufacturers, sheet metal workers, exporters, etc. Permanent directors are: H. S. Abrey and W. Gerratt. Reg. office: Wexham Road, Slough, Bucks.

World's Electric Co.

WORLD'S ELECTRIC CO., LTD. (182 283.)—Private company. Reg. June 2. Capital, £1 000 in 1s. shares. Manufacturers of and dealers in electrical accessories, appliances, lamps, apparatus, plant and machinery, contractors, etc. First directors: A. Richmond, J. W. Conrad and W. F. Pearce. Reg. office: 1, Gresham Buildings, E.C.2.

Johnson Radio Co.

JOHNSON RADIO CO., LTD. (182 326).—Private company. Reg. June 7. Capital, £100 in £1 shares. Engineers, manufacturers of and dealers in ordinary and wireless telegraphic and telephonic apparatus and accessories, electrical apparatus, etc. Directors are: H. M. Smith and S. Tootill. Secretary (*pro tem*): H. G. Goodsman. Reg. office: 244, Tottenham Court Road, W.C.

V. P. & G. Hastings.

V. P. AND G. HASTINGS, LTD. (182 307.)—Private company Reg. June 6. Capital, £5 000 in £1 shares. Engineers, manufacturers of machinery, tool makers, founders, metal workers, electrical engineers, manufacturers of and dealers in automobiles, etc. Permanent directors are: V. P. Hastings and G. S. Hastings, Reg. office, Duchy Chambers, Clarence Street, Manchester.

New Electric Sign Co.

NEW ELECTRIC SIGN CO., LTD. (182 266.)—Private company. Reg. June 2. Capital, £2 500 in £1 shares (1 000 preference). To take over the business of an electric sign manufacturer and agent carried on by A. E. Davis as the "New Electric Sign Co.," at 53, Haymarket, S.W. First directors: A. E. Davis and J. H. Slingsby. Secretary: S. H. Grant. Reg. office: 53, Haymarket, Westminster, S.W.

W. Blackburn (Kew).

W. BLACKBURN (KEW), LTD. (182 280.)—Private company. Reg. June 2. Capital, £1 000 in £1 shares (800 8 per cent. cumulative preference). Electrical, mechanical, motor, and general engineers and contractors, manufacturers of and dealers in transformers, radiators, dynamos, motors, and all kinds of electric lighting, power and transmission plant, etc. Solicitors: T. E. Godbold, 529, High Road, Chiswick, W.4.

Chimes, Ltd.

CHIMES, LTD. (182 289).—Private company. Reg. June 6. Capital, £500 in £1 shares (400 "A" ordinary and 100 "B" ordinary). To adopt agreement with W. A. Greening, W. A. Rowe, and W. E. Schall and to develop and turn to account patent No. 171 835 for the manufacture of apparatus for the electrical chiming of church bells. Permanent directors are: W. E. Schall and W. A. Greening. Secretary, E. Dunkel. Reg. office, 71–75, New Cavendish Street, W.

Radio Instruments.

RADIO INSTRUMENTS, LTD. (182 272.)—Private company. Reg. June 2. Capital, £10 000 in 7 500 8 per cent. cumulative preference shares of £1 each and 50 000 ordinary shares of 1s. each. Electrical, mechanical and general engineers and contractors, manufacturers and sellers of transformers, radiators, dynamos, motors and radio instruments of all kinds, and electric lighting power and transmission plant and wireless apparatus, etc. Permanent directors: J. Joseph and W. A. Appleton. Reg. office: 18A, Hyde Street, Oxford Street, W.

A. Adams & Co.

A. ADAMS AND CO., LTD. (182 208.)—Private company. Reg. June 1. Capital, £9 000 in £1 shares. To acquire the business, and all or any of the assets and liabilities in connection therewith, carried on by B. Foulkes Winks at 24, Charing Cross Road, W.C., as Adams and Co., and to adopt agreements with the said vendor and C. J. Bannister and to carry on the business of manufacturers of electrical and scientific apparatus, and electrical, mechanical or scientific instruments, etc. First directors: B. Foulkes Winks, C. J. Bannister, and Miss M. A. Foulkes Winks. Reg. office: 24, Charing Cross Road, W.C.

The "Falco" Breakfast Cooker.

The "Falco" electric breakfast cooker has just been placed on the market by the FALKIRK IRON COMPANY. It is substantially constructed of fine cast iron, with a bright top table and adjustable strip tin and grid. The inside measurements are 10½ in. wide by 9 in. deep by 5¾ in. high. The top table measures 12½ in. by 10½ in.,

"FALCO" ELECTRIC BREAKFAST COOKER.

and is fitted with a grid covering the grilling element, which also acts as a boiling plate. An asbestos mat is also supplied to lay on the grid when grilling only The cooker is fitted with an easily accessible, open coil heating element protected by a wire guard and controlled by a three-heat switch.

The Multiversal Test Set.

A booklet recently issued by ELLIOT BROS. (London), Ltd., contains full details of their "Multiversal" test set, an instrument which recalls the many happy days we once spent in company with their "Century" standard test set. The Multiversal test set was, it will be remembered, originally designed to give the mains engineer a testing set as accurate and practical as the meter engineer or consultant found the Century set. As time has gone on, however, the scope of the original set has been enlarged and it now covers practically the whole field of direct current testing.

The test set comprises a sensitive pivoted moving coil galvanometer with specially arranged constant resistance shunts for varying the sensibility, together with a number of coils giving from 0 to 110 Ω by steps of 1 Ω (an infinity step is also provided), coupled up in conjunction with two ratio arms to form a Wheatstone Bridge. Each ratio arm consists of four coils of 1 000, 100, 10, 1 Ω, respectively, together with a special stud for use in fault localising by the Murray loop test.

A self-contained standard resistance of 100 000 Ω and a three-way switch is provided for taking the "constant" of the galvanometer and making insulation tests. By means of a constant resistance universal shunt five sensibilities can be given to the galvanometer. An enclosed key is fitted in the insulation portion of the apparatus, and a double successive key, that breaks both galvanometer and battery circuits, in the bridge part. The galvanometer is provided with external zero adjuster, and knife edge pointer and mirror scale for taking accurate readings.

An impressive series of tests can be made with the instrument, the range of voltages being from 0·75 millivolt to 1 200 V, and the current from the microampere up to any magnitude by means of external standard resistances or shunts, the instrument being direct reading in all cases. Insulation resistances and conductor resistances over wide ranges; fault localisation and capacities can also be measured.

The whole equipment is mounted on ebonite in a varnished teak case with carrying handle, and a 3-foot tripod is provided on to which the set can be screwed when in use.

COMMERCIAL INTELLIGENCE.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

ARROTA ELECTRICAL & MOTOR ACCESSORIES CO., LTD., Charles Street, Louth, electrical engineers. £20 6s. 6d. March 30.

BARTLE, Charles H., 1, Mount Parade, Harrogate, electrician. £14 6s. 6d. March 31.

BURGE, A., & CO., 300, Garratt Lane, Earlsfield, electrical engineers. £16 5s. 3d. April 6.

GAUNT & CO., Cambridge Place, Paddington, electrical engineers. £17 9s. 3d. April 11.

JEFFERYS, Arthur Neast, 8, Denman Place, Denman Street, W., electrical engineer. £48 12s. 4d. April 7.

SHEPHERD, Mr. F., 7, Hamsell Road, E.C., electrical factor. £13 6s. 5d. April 1.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

ARROTA ELECTRICAL AND MOTOR ACCESSORIES CO., LTD., Louth. Registered May 29, £15,000 debentures; charged on Great Northern Mills, Louth, also general charge. *Nil. August 23, 1921.

BRITISH DRIVER-HARRIS CO., LTD. (late DRIVER DRENNAN AND COOPER, LTD.), Manchester, cable manufacturers, &c.—Registered June 1, £14,500 mortgage. *Nil. November 8, 1921.

BUCKLEY, SAUNDERS AND CO., LTD. (late NATIONAL ELECTRIC WELDING CO., LTD.), London, S.W.—Registered May 30, £4,000 debentures, present issue £2,000; general charge. *£700. December 31, 1921.

HACKBRIDGE ELECTRIC CONSTRUCTION CO., LTD.—Registered May 31, £10,000 mortgage to A. I. Drapkin, 33, Highbury Place, N. *Nil. July 2, 1921.

MIDLAND ELECTRIC LIGHT AND POWER CO., LTD., London, E.C.—Registered June 2, £10,000 debentures, balance of £30,000; general charge. *£20,000. March 4, 1921.

SAUNDERS ELECTRICAL CO., LTD., Coventry.—Registered May 30, £1,000 debenture, to G. E. Stanley, 23A Coundon Road, Coventry, engineer and another. *£1,500. October 27, 1921.

WATFORD ELECTRIC AND MANUFACTURING CO., LTD. (late THOMAS KESNOR & CO., LTD.).—Registered May 26, conveyance supplemental to and giving further security for the moneys secured by mortgage dated November 16, 1920, and transfer of mortgage dated November 16, 1921, securing £5 000, to J. Fletcher, Carnarvon, slate manufacturer. *£5 400. August 29, 1921.

Satisfaction.

CHAGFORD AND DEVON ELECTRIC LIGHT CO., LTD.—Satisfaction registered June 7, £2,925, total amount issued of debentures registered March 1, 1911.

Private Meetings, etc.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

PATTISON, W., asbestos-cement manufacturer, etc., Widnes. The committee of inspection which was appointed at a meeting of the principal creditors, has deferred calling the general body of creditors together to enable Mr. Pattison to come to some satisfactory terms with parties who had made tentative offers to work his processes. Mr. Pattison has reported that arrangements are now almost completed for the working of his processes which he hopes will prove satisfactory, in which event he will at once put before his creditors a scheme whereby their claims may be satisfied. The committee have no alternative scheme to recommend and suggest giving the debtor a further six months' grace, when he should call the creditors together again, whether his expectations have materialised or not, or earlier, if he has been successful, and has the details of a satisfactory scheme worked out for their discussion and acceptance.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Companies Winding-up Voluntarily.

DOYLE, Herbert, trading as ACCESSORIES SUPPLY CO., 56, Hardman Street, Deansgate, Manchester, factor in electrical accessories. Amount per £, 9s. 1d. First and final. Payable, June 21, Official Receiver's Offices, Byrom Street, Manchester.

KEYNSHAM ELECTRIC LIGHT AND POWER CO., LTD.—A. Collins, 28, Baldwin Street, Bristol, appointed liquidator.

RICKARD, WRIGHT AND DEAN, LTD.—R. S. Dawson, Tanfield Buildings, Hustlergate, Bradford, appointed liquidator. Meeting of creditors at Tanfield Buildings, Bradford, Tuesday, June 27, at 3 p.m.

Bankruptcy Information.

COATON, Thomas Green, 16, Humberstone Road, Leicester, under the style of T. G. COATON & CO., electrical engineer. First meeting, June 16, 3 p.m., 1, Berridge Street, Leicester. Public examination, July 7, 11 a.m., The Castle, Leicester.

HOGG, George James (trading as F. HOGG & CO.), 66, Waterloo Road, Smethwick, Stafford, electrical engineer. Receiving order, June 2. Debtor's petition.

Partnerships Dissolved.

BARNET, Bernard, HELLER, Myer, and LEDERMAN, Raphael, 104, Whitechapel Road, E., and 17, Maddox Street, E., under the style of THE REGENT ELECTRICAL INSTALLATION CO., by an Order of the High Court of Justice, July 29, 1921. Particulars of claims by June 15 to the Receiver, A. C. Heyward, 14-15, Coleman Street, E.C.

Bankruptcy Proceedings.

CLAYTON, Aubrey Victor, trading as CLAYTON MOTORS, Park Lane Mills, Chorley Lane, Leeds, engineer. In this matter the following are creditors:—Coquantin, M., London, £27; Electrical Apparatus, Ltd., London, £383; English, A., Leeds, £18; General Electric Co., Ltd., Leeds, £16; London Electric Wire Co. & Smiths, Ltd., London, £28; Mica & Micanite Supplies, Ltd., London, £15; Rhodes Gill & Co., Leeds, £28; Sankey, Joseph, & Sons, Ltd., Bilston, £1 493; Vono Co., Port Dudley, £470; Whitehead Bros., Farsley, £23; New Felaphone Engine Co., Ltd., Leeds, £148; Spencer, P., Bedford, £1 302; Elvey Robb & Welch, London, £275.

COATON, Thomas Green, trading as T. G. COATON AND CO., 16, Humberstone Road, Leicester, electrical engineer. The receiving order was made on May 29 on debtor's own petition. Statement of affairs shows liabilities £2 331, net assets estimated to realise £1 022, deficiency £1 309. Debtor attributes his failure to bad trade for the past two years owing to general slump, bad debts, depreciation in value of machinery and stock in trade, and ill-health of children. A private meeting of creditors was held on March 31 last, when it was decided to accept a composition of 10s. in the £ payable by instalments, satisfactorily guaranteed. For the protection of the estate, debtor executed a deed of assignment. He was unable to carry the proposed composition into effect and consequently filed his petition. Debtor states that in April, 1914, he and his brother entered into partnership and commenced business in Leicester as electrical engineers with a combined capital of £250, of which he contributed £50. In 1918 they were joined by another partner who provided £100 capital. In the same year debtor's brother retired from the business, and in August, 1919, his other partner also withdrew. The usual books of account have been kept. Debtor became aware of his position early in the present year.

KEENAN, John Norman, 63, Queen Victoria Street, E.C. The first meeting of creditors under a receiving order made against the debtor on May 24 was held last Friday. It appears that he is an electrical and rubber engineer, and has recently been trying to induce friends to form a company with the idea of manufacturing ebonite. He came to England from the U.S.A. in 1915. He has been obliged to obtain loans from moneylenders and as a result now owes £150. He says that he possesses no assets and he attributes his failure to his inability to obtain employment. The debtor consented to being adjudged a bankrupt and his affairs remained in the hands of the Official Receiver.

Arrangements for the Week.

TUESDAY, JUNE 20th.

INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

9.0 *a.m. to* 9.45 *a.m.* Assembly at Grand Theatre, Lichfield Street, Wolverhampton.

10 *a.m.* At the Grand Theatre, Wolverhampton. Opening of the Convention. Welcome by the Mayor; Presidential address by Mr. S. T. Allen, chief engineer and general manager of the Wolverhampton Electricity Supply Department; paper on "The Extension of the Uses of Electricity for Domestic Purposes," by Lieut.-Col. W. A. Vignoles, borough electrical engineer, Grimsby.

1 *p.m.* Luncheon at the Royal Artillery Headquarters, West Park, Newhampton Road, Wolverhampton.

2.30 *p.m.* Visit to Apley Terrace on the River Severn.

8.30 *p.m.* Reception by the Mayoress at the Art Gallery, Lichfield Street, Wolverhampton.

WEDNESDAY, JUNE 21st.

9 *a.m.* Members residing in Birmingham assemble outside the Queen's Hotel (New Street Station), where the conveyances for Stoke-on-Trent will be in readiness; members residing in Wolverhampton assemble at St. Peter's Steps.

11 *a.m.* In the Assembly Room, Town Hall, Stoke-on-Trent. Paper: "The Administration and Control of Electricity Departments," by Mr. E. Calvert, chief electrical engineer, Finchley. (A visit to Pottery Works will be arranged for any of the ladies or others who do not attend the reading of the paper. Conveyances will be in attendance at 11.15 a.m.)

1 *p.m.* Luncheon to members, delegates, and visitors, by the Stoke-on-Trent Electricity Committee, in the King's Hall, Town Hall.

2.15 *p.m.* Visit to: (1) Central Power Station; or (2) Main Electricity Sub-Stations of the Stoke-on-Trent Corporation; (3) Pottery Works*; or (4) Trentham Gardens direct.

4 *p.m.* Assemble at Trentham Gardens, where facilities for tennis and boating are available.

5.30 *p.m.* Conveyances will leave the Gardens for Wolverhampton and Birmingham.

* The following firms have arranged to conduct parties of members through their works:—Pottery Works—Cauldon Potteries, W. T. Copeland and Sons, Doulton and Co., Ltd., Mintons, Ltd., Josiah Wedgwood and Sons, Ltd.; Engineering Works—The Boving Engineering Works, Cowlishaw, Walker and Co. (1920), Ltd., Kerr Stuart and Co., The North Staffordshire Railway, The Potteries Electric Traction Co.

THURSDAY, JUNE 22nd.

9 *a.m.* Members residing in Wolverhampton should assemble at St. Peter's Steps, where the conveyances for the General Electric Company's Works, Witton, Birmingham, will be in readiness.

9.40 *a.m.* Members residing in Birmingham should assemble outside the Queen's Hotel (New Street Station).

10 *a.m.* In the Main Hall, Magnet Club, Witton. Paper: "Sub-Station Equipment, including Automatic Control," by Mr. R. A. Chattock, city electrical engineer, Birmingham.

11.30 *a.m.* Tour round the various branches of the Witton Works.

(The General Electric Co. have placed their club house, with recreation rooms and grounds, at the disposal of members. An exhibition of domestic and other electrical labour-saving appliances will also be held during the visit).

1.30 *p.m.* Luncheon at the Magnet Club.

2.30 *p.m. prompt.* Visit to Nechells Power Station of the Birmingham Corporation.

3.45 *p.m.* Conveyances will leave Nechells Power Station for the Botanical Gardens, where members will be received and entertained by the Rt. Hon. the Lord Mayor of Birmingham.

5.30 *p.m. prompt.* Leave Garden Party.

7.45 *p.m. for* 8 *p.m.* Annual dinner (evening dress), in the Royal Field Artillery Headquarters, West Park, Newhampton Road, Wolverhampton.

FRIDAY, JUNE 23rd.

9.30 *a.m.* Meeting of the Council in the Grand Theatre, Wolverhampton.

10.30 *a.m.* Annual general meeting in the Grand Theatre, Wolverhampton.

Afternoon. Visit to Wolverhampton Corporation Electricity Generating Station, Commercial Road, when the President (Mr. S. T. Allen) will personally welcome members.

WEDNESDAY, JUNE 21st.

INSTITUTION OF RAILWAY SIGNAL ENGINEERS.

3 *p.m.* At the Institution of Electrical Engineers, Victoria Embankment, London, W.C.2. Papers entitled "Light Signals," by Mr. H. E. Fawkes and Mr. W. J. Sadler.

FRIDAY, JUNE 23rd.

PHYSICAL SOCIETY OF LONDON.

5 *p.m.* At the Imperial College of Science, South Kensington, London.

1. "An Experiment on Molecular Gyrostatic Action," by Mr. J. W. Fisher, B.Sc.
2. "On the Viscous Properties and Molecular Dimensions of Silicane," by Prof. A. O. Rankine, D.Sc., and Mr. C. J. Smith, B.Sc.
3. "The Pressure-Gradient in Liquids Flowing through Cones," by Mr. W. N. Bond, M.Sc.
4. Demonstration of "A Mercury-Drop Method of Producing Visual Effects by Means of Sound," by Dr. E. E. Fournier d'Albe.

Peking Tramways.

The latest weekly bulletin to hand from the Chinese Government Bureau of Economic Information gives the following particulars of the PEKING TRAMWAYS CO. The company, it is stated, is entirely Chinese. Originally a concession was given to the Banque Industrielle de Chine, but on the representations of various public bodies, which reminded the Government that tramway undertakings are generally controlled by municipalities, the first agreement was superseded by a second, and this whittled down the concession to such an extent that the French bank was only given the privilege of appointing certain officials. The capital of the company was fixed at $4 000 000, of which $2 000 000 was to be subscribed by the Chinese public and $2 000 000 by the Government. Public subscriptions amounted to $2 000 000, so the first call was for $500 000 from the public and $500 000 fron. the Government. The arrangement between the Banque and the Government was that the latter's share of the capital should be furnished out of its credit with the Banque. However, the Banque suspended operations soon after the second agreement was signed, and left the Government to find the $500 000 unaided. There was a long delay before the money was forthcoming. Eventually the Ministry of Finance found the Government quota, and, as the necessary preliminaries had been completed, tenders were called.

There are eleven directors in the company—six elected by the Government and five by the Chinese shareholders. One of the stipulations of the agreement between the Banque and the Government was that the Peking manager of the Banque Industrielle should have a seat on the Board. That seat has been left vacant since the suspension of the Banque. The remaining ten directors—all Chinese—have met on numerous occasions, but the French bank representative has never put in an appearance, although nominally he remains a director. The company is governed according to Chinese law.

Tenders for the supply of power plant, machinery, rolling stock and accessories, have been received from the following firms: Siemens (China); Innis and Riddle; Brush Electrical Engineering Co.; Mitsui Bussan Kaisha; Arnhold Brothers; Jardine Matheson; Anglo-French (China) Corporation; Compagnia Italiana d'Estreme Oriente; Chinese Commercial Corporation; Zedelius, Westphal and Co.; Sintoon Overseas Trading Co.; Reiss and Co.; Wah-Chang Trading Co.; Liang Mao Trading Co.; Andersen, Meyer and Co. and William Forbes and Co. These tenders are being examined by a commission of experts who will make their recommendations in due course. The laying of the track is expected to be begun in the late summer.

Books Received.

"Boiler Plant Testing." By David Brownlie. (London: Chapman and Hall.) Pp. x.+168. 10s. 6d. net.

"Drahtlose Ubersee-Verkehr." By Dr. Gustav Eichhorn. (Zurich: Beer and Cie.) Pp. 69+xix. Fr. 7.

"Elektrische Zugförderung." By Dr-Ing. E. E. Seefehlner. (Berlin: Julius Springer.) Pp. xi.+587. £2 10s.

"Wireless Telegraphy and Telephony." By E. Redpath. (London: Cassell and Co.) Pp. 150. 1s. 6d. net.

"The Lead Storage Battery." By H. G. Brown, A.M.I.E.E. (London: Locomotive Publishing Co.) Pp. 162. 5s. net.

"Alternating Current Electrical Engineering." By Phillip Kemp, M.Sc. (London: Macmillan and Co.) Pp. xi.+515. 17s. net.

"Elementary Determinants for Electrical Engineers." By H. P. Few. (London: S. Rentell and Co.) Pp. 95. 4s. net.

"Principles of Electrical Engineering." By Wm. H. Timbie and Vannevar Bush. (London: Chapman and Hall.) Pp. viii.+513. 20s. net.

"Testing of Transformers and A.C. Machines." By Charles F. Smith, D.Sc. (London: Sir Isaac Pitman and Sons.) Pp. x.+91. 2s. 6d. net.

"Switching and Switchgear." By Henry E. Poole, B.Sc. (Hons.), Lond. (London: Sir Isaac Pitman and Sons.) Pp. viii.+118. 2s. 6d. net.

"Report on Peat." Issued by the Commission of Inquiry into the Resources and Industries of Ireland. (Dublin: Commission of Inquiry into the Resources and Industries of Ireland.) Pp. 110. 2s. 6d. net.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MEWBURN, ELLIS & CO., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

COMPLETE SPECIFICATIONS:

172 787 CARPENTER, R. E. H., CREED, F. G., and CREED AND CO., LTD. Electro-magnetically controlled switching-apparatus. (4/10/20.)
172 795 JOHNSON AND PHILLIPS, LTD., and WOOD, P. M. Switch-gear of the truck or similar type for electric installations. (7/10/20.)
172 805 WINTERBOTHAM, C. W. Electrically-heated sad-irons. (12/10/20.)
152 652 VOGLHUT, F. Process for the regeneration of electric incandescent lamps. (17/10/19.)
166 506 SCHAEFFER, E. Luminous electric discharge lamps. (14/7/20.) (Addition to 150 957.)
172 844 LEHMANN, G. Electric switches. (5/11/20.)
172 845 WESTERN ELECTRIC CO., LTD. (Western Electric Co., Inc.). Terminal blanks for selector switches. (5/11/20.)
172 850 CHLORIDE ELECTRICAL STORAGE CO., LTD. (Smith, E. W.). Secondary battery plates or electrodes. (12/11/20.)
172 865 RUTTER, W. V., FARRINGTON, A., and NICKLIN, G. M. Sparking-plugs for internal-combustion engines. (11/12/20.) (Addition to 136 109.)
155 264 AKT.-GES. BROWN, BOVERI, ET CIE. Apparatus for measuring the temperature of windings in electrical machines and apparatus. (12/12/19.)
172 868 BECKTON, E. Twin clip for regulating the height of electric lamps attached to flexible electric wire. (20/12/20.)
172 872 TELEGRAPHON GES. Telegraphonographs. (3/1/21.) (Additlon to 147 555.)
156 554 REINICER, GEBBERT, AND SCHALL AKT.-GES. Röntgen-ray apparatus. (23/6/15.)
156 678 REINIGER, GEBBERT, AND SCHALL AKT.-GES. Röntgen-ray apparatus. (12/1/21.) (Addition to 156 554.)
156 721 METROPOLITAN-VICKERS ELECTRICAL CO., LTD. Electric fuses. (12/1/20.)
157 383 LEDERER, A. Electric gas-filled flow discharge lamps. (15/9/13.)
158 907 GES. FÜR DRÄHTLOSE TELEGRAPHIE. Wireless signalling in mines (9/2/20.)
172 901 COATES, W. A., DAVIES, D. R., and METROPOLITAN-VICKERS ELECTRICAL CO., LTD. Electrical switch-gear. (28/9/20.) (Divided application on 27 557/20.)
172 995 AUTOMATIC TELEPHONE MANUFACTURING CO., LTD., BATES, P. T., MERCER, R., and GILLINGS, C. Telephone systems. (16/6/20.) (Cognate application 28 143/20.)
172 996 APOLLO PLUG MANUFACTURING CO., LTD., and BROWN, F. Electric diaphragm alarms. (24/6/20.)
172 998 CREED AND CO., LTD., and LENAGHAN, T. Electro-magnetic relays. (26/6/20.)
146 491 FOREST, L. DE. Electric signalling. (17/4/19.)
147 753 GES. FÜR DRÄHTLOSE TELEGRAPHIE. Electro-magnetic wave navigational or direction-finding systems. (23/10/18.) (Addition to 145 629.)
147 784 APPLE, V. G. Construction and operation of dynamo-electric machines. (23/4/17.)
148 445 GES. FÜR DRÄHTLOSE TELEGRAPHIE. Thermionic-tube electro-magnetic wave generating apparatus. (25/10/18.) (Addition to 148 447.)
148 447 GES. FÜR DRÄHTLOSE TELEGRAPHIE. Thermionic-tube electro-magnetic wave-generating arrangements. (9/9/18.)
148 803 HUTH GES., DR. E. F. Method of connection for producing oscillations wtih vacuum tubes. (27/9/17.)
148 995 SOC. FRANCAISE RADIO-ELECTRIQUE. Wireless telephony systems. (26/10/16.)
149 951 SIEMENS-SCHUCKERTWERKE GES. Electric are welding-apparatus. (19/8/19.)
173 009 WESTERN ELECTRIC CO., LTD. (Western Electric Co., Inc.). Telephone systems. (10/8/20.)
173 010 BYRNE, E. L. W. Submersible dynamo-electric machines. (11/2/21.) (Cognate applications, 29 380/20, 34 537/20, 4 801/21 and 10 799/21.)
173 028 BARKER, J. T., and UNITED ALKALI CO., LTD. Electrolytic cells, more especially intended for use in the production of the chlorates of the alkali metals. (10/9/20.)
173 033 SMITH, E. R. Electric calling or time-alarm devices for use in hotels and the like. (14/9/20.)
173 062 BRITISH THOMSON-HOUSTON CO., LTD., and BODDY, W. J. Oil-immersed transformers. (21/9/20.)
173 066 IMRAY, O. Y. (legal representative of Imray, O., deceased) (Bosch Akt.-Ges. R.). Electric-starting device for internal-combustion engines. (22/9/20.) (Addition to 2 815/20.)
160 746 BOUDOU, G. Electric apparatus for the permanent waving of the hair. (26/3/20.)
173 089 MARKS, E. C. R. (National Carbon Co., Inc.). Deferred-action dry battery. (5/10/20.)
173 098 GITTINS, G. E., and METROPOLITAN-VICKERS ELECTRICAL CO., LTD. Electrical oil switches. (9/10/20.)
173 125 PEARCE, H. Means for protecting alternating electric-current apparatus. (23/10/20.
173 130 ROSSI, P. Device for automatically controlling a gas or oil burner or an electrical heating element. (3/11/20.) (Cognate application, 32 307/20.)
173 134 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Systems of electric power transmission. (9/11/20.)
155 823 AUTOMATIC TELEPHONE MANUFACTURING CO., LTD. Telephone systems. (20/12/19.)
156 494 EUSTICE, A. L. Enclosed electric fuses of the cartridge type. (22/6/14.)
161 171 AUTOMATIC TELEPHONE MANUFACTURING CO., LTD. Automatic or semi-automatic telephone systems. (29/3/20.)

APPLICATIONS FOR PATENTS.

May 29.

15 000 A. HEWLETT. Current testing apparatus.
15 003 G. C. CLARK and W. J. H. WALTER. Removing and refitting apparatus for electric bulbs.
15 004 A. M. TAYLOR. Electric transmission systems.
15 009 E. PHILLIPSON. Electric heating apparatus.
15 019 AIR REDUCTION CO. Spark gap detector. (7/6/21 U.S.)
15 025 A. C. HESS. Electric transmission mechanism.
15 048 P. L. JENSEN and E. S. PRIDHAM. Telephone, etc., receivers.
15 049 AUTOMATIC TELEPHONE MANUFACTURING CO. Telephone systems. (6/7/21 U.S.)
15 052 F. W. UREN. Electric switchboard, etc. (29/6/21 Australia.)
15 058 V. AMBERG. Automatic telephone systems, etc.
15 087 THURINGESCHE LANDESUNWERSITÄT JENA. Dissociating oscillatory electric circuits. (27/5/21 Germany).
15 097 W. A. LOTH. Staking out a route by phonic cables.
15 105 J. W. EWART. Generating electric power from water supplies.
15 109 E. L. GASTON. Production of tubular metallic articles by electro-deposition. (3/6/21 France.)

May 30.

15 132 A. WILKINSON. Locking electric lamps in holders.
15 135 FORGES ET ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE JEUMONT. Direct current circuit breakers. (21/3/22 France.)
15 136 R. BOSCH AKT. GES. Electric head lights. (11/8/21 Germany.)
15 143 G. ECCLESTON. Combined switch and fuse.
15 167 MULLARD RADIO VALVE CO. and C. F. M. HAYES. Thermionic valves, etc.
15 200 METROPOLITAN VICKERS ELECTRICAL CO., B. BEESLEY and J. B. HANSELL. Terminals for transformers.
15 201 METROPOLITAN-VICKERS ELECTRICAL CO. Transformers. (3/6/21 U.S.)
15 204 GES. FÜR DRAHTLOSE TELEGRAPHIE. High frequency telegraph and telephone systems. (1/6/21 Germany.)
15 214 A. M. E. BEAVAN. Electric heating apparatus.

May 31.

15 228 A. T. THOMPSON. Transmitter for telephony, etc.
15 229 E. KIRK. Electric indications of lamps being alight.
15 237 A. E. ROBERTS and L. H. THOMPSON. Sound conduits and amplifiers for wireless telephones and recorders.
15 296 W. H. JONES and W. A. ROBINSON. Prepayment apparatus for telephones.
15 304 F. E. PERNOT and L. J. RICH. Multiplex telegraphy.
15 305 DEUTSCHE GLIMMLAMPEN GES. and J. M. SCHMIERER. Current direction indicator. (30/3/21 Germany.)
15 306 W. E. PEEK. Wireless receiver sets.
15 307 W. E. PEEK. Variable condensers.
15 320 T. W. BENNETT. Electric switches.
15 332 METROPOLITAN-VICKERS ELECTRICAL CO. and A. H. BRUNESSAUX. Incandescent lamps.
15 334 SIEMENS SCHUCHERTWERKE. Electrolytic protection of boilers, etc., from corrosion. (1/6/21 Germany.)
15 346 RUDGE-WHITWORTH, LTD., and W. H. WHITMILL. Controlling magneto-electric machines.
15 349 M. LATOUR. Electric outfit for games or demonstrations. (4/6/21 France.)
15 351 SOC. ANON. LE CARBONE. Dry batteries. (1/5/22 France.)
15 359 BUREAU D'ORGANISATION ECONOMIQUE. Metallic vapour electric rectifier (2/6/21 France.)
15 365 W. T. DITCHAM. Electric condensers.
15 367 H. J. ROUND. Wireless telegraph receiving circuits.
15 368 J. R. COLTMAN and N. DAVAN. Burglar alarm, etc., electric circuits.

June 1.

15 381 J. WALMSLEY. Incandescent lamps.
15 408 H. I. JONES and C. E. WOOD. Electro-magnets.
15 442 F. M. THOMSON. Electric signs.
15 448 FAHRZENGFABRIK EISENACH ZWEIGNIEDERLASSUNG DER GOTHAER WAGGONFABRIK A.G. Magneto-electric ignition and illumination. (31/3/22 Germany.)
15 452 C. E. PRINCE. Electric clocks.
15 460 DUBILIER CONDENSER CO. (1921) and W. H. GOODMAN. Electric condensers.
15 472 J. P. WILLIAMS. Electric protection systems.
15 473 W. T. HENLEY'S TELEGRAPH WORKS CO., E. MOOR and E. E. JUDGE. Electric distribution apparatus.
15 476 GENERAL ELECTRIC CO., LTD. Electric filaments. (18/6/21 Germany.)
15 481 MUIRHEAD AND CO. and E. S. HEARTLEY. Automatic telegraphy.

June 2.

15 483 BRITISH BATTERY CO. and J. W. H. REYNOLDS. Electric connections for batteries.
15 493 and 15 495 S. H. HEYWOOD AND CO. and C. L. BROWNE. Electric lifting blocks, etc.
15 494 S. H. HEYWOOD AND CO. and C. L. BROWNE. Electric controllers.
15 516 P. FREEDMAN. Electric arc devices.
15 532 E. R. MADDOX. Electrical variable condensers.
15 551 H. BOOTH. Electric heating units for irons, cookers, etc.
15 584 TELEPHONE MANUFACTURING CO. and R. L. MURRAY. Receiving apparatus for oscillating electric circuits.
15 594 A. R. MATTHEWS and R. F. TUMNER. Electrical connectors, terminals, etc.
15 596 SIEMENS and HALSKE AKT. GES. Telephone systems. (21/6/21 Germany.).

Prices of Metals, Chemicals, etc.

TUESDAY, JUNE 13.

	Price.	Inc.	Dec.
Copper—			
Best Selected .. per ton	£66 10 0	—	£1 0s. 0d.
Electro Wirebars .. ,,	£70 10 0	—	£1 0s. 0d.
H.C. Wire, basis .. per lb.	0s. 10⅜d.	—	⅛d.
Sheet .. .. ,,	0s. 10⅛d.	—	—
Phosphor Bronze Wire (Telephone)—			
Phosphor Bronze Wire, basis .. per lb.	1s. 2⅜d.	—	⅛d.
Brass 60/40—			
Rod, basis .. ,,	7d.	—	—
Sheet, basis .. ,,	9¼d.	¼d.	—
Wire, basis .. ,,	10⅛d.	⅛d.	—
Pig Iron—			
Cleveland Warrants per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 S.W.G. ,,	£18 0 0	—	—
Lead Pig—			
English .. .. ,,	£26 0 0	—	—
Foreign or Colonial ,,	£24 15 0	—	2s. 6d.
Tin—			
Ingot .. .. ,,	£152 0 0	—	£2 2s. 6d.
Wire, basis .. per lb.	2s. 1d.	—	¼d.
Aluminium Ingots .. per ton	£100 0 0	—	—
Spelter .. .. .. ,,	£28 2 6	—	1s. 3d.
Mercury .. .. per bottle	£12 10 0	—	—

Sulphur (Flowers)—Ton £10 15s. *Sodium Chlorate*—Per lb. 3¼d
,, (Roll-Brimstone)—per ton £10 15s. *Sulphuric Acid* (Pyrites, 168°) per ton, £9.
Sodium Bichromate.—Per lb. 5¼d. *Copper Sulphate*.—Per ton £26 10s.
Boric Acid (Crystals). Per ton £60.
Rubber.—Para fine, 9⅜d.; plantation 1st latex, 7⅛d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Company.

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CONTENTS.

Notes of the Week.

The I.M.E.A. Convention.

THE twenty-seventh annual Convention of the Incorporated Municipal Electrical Association opened at Wolverhampton on Tuesday, under the presidency of Mr. S. T. ALLEN. In accordance with our usual custom we shall defer until next week's issue a full and complete account of the proceedings, which do not conclude until Friday. We shall content ourselves here with giving some impressions gathered at an early stage in the meeting. The attendance does not seem to be so large as usual, certainly the number of ladies is less. This may be due to the strenuous times, but it is also undoubtedly partly due to the unavoidable scattering of the members over more than one town. This is both an administrative and social disadvantage, and we suggest to the Council that the time has come when precedent should be disregarded and the Convention held in some place which is either naturally or artificially designed for the accommodation of large numbers of visitors.

Wolverhampton—Past and Present.

THE Convention opened with a municipal welcome from the Mayor of Wolverhampton (COUNCILLOR JAMES THOMPSON, J.P.). Councillor THOMPSON is also chairman of the Electricity Committee. This probably saved him from declaring *ore rotundo* that electricity is still in its infancy. Instead, beginning with the Romans he connected Wolverhampton with the high lights of English history and finished by paying a tribute to the town as a health resort and to the beauty of the surrounding scenery. This caused some amusement, but everyone agreed during the afternoon that the Mayor was justified. The Black County, *in itself*, is not a thing of beauty, but it does at least heighten the contrast of mountain, woodland and river into which one drives quite suddenly when driving towards the Shropshire border.

A Brain Stimulant.

THE Presidential address was full of meat. We shall refer to it more particularly next week. Its form, as Ald. BEAUMONT suggested, is almost Baconian, and it certainly provides a cerebral stimulation whose oscillations will, we hope, effect some not too sensitive receiving apparatus. It says what everyone is thinking, which makes it seem trite. But it also indicates what everyone ought to be doing. And it is from this point of view it must be primarily regarded. It was, therefore, an excellent idea to make Colonel VIGNOLES' Paper on "The Extension of the Uses of Electricity for Domestic Purposes" a sequel to the Presidential Address. As the author pointed out, a number of domestic consumers are being supplied at a loss and the soundest, if not the obvious, method of combating this is to encourage a greater use of electricity. This is the more necessary as the domestic load is a "big thing," as large as the power load in a highly developed domestic area. To achieve a success in this direction the price must be right, there must be publicity, and the supply authority must hire and maintain. The discussion largely turned on the tariff question, and Mr. L. L. ROBINSON's remarks on this subject were particularly apposite, as were Mr. WORDINGHAM's on diversity and multiplicity of tariffs. And so to lunch and Severn scenery, and on Wednesday to Stoke-on-Trent, municipal finance, and pottery.

The Nechells Generating Station.

ON another page of this issue we give a description of the new generating station which the Birmingham Corporation have erected at Nechells. This station, which is nearing

completion, has been available for the inspection of those attending the Convention of the Incorporated Municipal Electrical Association during the present week, and the formal opening will probably take place in about a month's time. In these days of standardisation it is a little difficult to pick out from the equipment of modern generating stations anything of outstanding interest. Nechells is, however, fortunate in this respect, both from the engineering and the journalistic points of view. In the first place, orthodoxy will be shocked by the idea of using cooling towers and sewage effluent instead of the more usual river for condensing purposes. The decision required courage (perhaps the courage of despair), but experience at the Nechells temporary station shows that the practice gives rise to no difficulties and indeed forms a method of solving what, in Birmingham at least, would otherwise be a very difficult problem.

The Auxiliary Problem.

THE other main point of interest lies in the system adopted for obtaining the necessary auxiliary supply of electricity. Not only have both electric motors supplied for the main 'bus bars and steam engines been provided for this purpose, but a special auxiliary generator in addition to the exciter is carried on the main alternator shaft. Other minor points (minor because they are not quite new) are the switchgear and the building construction. The latter is mainly of concrete, and special difficulties were encountered owing to the marshy nature of the ground. The former is of the ironclad construction and combines safety with robustness in a way which, as our photographs show, is most impressive. The whole structure is an example of the best modern practice, upon the design and construction of which Mr. CHATTOCK and his assistants are to be heartily congratulated.

Coue-ism at the Post Office.

FORCE of circumstances require that POSTMASTER-GENERAL after POSTMASTER-GENERAL shall become a disciple of M. COUÉ and attempt to persuade a sceptical House of Commons, and a still more sceptical public, that the British telephone system is not only not bad, but is every day becoming better and better. Mr. KELLAWAY's task in performing variations on this theme on Friday was a good deal easier than that of some of his predecessors. It has always been the general opinion that one of the ways of improving the telephone system would be to spend more money upon it, and in announcing that a five-year programme of expansion had been prepared, involving an expenditure of some £35 700 000, he therefore carried his audience with him. This programme will be based on an estimated cumulative growth in the number of telephones of 8½ per cent., which was the actual growth in 1920-21, an estimate which is certainly on the conservative side, for if, as Mr. KELLAWAY argues, reviving trade means a greater demand for telephones, there is every reason why this figure should be exceeded, especially when the domestic demand is taken into account. But to stimulate or check that demand is largely in the Post Office's own hand.

Providing for the Future.

WE are glad to see that a large proportion of the proposed expenditure is to go in placing trunk lines underground, £504 000 being allocated for this purpose during the present year. The provision of new exchanges and the modernisation of old exchanges are other important matters which are to be taken in hand, and we hope that there will as well be plenty of provision allowed for expansion in laying subscribers' cables and junctions, so that when the demand does arise, as it assuredly will, there will be no delay in meeting it, as there has been until quite recently. How this is done in the United States was described by Mr. E. S. BYNG in the Paper he read before the Institution of Electrical Engineers some months ago, and though Sir WILLIAM NOBLE, who is an even more advanced disciple of M. COUÉ than Mr. KELLAWAY, assured the audience that everything that could possibly be done was being done over here, still there is no harm in doing just a little more. Major PURVES states that expansion is to be the first plank in his policy. We congratulate him on building on so sure a foundation, for combined with efficient working this must lead to an improved telephone system, especially if reduced charges and a more enlightened administration are the order of the day.

Wireless Legislation.

APART from the necessity for providing for the "broadcasting" craze, it is time the legislation governing the use of wireless telegraphy and telephony was put on a more satisfactory basis. The Act of 1904, which conferred certain powers of control and of issuing licences upon the POSTMASTER-GENERAL, was only meant to be a temporary measure. Actually, it expired at the end of 1906, though it has since been continued by means of the Expiring Laws Continuance Act. But Mr. KELLAWAY has now introduced a short Bill, which has already been read a second time in the House of Commons, to amend and make permanent the Act of 1904. According to the provisions of this measure wireless licences are to be subject to such terms, conditions and restrictions as the POSTMASTER-GENERAL may lay down, and penalties are provided for the contravention of the regulations or of the terms of a licence.

Three Specific Offences.

THREE specific offences are also created, viz., the sending by wireless telegraphy of a message of an offensive character, or a misleading signal as to a vessel in distress, or improperly divulging the purport of any message. For these offences a fine not exceeding £10, or imprisonment for 12 months, may be inflicted, and the penalties under the 1904 Act have also been increased. Apparently, the old distinction as to experimental licences is to disappear, and the Act is to be applied to aircraft (with the necessary modifications) and to visual or sound signalling stations for communicating with ships at sea. Provision is made for the control of wireless telegraphy, or of visual or sound signalling apparatus in cases of national emergency. The Bill seems to be devoid of definitions, and though no doubt a good deal will depend upon the Regulations, it would be well if certain technical terms were clearly and unambiguously defined. Apart from this we see little to object to in the new measure. Regulation is absolutely necessary unless we wish to get into the state of confusion and chaos which at present prevails in the United States.

The Railway Supply Inquiry.

WE had hoped that last year's exhaustive inquiry into the electricity supply problem of London and Home Counties would have been the last. But probably owing to the chaotic condition of affairs we have been compelled

to listen for the past fortnight to evidence by a succession of expert witnesses (all of whom were heard by the Electricity Commissioners at the last inquiry) on the subject of the supply for electric traction. This enquiry has been occasioned by the South Eastern and Chatham Companies being unable to obtain definite quotations for supply from the West Kent Electric Power Co. or the London Electric Supply Corporation for the electrification of their suburban lines. They therefore applied to the Commissioners for sanction to erect their own generating station at Angerstein's Wharf, Greenwich, and the enquiry into the matter occupied ten sittings.

Is a Traction Station Desirable?

In addition to the application of the railway companies, the Commissioners also investigated proposals of the West Kent Electric Power Co. for the erection of a power station at Belvedere and of the County of London Electric Supply Co. to give a supply for traction purposes from their projected station at Barking. We have given a full abstract of the evidence adduced in support of each of the three schemes and we now await the decision of the Commissioners with keen interest. The South Eastern and Chatham lines are about to be reorganised, with the London, Brighton and South Western companies, into the Southern Group of railways, and we consider it would be a misfortune if each of these three units were allowed to electrify on different systems with three separate sources of supply. The proposal to use a periodicity of 25 at Angerstein's Wharf, instead of the standard 50 periods, would also make it more difficult to introduce uniformity into a complex situation, though to adopt such a high frequency for a traction load presents many difficulties. Moreover, it is generally agreed that it would be an advantage if railway supplies were obtained from a common source as this would mean a reduction in cost. We hope, therefore, that the Commissioners will not authorise the erection of a separate traction station unless there is a manifest advantage to be gained by doing so or there is no suitable alternative source of supply which would be as cheap as that from Angerstein's Wharf.

Progressive Hackney.

Hackney Borough Council is exhibiting commendable energy and enterprise in developing its electricity undertaking. Recently it organised a successful exhibition of electric labour saving appliances for domestic purposes, and now its borough electrical engineer (Mr. L. L. Robinson) has prepared an interesting scheme for wiring the premises of the working and middle classes. Undoubtedly the chief obstacle to the more extended use of electricity in the majority of houses is the initial cost of the wiring and fittings, and the Council are now recommended to devote £5 000 out of the revenue of the undertaking in order to embark upon an experimental scheme. It is truly pointed out that the gas industry has already proved that it was essentially sound business to put in installations free, or nearly free, of initial cost to the consumer, charging a little more for gas by prepayment methods in order to avoid bad debts and to secure an adequate return both for the gas supplied and the installation. We believe Mr. Robinson is right when he says his committee should tackle the same kind of business in a similar manner.

Mr. Robinson's Scheme.

Accordingly, he recommends that consumers should be supplied, free of initial expense, with simple pendant lighting installations and cooking and heating services, but the consumer must pay outright for lamps, glassware, any special lights or certain portable articles such as immersion heaters or irons. Supply would be given through shilling-in-the-slot prepayment meters and the charge would be 2d. per unit in excess of the ordinary flat rate for lighting and ½d. in excess of the flat rate for cooking and heating, and at present this would be 8d. for lighting and 1½d. for domestic uses. A six-light installation would cost £14, and the average consumption would be 150 units a year, giving a revenue of £5 a year. Of this sum £1 5s. would be allocated for fixed charges. The cost of a complete cooking installation would be £20, and with a family of four the consumption would average 1 000 units, the revenue being £6 5s. per year, of which one-third, or £2 1s. 8d. would be taken for fixed charges. The consumer would naturally have the option of purchasing the installations at any time. We believe that the interest, sinking fund and depreciation on installations of this class should not be less than 12½ per cent., and though Mr. Robinson's estimate does not amount to this, we are inclined to agree that with the better class of consumer there would be little risk. Consequently, we hope that the Council will give the opportunity of making an experiment, which, if successful, should lead to good results for the industry as a whole.

Model Conditions of Contract.

The preparation of suitable conditions of contract is an important subject which crops up periodically at meetings of engineering and other professional associations. The ideal of a complete set of standard conditions which can be used as occasion requires will never be reached owing to the changes which are always taking place in engineering practice, necessitating constant modifications in the conditions. Nevertheless some standardisation is possible, and in the past the Institutions of Civil and Electrical Engineers, the B.E.A.M.A., the F.B.I., the I.M.E.A. and other associations have indulged in the compilation of model conditions. Recently the Association of Consulting Engineers have also exercised themselves in the preparation of a set of their own, on the ground that they found themselves unable to accept the revised set of the Institution of Electrical Engineers.

A Fundamental Weakness.

All these codes, however, have the weakness that those who prepare them have as their primary object the production of conditions which, though fair and equitable to themselves and their friends, may quite unconsciously be entirely the reverse to the other parties to the contract. For instance, the Association of Consulting Engineers, who drafted their conditions in consultation with members of the B.E.A.M.A., failed to reach agreement on two clauses relating to the limitation of the contractor's liability for negligent or improper workmanship and to the penalty for delay in completion.

Asking Too Much.

On the first point the B.E.A.M.A. desired to limit the liability for damage or loss caused by neglect or improper workmanship or design to a sum not exceeding the value of the contract. As the contractor is frequently not the maker or designer of the plant used, and as the value of the plant usually represents a substantial sum, we are disposed to think that the demand of the consulting engineers for the full

common law rights, which do not admit of any such limitation, is asking for too much. On the other hand, we think that they are right in rejecting the claim of the manufacturers to limit the penalty for delay in completion to 25 per cent. of the contract value. The usual penalty is 1 per cent. of the value of any portion of the plant for each week by which the time fixed for completion is exceeded, and thus the contractor's liability would cease at the end of 25 weeks. This is scarcely fair, as under another clause of the conditions the time is to be extended in all cases where the delay is caused by anything beyond the contractor's control.

Patent Office Report.

GOVERNMENT reports are not remarkable for their lucidity or for the ease with which information can be obtained from them, and the annual report of the COMPTROLLER-GENERAL OF PATENTS must rank as one of the worst examples. It consists of a dry record of facts, and a number of drier tables. Now a record of the trend of invention, with particulars of the subject matter of the year's patents, would make useful and interesting reading. Instead we have fourteen pages of bare summaries and arid statistics, for which the sixpence charged, represents a great deal more than the report is worth.

Past Year's Record.

WE gather that during the past year the total number of patent applications was 35 132, a decrease of 1 540 compared with 1920, and that the complete specifications filed were 19 159, or 2 637 less, mainly due to the expiry of the extensions of time granted by the Treaty of Peace with Germany and the Berne agreement of 1920. The number of new patents sealed during the year was 17 697, against 14 191. In spite of the fact that we now have women engineers, chemists and scientists, they do not appear to trouble the Patent Office examiners much, for the women inventors decreased from 311 to 297. The patents of addition also dropped from 959 to 827, but the applications by way of communication from abroad increased from 1 265 to 1 339. There were 594 requests for licences of right, and endorsements were effected in 561 cases. Only 4 of the requests were withdrawn, and 29 were still pending at the end of the year, so that the licence system seems to be pretty extensively used.

Increase of Renewal Fees.

IT is interesting to note that there was an increase in the amount of the renewal fees from £286 498 to £303 823, but less than 15 per cent. of patents survive their eleventh year, over 7 per cent. continue to the fourteenth year, and only 3·6 per cent. run the full period of 16 years. Inventors are notorious for their optimism and hopeful views, and though this high percentage of patent mortality would be enough to damp the spirits of the most ardent inventor, we do not suppose it will check the flow of invention. The inventor is the greatest public benefactor on the earth's surface, and though he seldom reaps a proper reward for his inventive skill and genius yet he has still the satisfaction of knowing that he has done something for progress and for the benefit of his fellow-man.

A Burning Question.

THE Institution of Gas Engineers has been having a joyous time at Cardiff. As members of the Institution of Electrical Engineers know, Cardiff is quite a good place to have a joyous time, but in this case its tonic qualities seem to have over-stimulated the President, Mr. JAMES ROBB, of Chepstow, to say things which he may by now regret. Mr. ROBB'S presidential address was devoted to the question, "Does the gas industry receive the recognition and respect which from its great importance is its due?" We do not propose to assist Mr. ROBB in elucidating that burning question, except to say that when it is necessary to devote more attention to pointing out what an industry has done than to what it is going to do the future of that industry is, as the Irishman said, behind it.

The Present Condition of the Gas Industry.

MR. ROBB ascribes the present condition of the gas industry (whatever that is) to Government indifference (would we had had a little of that indifference in the electrical industry), and, descending from the general to the particular, considers that the Government decided to build the Chepstow generating station solely to find employment for ex- "so-called Royal Engineers" (this is a joke, but we cannot see it) who had been trained in electricity but knew nothing about gas. But worse remains behind! When the Office of Works first investigated the relative advantages of electricity and gas for lighting the model villages at Pennsylvania and Bulwark, near Chepstow "gas came out triumphantly, which it always did when it had a fair field and no favour." Nevertheless this inept Government Department insisted on wasting public money in laying electric cables, and now the tenants of Bulwark were "clamouring for a supply of gas," which is "the finest, most diffusive, effective, healthy and cheapest artificial light for general use in existence."

A Joyous Document.

ON the other hand, electric lighting is "destructive to the eyesight, nerves and hair, and, if persisted in, would convert us into a nation of Chinese, besides exhausting our coal supplies within a very short period." The only thing that worries us about all this is, "Why Chinese?" But, more strange still, a fact of which Mr. BEAUCHAMP ought to take immediate note, "Everyone connected with electricity held a brief for it, from the top dog down to the messenger boy—including directors, shareholders and workmen's wives. Everyone of these was an active canvasser filled up to the brim with the fanciful, preposterous, unattainable virtues of electricity." Altogether a joyous document which every electrical engineer should study.

Electricity and Matter.

IN these days of labour troubles, financial stringency, and economic pressure, engineers worthy of the name will be glad to be given an opportunity of considering problems which, though of high interest, are as little affected as it is possible for problems to be by either finance or the human element. These problems include those where pure Science, with her immutable laws, is supreme. The mental tonic which such a study provides is in itself worth the labour expended, and at the same time there is the comfortable feeling that the knowledge acquired may some day be put to useful purpose in unexpected ways. An opportunity of thus widening the intellectual basis is afforded to electrical engineers in the Kelvin Lecture recently delivered by Sir ERNEST RUTHERFORD before the Institution of Electrical Engineers on "Electricity and Matter." This lecture we

have summarised on another page of this issue. Both as an historical document and from the prospect it opens of new fields of electrical development it is worth close study.

Some Necessary Expository Qualities.

Now, to make clear the hidden paths of a new and abstruse subject, such as that with which Sir ERNEST deals, certain qualities are required. Needless to say, the lecturer must know his work. He must be an enthusiast, well equipped with the talent of selection so that not only shall he avoid stressing the obvious, but that he shall give all the information that an audience not entirely composed of experts may require to assist them in understanding his arguments. All these qualities Sir ERNEST possesses. He is in the first rank of workers in the dark fields of the atomic constitution. He is an enthusiast in his work—he says so himself—and his gift of presentation has been polished by frequent delivery of lectures on the same subject.

Indeed, it would be interesting to know how many lectures on the various facets of the atomic theory Sir ERNEST has delivered during the past few months. We know of at least half a dozen ; and from the electrical engineer's point of view, and doubtless because constant practice makes perfect, the Kelvin lecture seems to have been the best of them all.

It is certainly the best for electrical engineers to study because it is a review of the great advances that have been made in recent years in our knowledge of the relations between electricity and matter, a question which is intimately bound up with the constitution of the atoms of the elements. Such a review is very useful at the present time, when some progress has been made and yet more remains to be done.

Kelvin and the Atomic Structure.

IN a Kelvin Lecture it is only fit that the subject chosen should be connected with some phase of that master's work and that his own contribution to the solution of the problem under discussion should be mentioned. This has usually been done, and Sir ERNEST did his best to follow precedent. But the task is not easy ; for though, as he pointed out, KELVIN as long ago as 1883 gave an illuminating account of the evidence that went to prove that all matter is atomic in structure, he did not accept entirely the current explanation that radio-activity is a consequence of the successive disintegrations of the atoms. To that extent, therefore, and though he devised types of atoms which under certain disturbances broke up with explosive violence simulating in behaviour the atoms of radium, the trend of modern thought and work has rather been away from than in continuance of his ideas.

The Modern Line of Thought.

WHAT that modern line of thought is was clearly laid down by the lecturer. FARADAY'S laws of electrolysis form a remote beginning, followed, after a long interval, by JOHNSTONE STONEY, TOWNSEND, and MILLIKAN showing conclusively that the charge carried by the electron is numerically equal to that carried by the hydrogen ion in the electrolysis of water, and thus allowing the mass of the atom of all the elements to be deduced. Moreover, CROOKES' assumption that the different properties of the elements were not due to the existence of different kinds of matter, but to different quantities and arrangements of a single fundamental " substance," was an advance of importance.

The Constitution of the Atom.

THE next stage was the conception that the atoms of the different elements, so far from being indivisible, have a common complex structure made up of protons (or units of positive electricity) and electrons. Progress during the past twenty years has mainly depended on a clearer understanding of the relative part played by positive and negative electricity in the atomic structure, and it is now generally accepted that the atom is an electrical system. Further, the nuclear charge of any element is identical with the number of the places into which that element falls in the series originally discovered by MENDELEEFF from other considerations.

Transmutation of the Elements.

IF we accept these theories, it is but a step to the idea that one element can be changed into another, so that a very old dream for which many worked and suffered has at last been realised. Sir ERNEST himself has bombarded a number of the lighter elements with α particles, and has thereby succeeded in breaking up nitrogen into hydrogen and helium. We hasten to add for the benefit of those who would otherwise entertain ideas of alchemical wealth that this disintegration has only been effected on a very small scale, and that most of the atoms are stable bodies held together by enormously great forces.

The Engineer and Atomic Disintegration.

BUT nevertheless it is upon the part of Sir ERNEST'S lecture which deals with this subject of disintegration that the imagination of the engineer may well fix. For it is conceivable that in the energy changes which take place as a part of these phenomena is to be found the solution of some of our present difficulties in power generation. Great as are the advances in the economic utilisation of fuel that have been made during the past few years, the total efficiency of the process is still low, and this means, among other things, that we are expending our resources without adequate return. We do not mean to suggest that within the next few years our generating stations will be equipped with plant for transforming nitrogen into hydrogen and helium ; or that the place of the present boiler house staff will be taken by bespectacled workers from the Cavendish laboratory engaged in these pursuits. But the possibility of utilising the energy set free by the disintegration of the complex atom into something simpler does suggest methods which must for every reason receive the fullest investigation.

Atomic Structure and the Strength of Materials.

THE problem has another aspect which should be of more immediate importance to the engineer. For the greater our knowledge of the atomic structure the greater will be the information we shall be able to obtain of the capabilities of the materials that are being employed in engineering, until the point is reached when methods of trial-and-error can be replaced by definite knowledge, a state which will not only be of theoretical but of practical engineering advantage. As it is, X-ray analysis is being used to obtain fresh information on the internal structure of metals and their behaviour under heat and stress. More might well be done on these lines, for, after all, that is only a first step towards linking up more closely the work of the theoretical physicist with the solution of problems of a most practical nature. In this linking up lies one of the brightest chances of future progress in many fields.

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Electricity and Matter.*

By SIR ERNEST RUTHERFORD, F.R.S.

In the Kelvin lecture Sir Ernest Rutherford gives a review of the great advances made in recent years in our knowledge of the relations between electricity and matter. This leads to a consideration of the fundamental problem of physics—the constitution of the atoms of the elements.

In the earlier Kelvin lectures it has been customary to give an account of some phase of Kelvin's work. This could easily be done this evening by concentrating on the publications of Kelvin that deal with the proof of the atomic nature of matter, the dimensions of atoms and molecules, including the first suggestions of the mechanism of atomic constitution. This was a subject in which Kelvin was permanently interested. In his Royal Institution lecture of 1883, reprinted in "Popular Lectures and Addresses," vol.i, he gives an illuminating account of the different lines of evidence that all converge to a cumulative proof that matter is coarse-grained or atomic in structure and set a definite minimum limit to the dimensions of the atom. His deduction of the diameter of the water molecule from the cooling effect observed when a water film is stretched, is one of the most notable of his examples. In his later papers, he accepts Stoney's arguments in support of the atomic nature of electricity and in a paper of curious title "Æpinus Atomized,"† he restates the old theory of Æpinus of the nature and relation of positive and negative electricity in a more modern form by assuming that the negative electricity in an atom is distributed in the form of definite units called "electrions" held in equilibrium embedded in a sphere of uniform positive electrification. In some of his later papers Kelvin devised types of atoms which, under certain disturbances, broke up with explosive violence, simulating in behaviour the atoms of radium. While keenly interested in such speculations, there remained the curious anomaly that he did not entirely accept the current explanation that radio-activity was a consequence of the successive disintegrations of atoms.

An Event of Extraordinary Significance.

The discovery in 1897 of the individual existence of the negative electron of small mass, and the proof that it was a component of all the atoms of matter, was an event of extraordinary significance to science, not only for the light which it threw on the nature of electricity but also for the promise it gave of methods of direct attack on the problem of the structure of the atom.

The Relationship between Electricity and Matter.

The first definite proof of the close relations that exist between electricity and matter we owe to the famous experiments of Faraday on the passage of electricity through electrolytes. After a long interval the suggestion of the atomic nature of electricity was mentioned by Maxwell and Helmholtz, although with reservation, but was revived with conviction by Johnstone Stoney, who suggested that the name "electron" should be applied to the fundamental unit of electricity and made a rough estimate of its magnitude. Following the discovery of the independent existence of the electron and the proof of the production of charged ions in gases by X-rays and other radiations, it was implicitly assumed by scientific men that electricity must be atomic in nature, and all the experimental data were interpreted on this view.

Nature of the Negative Electron.

It was soon recognised that the negative electron of small mass was an actual disembodied atom of electricity and that its apparent mass was electrical in origin. J. J. Thomson had early shown (1881) that a charged body in motion behaved as if it had an additional electric mass due to its motion. The experiments of Kaufmann and others on the swift electrons ejected from radium showed that the mass of the electron, while sensibly constant for slow fields, increased rapidly as the velocity of the electron approached that of light. Later, Einstein from considerations of relativity showed that for any material particle, whether charged or not, the mass m must vary with speed according to the relation $m/m_0=(1-\beta^2)^{-\frac{1}{2}}$, where m_0 is the mass for low speeds, and β is the ratio of the velocity of the particle to the velocity of light. Experiment has been shown to agree closely with this calculation.

The Positive Electron.

One of the main difficulties in the attack on the question of atomic constitution has lain in the uncertainty of the nature of positive electricity. The evidence as a whole supports the idea that the nucleus of the hydrogen atom is the positive electron. It might *a priori* have been anticipated that the positive electron would be the counterpart of the negative electron and have the same small mass. There is, however, not the slightest evidence of its existence. The unsymmetrical distribution of positive and negative electricity that is characteristic for all atoms is a consequence of the wide difference in the mass of the ultimate electrons which compose their structure. No explanation can be offered at the moment why such a difference should exist between positive and negative electricity.

Estimates of Electron Mass.

On the classical electrical theory the mass of the electron can be accounted for by supposing that negative electricity is distributed on a spherical surface of radius about 1×10^{-13} cm. In some recent theories of Compton and others it has been supposed that the electron behaves like a flexible ring whose dimensions are about 10^{-11} cm, or about 100 times the original estimate. Without going into these difficult questions, what little experimental evidence there is seems to support the older estimate of size. Taking this view the greater mass of the proton or unit of positive electricity is to be explained by supposing that the distribution of electricity is much more concentrated for the proton than for the electron. Supposing the shape spherical, the radius of the proton should be only 1/1800 of that of the electron.

The Nuclear Theory of the Atom.

Progress in our knowledge of atomic constitution during the last twenty years has depended mainly on a clearer understanding of the relative part played by positive and negative electricity. It is now generally accepted that the atom is an electrical system, and that the atoms of all the elements have a similar type of structure.

The nuclear theory of atomic constitution has been found to be of extraordinary value in offering an explanation of the fundamental facts that have come to light, and is now generally employed in all detailed theories of atomic constitution. On this view of the atom the problem of its constitution naturally falls into two parts, one the distribution and mode of motion of the outer electrons and the other the structure of the nucleus and the magnitude of the resultant positive charge carried by it. In a neutral atom the number of external electrons is obviously equal to the number of units of positive (resultant) charge on the nucleus.

The general conception of the nuclear atom arose from the need of explanation of the very large deflections experienced by swift α and β particles in passing through the atoms of matter. The next great advance we owe to the experiments of Moseley on the X-ray spectra of the elements. He showed that his experiments received a simple explanation if the nuclear charge varied by one unit in passing from one atom to the next. In addition, it was deduced that the actual magnitude of the nuclear charge of an atom in fundamental units was equal to the atomic or ordinal number when the elements were arranged in order of increasing atomic weight. On this view, the nuclear charge of hydrogen is 1, of helium 2, lithium 3, and so on up to the heaviest element, uranium of charge 92.

Bohr's Distribution Theory.

It is now generally supposed that the electrons are arranged in groups or shells round the nucleus. The theory of Bohr offers a general explanation of the periodic variation in the properties of the elements and even accounts for the presence of the group of rare earths where the chemical properties of successive elements closely resemble one another. It endeavours to account not only for the light spectra but also for the X-ray spectra of all the elements. While it is too soon to express a definite opinion of how far it is capable of explaining the great multitude of facts known about the elements, there can be no doubt that a substantial advance

* Abstract of the Thirteenth Kelvin Lecture delivered before the Institution of Electrical Engineers.

† "Philosophical Magazine," March, 1902.

has been made in the attack of this most fundamental of problems which lies at the basis of physics and chemistry.

The Structure of the Nucleus.

The most definite information on the structure of the nucleus has been obtained from a study of the modes of disintegration of the radio-active atoms. In the great majority of cases the atoms break up with the expulsion of a single α particle which represents the doubly charged nucleus of the helium atom; in other cases a swift β ray or electron is liberated. The expulsion of an α particle lowers the nuclear charge of the atom by two units and its mass by four, while the expulsion of an electron raises it by one. On this simple basis we can deduce the atomic number and the general chemical properties of the long series of radio-active elements and understand the appearance in the radio-active series of isotopes.

Elements Without Isotopes.

Some very definite and important information on the structure of nuclei has been obtained by Aston in his experiments to show the existence of isotopes in the ordinary stable elements by the well-known positive-ray method. He found that a number of the elements were simple and contained no isotopes. Examples of such "pure" elements are carbon, nitrogen, oxygen and fluorine. It is significant that the atomic weights of these elements are nearly whole numbers in terms of O=16; on the other hand, elements such as neon, chlorine, krypton, and many others consist of a mixture of two or more isotopes of different atomic masses. Aston found that within the limit of error the atomic weights of these isotopes were whole numbers on the oxygen scale. This is a very important result, and suggests that the nuclei of elements are built up by the addition of protons of mass nearly one in the nuclear combination.

Disintegration of the Elements.

To obtain evidence to prove that the proton exists as a unit of the structure of the nucleus the obvious method is to effect the disintegration of some of the ordinary elements and to examine the masses and charges of the ejected fragments. In order to test whether the atoms can be artificially disrupted, a stream of α particles have been employed to bombard the atoms of the material under examination. When a stream of α particles is passed through oxygen or carbon dioxide, a few long-range particles are observed which appear to be H nuclei liberated from hydrogen present in the radio-active source. When dry air or pure nitrogen is used, the number of particles is three or four times as numerous and of greater average range. These swift particles are bent in a magnetic field as if they were hydrogen nuclei, and it was thus concluded that they arose from the disruption of the nitrogen nuclei due to close collisions with α particles.

Examination of the Lighter Elements.

Further progress has depended mainly on improving the methods of counting the weak scintillations produced by these particles. Dr. Chadwick and the author have made a systematic examination of a number of the lighter elements and have found that similar long-range particles are liberated from boron, fluorine, sodium, aluminium and phosphorus, as well as from nitrogen. The range of the particles in all cases is greater than that of the H particles liberated from free H atoms under similar conditions. In some recent experiments it has been found that these long-range particles are bent in a magnetic field as if they were hydrogen nuclei. While it is very difficult to measure the mass of these flying particles with accuracy, there can be little doubt that the long-range particles from these elements consist of hydrogen nuclei in all cases. The maximum speed of emission of these nuclei depends on the speed of the bombarding α particle and varies from element to element.

These results suggest that the elements are in the main built up of helium nuclei, mass 4, and protons. The α particle is unable to liberate a proton from elements like carbon or oxygen which are built up entirely of helium nuclei as secondary units, but can do so from an element like fluorine which presumably is built up of 4 helium nuclei and 3 protons.

Disintegration by α Particles Small.

It should be borne in mind that the disintegration effected by α particles is on a very minute scale. Only two protons are liberated from aluminium for a million α particles traversing it. This disintegration has been observed only by the utilization of such a sensitive method that the individual proton can be counted. In some cases the energy of the expelled proton is greater than that of the α particle which liberates it. For aluminium, the proton has a maximum energy about 40 per cent. greater than that of the α particle. There thus appears to be a gain of energy in some cases, and this excess energy is presumably derived from the nucleus.

Radio-Active Evidence.

From the radio-active evidence, we know that the nuclei of heavy atoms are built up, in part at least, of helium nuclei and electrons, while from the experiment outlined above it seems clear that the proton can be released from the nuclei of certain light atoms. It is, however, very natural to suppose that the helium nucleus which carries two positive charges in a secondary building unit composed itself of a close combination of protons and electrons—viz., 4 protons and 2 electrons.

From the point of view of simplicity, such a conception has much in its favour, although it should be mentioned that it seems at the moment impossible to prove its correctness. If, however, we take this structure of the helium nucleus as a working hypothesis, certain very important consequences follow. On the oxygen scale, the helium atom has a mass very nearly 4·000, while the hydrogen atom has a mass 1·0077. The mass of the helium atom is thus considerably less than that of four free H nuclei. Disregarding the small mass of the electrons, in the formation of 1 gm. of helium from hydrogen there would be a loss of mass of 7·7 milligrams.

The First Fruits of the Investigation.

It has been pointed out by Perrin and Eddington that in all probability the energy of radiation from our sun and the stars is mainly derived from the enormous emission of energy accompanying the formation of helium from hydrogen. If this be the case, it is easy to show that sufficient energy can be derived from this source for our sun to radiate at its present rate for several thousand million years. This interesting suggestion of the probable origin of the greater part of the enormous energy radiated by the sun and stars is one of the first-fruits of the investigations on the structure of atoms. It is believed that the formation of helium from hydrogen occurs under certain conditions in the great central furnace of the sun and stars. There is no evidence so far that this combination can be produced under laboratory conditions. It may be that it can be effected only under conditions of very high temperature and enormous intensity of radiation such as occur in the interior of a sun. Even then the process of formation may go on at a very slow rate and for periods measured by millions of years.

Atoms Purely Electrical Structures.

It is hoped that it has been made clear that most workers on the problem of atomic constitution take as a working hypothesis that the atoms of matter are purely electrical structures and that ultimately it is hoped to explain all the properties of atoms as a result of certain combinations of the two fundamental units of positive and negative electricity—viz., the proton and electron. During recent years, unexpectedly rapid advances have been made in our knowledge of this subject, but we have only made a beginning in the attack on a very great and intricate problem.

Future Work.

Great difficulties arise the moment we consider why the nucleus of an atom holds together, and progress seems likely to be slow because it seems clear that the ordinary laws of force between electrified particles break down at such minute distances. There are, however, a number of obvious lines of attack that may yield us very valuable information. In particular, a closer study of the modes of transformation of radio-active bodies may be expected to give us much more important data. During recent years the study of the γ or very penetrating X-rays from radio-active bodies has progressed very rapidly. The general evidence indicates that the γ rays like the α and β particle have their origin in the nucleus. The study of the γ rays thus gives us information of the frequency of vibration of the electrons which form part of the nuclear structure. In addition, Ellis has shown that it appears probable that the laws of quantum dynamics which govern the motions and vibrations of the outer electrons apply also to the nuclear electrons. If this conclusion can be verified, it offers the hope that we may later be able to form some idea of the detailed structure of nuclei. Harkins has pointed out some very interesting relations that appear to exist between the relative abundance of elements in the earth and their atomic number, while the close study of stellar evolution should ultimately throw much light on the general problem.

Electricity Supply in Birmingham.

Details of the New Nechells Generating Station.

At the time when the Annual Convention of the Incorporated Municipal Electrical Association was held in Birmingham eight years ago, it was common though unofficial knowledge that the demands of the consumers of the electricity department had caused the Electricity Committee, on the advice of Mr. R. A. Chattock, to purchase a site at Nechells, on the outskirts of the city, and that preliminary work had been started there for the erection of a generating station. But Birmingham, fortunate enough in some ways, is not well favoured with places where power stations, which conform to modern ideas of design, can easily be erected. Coal supply is abundant, but water supply, owing to the absence of rivers, is more than usually limited. At Summer Lane, which was the principal generating station in 1914, a combination of canal water and cooling towers are used, but for this reason and owing to more physical difficulties connected with the site the ultimate capacity of 36 500 kW has been reached. Hence the original reason for building afresh at Nechells.

The Effect of the War.

So far the history of electricity supply development in Birmingham does not differ very greatly from that in many other towns. Nechells opens a new phase In the first place, it was decided to use the sewage effluent from the neighbouring sewage farm for cooling purposes, thus overcoming in an ingenious and successful way a problem which must always arise in towns situated as Birmingham ; and secondly, the outbreak of the war first caused the work to be discontinued ; then when an urgent demand for power and yet more power was made a temporary station had to be built ; and lastly, in 1919, work was resumed on the permanent station, work which is just now nearing completion.

A "Permanent-Temporary" Station.

It may be pointed out, however, that in spite of alternate booms and slumps demand has more than kept pace with supply. As a result the "temporary" station is in a fair way to become permanent and will at least be retained in use until some coalition between its plant and that in the "permanent" station can be made. For the time being the two stations feed into the network and are interconnected through special cables. The Nechells permanent station has a present capacity of 30 000 kW and an ultimate capacity of 105 000 kW.

A detailed description of the Nechells temporary station will be found in THE ELECTRICIAN, Vol. lxxv., p. 388, June 18, 1915. Its genesis was due to the reason mentioned above and to the fact that no other site could be found for the erection of the generating plant that was so urgently needed. Fortunately a site adjacent to the permanent station at Nechells was available, and here a station of 10 000 kW capacity was erected and got to work in the short space of eight months. This was partly achieved by making the buildings of a steel framework, covered with asbestos composition corrugated sheeting, an arrangement which, incidentally, saved a great deal of money. This station was subsequently increased to 22 000 kW capacity.

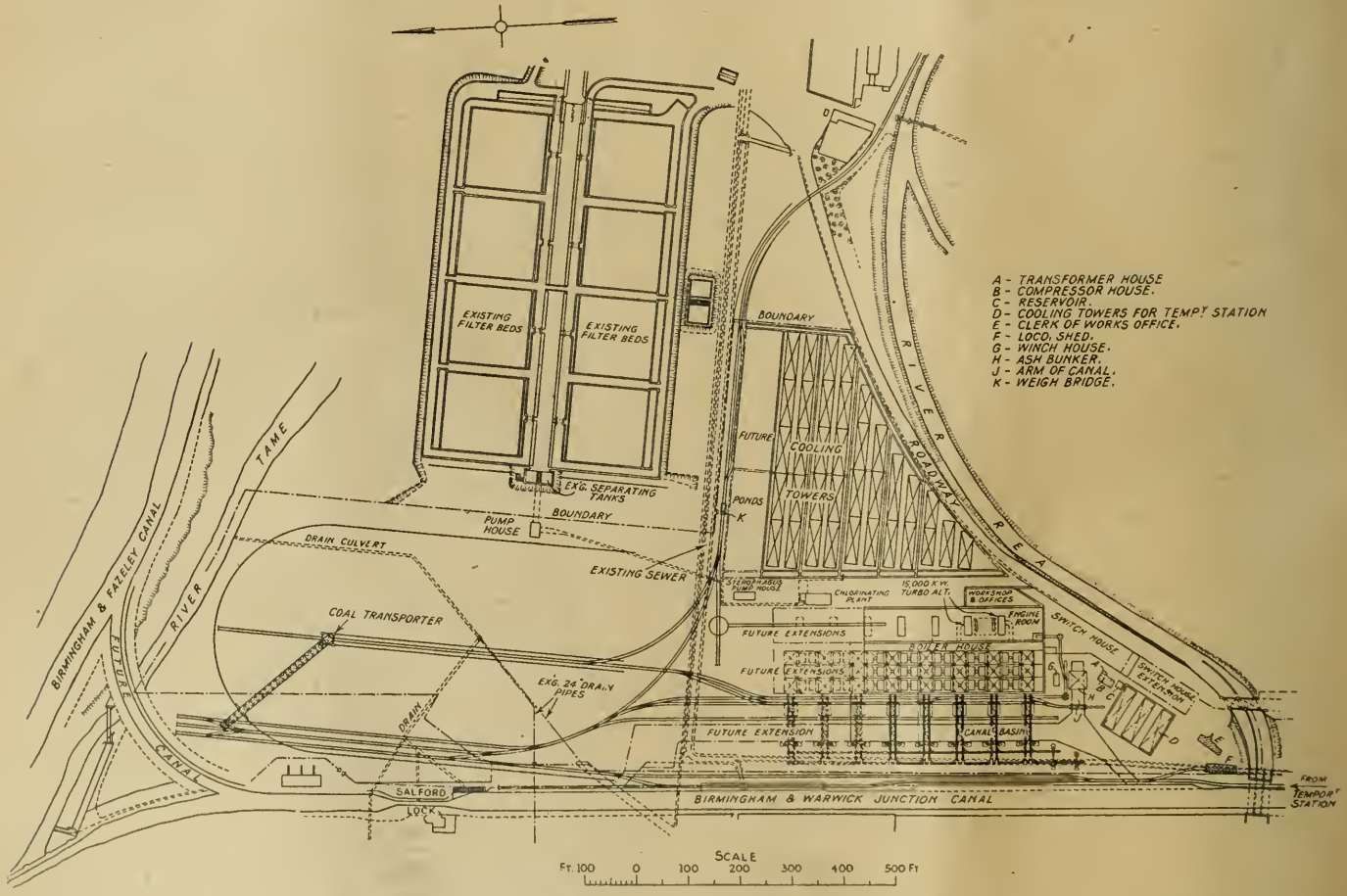


FIG. 1. SITE PLAN OF THE NECHELLS STATION.

Site of Permanent Station.

Turning now to the permanent station, the site utilised has an area of about 21 acres and is situated close to an industrial area where large power loads will be available. The surroundings are very open, and the site is bounded on one side by the Birmingham and Warwick Junction Canal. Railway connections can be made both to the Midland Railway main line to Derby and to the London and North Western Railway branch line from Stechford via Aston to the Black Country and Cannock Chase coalfields. Fig. 1 shows the boundaries and surroundings of the station.

As mentioned above, the site is close to a large block of filter beds belonging to the Tame and Rea District Drainage Board, from which approximately 3 000 000 gallons per day of filtered sewage effluent can be obtained for make-up for the towers used for cooling the condensing water.

Station Details.

The generating station, which is designed for an ultimate capacity of 105 000 kW, consists of an engine house, boiler

house, switch-gear house, workshop and offices, with cooling water reservoirs and towers, telpher system for coal and ashes, private canal basin having access to the Birmingham and Warwick Junction Canal (which is to be widened), railway sidings connected to the Midland Railway, and large coal storage accommodation. Fig. 1 shows the general lay-out, the portion shown in full lines being that already equipped, while the dotted lines indicate space available for future extensions.

Buildings.

It was determined after careful examination and consideration that, as the soil was composed largely of sewage sludge, and was soft, spongy and waterlogged in wet weather (being on the site of an old sewage farm), it would be necessary to support the whole of the buildings on ferro-concrete piles of a sufficient length to reach down to the bed of sandstone which runs pretty uniformly over the whole area, 17 ft. below surface.

The general plan of foundations was carried out on the Mouchel-Hennibique system of ferro-concrete construction. The total load on each cluster of piles in the boiler house is 276 tons, along the line supporting the wall separating the engine and boiler houses. The foundation raft constituting the basement floor of the boiler house consists of a slab of ferro-concrete 4 in. thick, divided by main secondary concrete beams into panels 13 ft. long by 5 ft. 3 in. wide.

The beds for the turbine foundations in the engine house consist of ferro-concrete slabs 15 in. thick, supported on 14 in. square piles, the total load on each bed being 1 180 tons. On the top of these come the massed concrete turbo-alternator foundations, bringing the level up from the basement to that of the operating floor.

The building work was carried out under the supervision of Messrs. A. Jackaman and Son, Ltd., of Slough. The architectural work was entrusted to Messrs. Ewen Harper, Bro., and Co., and the design of the ferro-concrete work to Messrs. L. G. Mouchel and Partners, Ltd.

Cooling Tower Foundations.

The foundations for the cooling ponds and cooling towers involved some very heavy ferro-concrete beam work and containing walls. The cooling ponds carry 10 ft. 6 in. depth of water, and are entirely above ground level. The whole system of beams is connected by a continuous slab of concrete 5 in. thick, forming the bottom of the ponds. An idea of the extent of the cooling tower system may be gained when it is remembered that there are at present 17 towers installed, and that there will ultimately be no less than 41 towers.

Owing to the shortage of bricks and of labour in the building trade, the architects desired to reduce to a minimum the employment of such trades as would be drawn upon largely in the erection of domestic houses, and decided to carry the whole weight of the structure and equipment upon steel stanchions and girders. The brickwork shell could then be considered as a covering only, with the result that the walls above ground-level in no case exceed 14 in. thick.

General Arrangements.

The engine house, see Figs. 2 to 5, at present measures 218 ft. 9 in. in length by 66 ft. 3 in. in width by 72 ft. high (to the underside of the roof); but an extension of 65 ft. 9 in. for the third turbo is now being commenced, and for future requirements there is a further extension available of 240 ft. 9 in., making an ultimate length of 525 ft. 3 in.

The boiler house at present measures 218 ft. 9 in. in length by 98 ft. wide by 54 ft. high; but an extension of 306 ft. 6 in. is available for future extensions, making an ultimate length of 525 ft. 3 in. The feed tank floor is at a height of 36 ft. above firing floor, and the pump room floor at 18 ft. above firing floor. The steel chimneys (104 ft. high) are carried upon a platform at a height of 32 ft. above firing floor.

The workshop and office block adjoins the engine house, and consists of stores, messrooms, workshop, battery room and offices.

The switch house block (see Fig. 1) adjoins the end of office block and of engine house, and consists of a covered yard (in which is situated a turn-table), control room, switch room, galleries, etc., a section of the building being in three storeys and the rest in two storeys; a granolithic staircase giving access to all floors. The transformer cubicles, for the 30 000 V transformers, are built into the west side of the switch-house block, at yard level.

The Control Room.

The control room occupies one end of the floor over the cartway, and covers an area of 5 400 super. ft., and is 20 ft. high. It has access to the engine room by the main staircase and is provided with large windows on both outer walls and towards engine room.

The switch room adjoins the control room, and has a height of 32 ft. a width of 44 ft. and a length of 79 ft. 2 in. On the floor of this room are situated the heaviest (or "M") oil switches. The general arrangements of the station are given in Figs. 2 and 4.

Coal-Handling Plant.

The contract for the coal and ash-handling plant was let to the Mitchell Conveyer and Transporter Co. The coal-handling plant was required to deal, on a large scale: (1) With coal arriving by railway truck, or (2) by barge. In the first case plant had to be provided for tippling the trucks bodily over the grabbing pit, then for removing the coal at the rate of 40 tons per hour per boiler house bay; lifting it through a height of 50 ft., traversing it from 200 to 300 ft., and dropping it into the coal bunkers situated over the various boiler-house sections at the top-floor level of boiler-house.

In the second case, the plant had to be suitable for lifting the coal by means of grabs out of the barges in the canal, or the canal siding, at the rate of 30 tons per hour per boiler-house bay, traversing some 200 to 300 ft. (ultimately some 500 ft.), lifting it some 50 ft. and dumping into the hoppers in the various boiler-house bays, at the top-floor level.

The wagon tipplers for discharging the railway trucks on to the coal dumps are entirely automatic, and are the latest form of labour-saving device. They can deal with 120 tons of coal per hour. Special advantages are claimed for this form of tippler, in the matter of distribution of the coal, quick handling later by the grabs, and avoidance of damage to railway trucks.

Ash-Handling Plant.

The ash-handling plant is required to collect the ashes and riddlings from the hoppers under the boilers (of which there will ultimately be 42), carry them to a convenient storage centre, and feed them from thence either into railway wagons or into barges. For the first three boiler sections equipped the capacity of the plant is sufficient to deal with 30 tons of ashes, clinker and riddlings per hour.

There are two trucks and an electric locomotive for dealing with the ashes and clinker, and one truck for dealing with the riddlings. A complete system of 30 in. tracks is laid under the boilers in the basement. These lead to the foot of the two ash hoists.

The capacity of the ash bunker, which is of ferro-concrete construction, is 300 tons.

Cooling Towers and Circulating Water System.

The sewage effluent used for cooling is first passed into a chlorinating house, where it is sterilised by chlorine treatment. Thence it passes through a suction culvert to the condensers, and from the condensers it is forced through discharge piping to the tops of the sprayers in the cooling towers and thence falls into the cooling ponds.

The contract for this work was divided up as follows: Cooling tower foundations, including cooling ponds and suction culvert and chlorinating house, A. Jackaman and Son, Ltd.; cooling towers, The Davenport Engineering Co.; heavy suction and discharge pipework and valves connecting cooling towers with condensers, E. E. Jeavons and Co.

The cooling towers are of the natural draught chimney type, capable of dealing with a total capacity on normal full load of 2 877 500 gals. of water per hour, reducing the temperature from 92° F. to 75° F., with atmosphere at 55° F. and 80 per cent. humidity.

There is a "main" trough, two "intermediate" troughs, and a large number of "distributing" troughs in connection with each tower. An excellent view of these cooling towers is given in Fig. 3.

Boilers and Steam Piping.

The boilers and steam and feed piping were supplied by Babcock and Wilcox, and the chimneys and Prat induced draft arrangements by Utting and Co. The first section of plant consists of twelve land type marine water tube boilers, each complete with an integral superheater, superposed steel tube economiser, and chain grate stokers.

Each boiler has a heating surface of 5 348 sq. ft.; the superposed steel tube economiser having a further heating surface of 3 393 sq. ft., making a total effective heating surface of boiler and economiser of 8 741 sq. ft. The boilers are constructed for a working pressure of 320 lbs. per sq. in., while

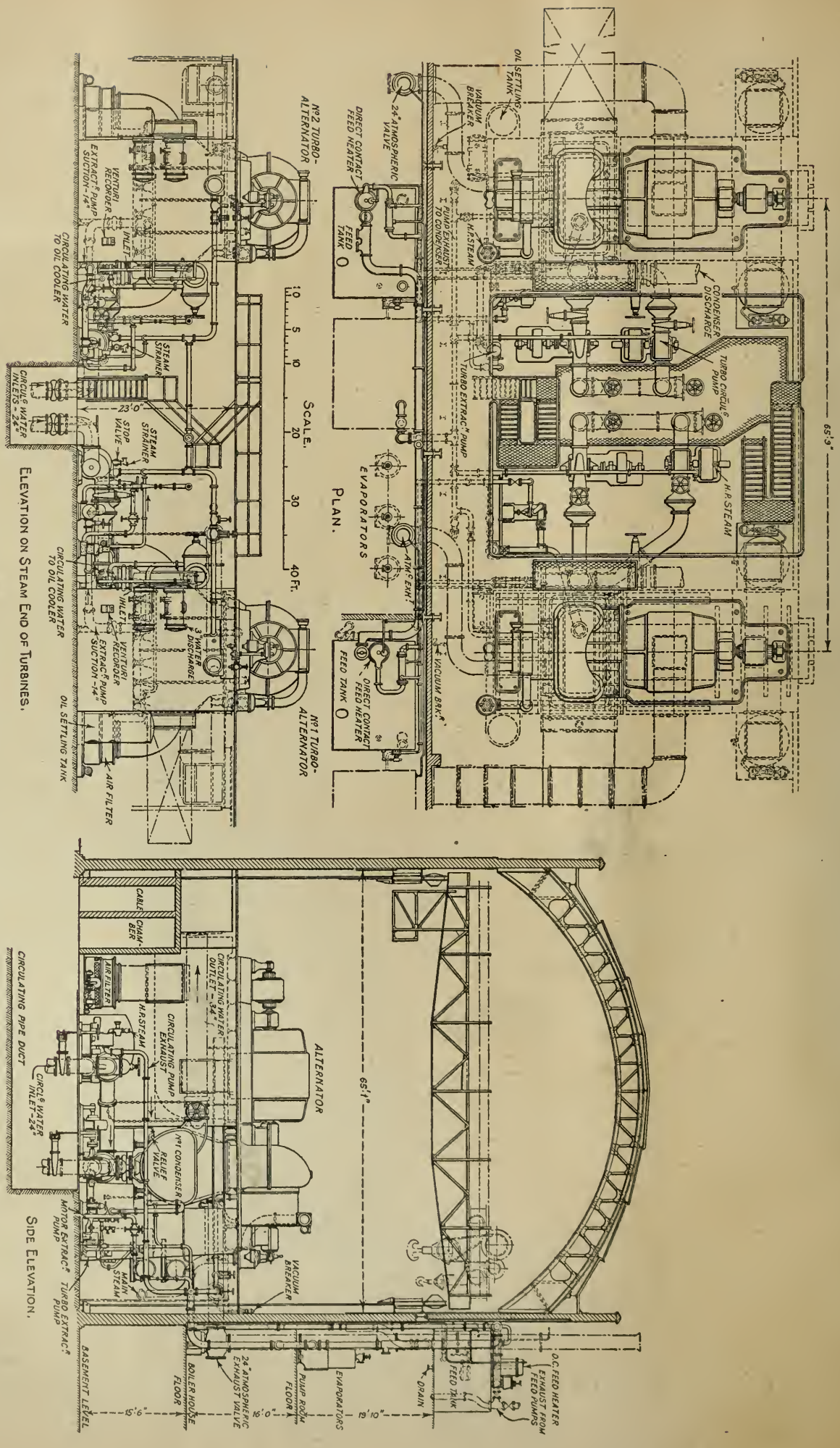


Fig. 2.—Plan and Elevations showing general arrangement of Turbo-alternators, Condensing Plant, Pumps, etc., at Nechells.

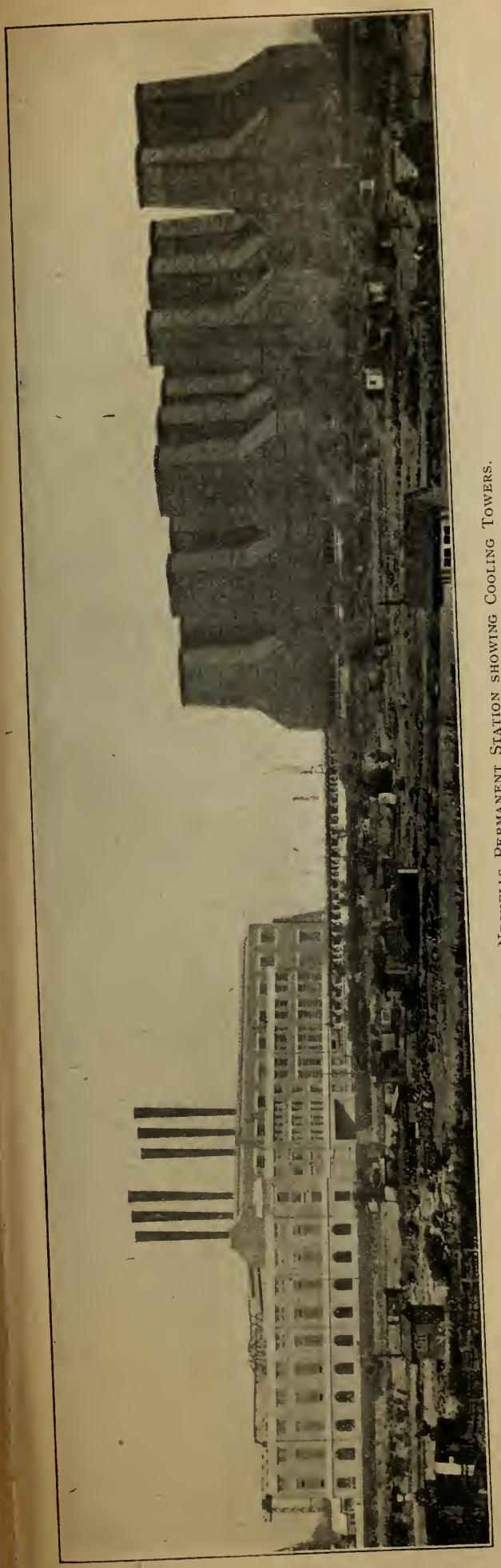


Fig. 3. View of Nechells Permanent Station showing Cooling Towers.

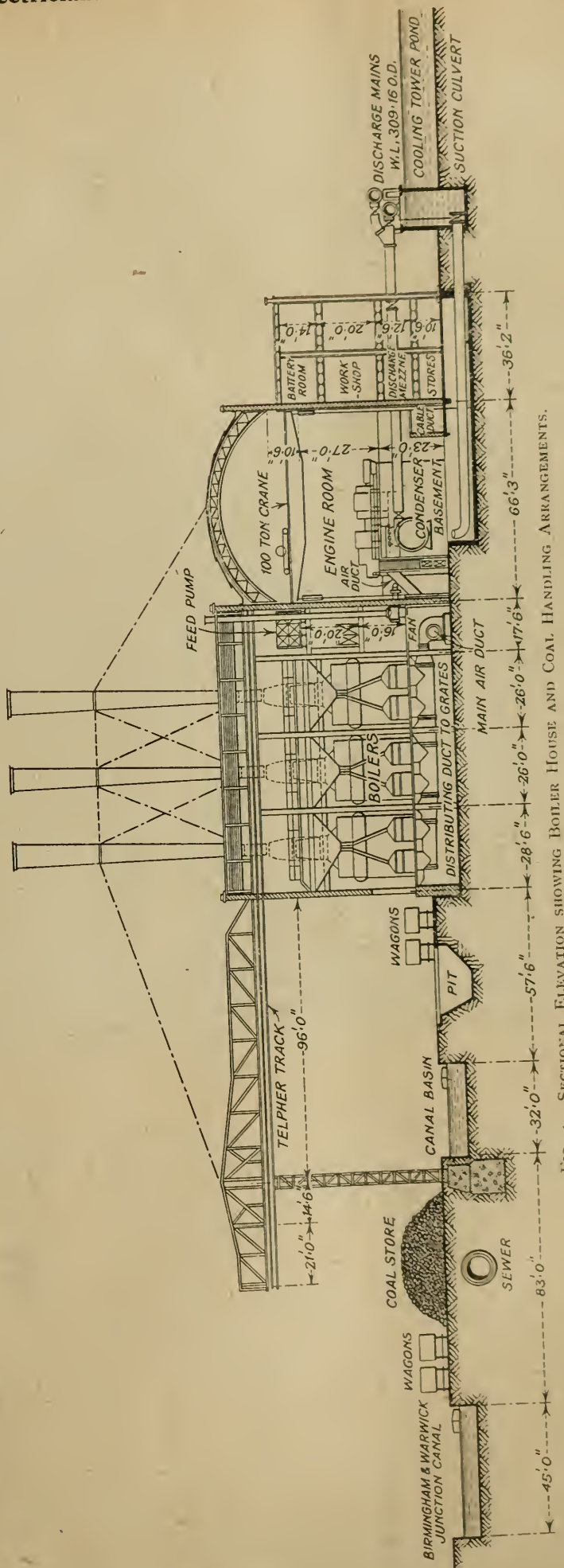


Fig. 4. Sectional Elevation showing Boiler House and Coal Handling Arrangements.

provision is made for superheating the steam to a final temperature of 700° F.

The chain grate stokers have a grate area, per boiler, of 224 sq. ft., are provided with forced draught attachment and, when burning fuel with a calorific value of 9 000 B.Th.U.'s and with a feed inlet temperature to the economiser of 150° F., each steam-raising unit is designed to easily evaporate 35 000 lbs. of water per hour under normal working conditions, with a maximum evaporation, when desired, of 42 000 lbs. of water per hour.

The first four groups of boilers deliver their steam through two 12 in. branches, with a separator in each branch, into a 12 in. cross-over main running parallel with the engine-house. From the cross-over mains 12 in. steam pipes branch off to the turbines.

There are four Weir reciprocating, and two turbine-driven pumps—all driven by steam. The six feed pumps deliver into two 8 in. mains of mild steel throughout: these are made for a working pressure of 375 lb. per sq. in.

shunt wound d.c. generator for the purpose of supplying auxiliary plant requiring d.c. current.

Alternator Construction.

The stator windings are of the bar type, arranged in two layers, in slots of the open type. The slots have openings shaped to accommodate dovetail section keys of impregnated hard wood which hold the windings securely in position. The winding consists of an upper and lower layer of conductors, there being one conductor per layer per slot. The end portions of the windings are supported by deep section bronze wings, well insulated and mounted on brackets on the end flanges.

The ventilation both of the stator and of the rotor is efficiently carried out and thermo-couples, embedded in the stator windings during construction, permit of the temperatures being observed during operation of the machine. The stator windings are subjected to a high potential test of 12 000 V for one minute, both to earth and between phases, before the machine is put into service.

Fig. 5. General View of the Turbine Room at Nechells.

Turbo-Alternators.

The contract for the two turbo-alternators, air filters, condensers, air and circulating pumps, water extraction pumps, feed heaters, evaporators, Venturi meters and atmospheric relief valves, was placed with The British Thomson-Houston Co., who sublet the condensers and other auxiliaries to G. & J. Weir, Ltd., and the air filters to Wm. Grice and Sons.

The two turbo-alternator sets each consist of a high-pressure Curtis horizontal combined-impulse type steam turbine, suitable for working at 300 lbs. pressure (gauge) and 278° F. of super heat (total—700° F.) with 28 in. vacuum, coupled to a 22 500 kVA alternator designed for giving a maximum continuous load as above either at 80 per cent. P.F. or at 66·6 per cent. P.F. at a speed of 1 500 revs. per min.

The normal full load current of each alternator is 2 470 A at 5 250 V when delivering its maximum continuous output, *i.e.*, 22 500 kVA. The instantaneous short circuit current (with full load excitation) will amount to approximately six times normal current.

The exciter for each alternator is mounted on an extension of the shaft and is 125 kW capacity at 220 V. It is capable or giving 20 per cent. more current and voltage than is required at 22 500 kVA at 66·6 per cent. power factor.

On the same shaft with each alternator there is also carried (in combination with the exciter) a 250 kW 440 to 460 V,

The rotor is of the cylindrical non-salient-pole type, with distributed windings. Axial and radial openings are provided through the rotor core at different points, to assist ventilation. The rotor windings are of solid copper strip, edgewise wound, insulated from one another with mica, and from the core by means of mica and fibre troughs. The slot keys are of hard copper and are connected at each end of the rotor to massive bronze end plates, so as to constitute a squirrel cage winding on the rotor. A view of the two sets at present installed is given in Fig. 5.

Air Filters.

The air filters supplied for the two alternators are of William Grice and Sons' manufacture, and are of their twin type "Invincible" wet air filters, each twin unit being capable of dealing with 60 000 cu. ft. of air per minute. Each filter is driven by a 1·75 H.P. direct current motor.

Condenser Details.

The surface condensers are of G. & J. Weir's manufacture, and each deal with 198 000 lbs. of steam per hour, and maintain a vacuum of 28 in. with barometer at 30 in. of mercury, and require 18 500 gallons of circulating water per minute at a temperature of 75° F. The cooling surface is 24 500 sq. ft.

The air pump is of the steam ejector type. Two sets, each at full duty, operate on one condenser. The joint consumption

is 1 130 lb. steam per hour at 150 lbs. pressure. The water circulating pumps are by G. & J. Weir and are in duplicate, one being turbine-driven and the other motor-driven, each set operating at half duty (*i.e.*, 9 500 gallons per minute) the total head is 51 ft. The water extraction pumps are also by G. & J. Weir and are also in duplicate, one being turbine-driven and one motor-driven. Each pump will deal with 198 000 lbs. of condensate per hour. The Weir ejector heater deals with the condensate before it enters the direct contact heater and utilises the exhaust from the air ejector for this purpose.

A Weir direct contact feed water heater imparts the final elevation in temperature to the condensate before it enters the hot-well tank, and utilises for this purpose the exhaust steam from the water extraction pump turbine and the circulating pump turbine, augmented by exhaust steam bled from the L.P. turbine if a higher temperature is desired. The evaporators are each capable of evaporating 7 000 lb. of water per hour when supplied with saturated steam direct from the boilers. The Weir boiler feed pumps, which are in duplicate and of two kinds, draw either direct from the hot well tanks, or alternatively from the condensed water tanks, through the normal, or the emergency, feed suction ranges.

Fig. 6. The Main Switchgear from Above, Showing the Massive Construction.

Step-up Transformers.

Standard 30 000 V Ferranti transformers are used to step up the pressure at Nechells from 5 000 V—the bus-bar pressure—to 30 000 V for transmission to the Summer Lane generating station (where it is stepped down to 5 000 V), and to the Bournville substation on the extreme south-west of the town, where the current is fed into the 5 000 V distributing system.

For this purpose two 10 000 kVA banks of Ferranti single-phase transformers, each having a rating of 3 500 kVA per transformer, with a ratio of 18 500/5 350 V with one spare single-phase unit, are employed at Nechells, one similar 10 000 kVA bank being at Summer Lane, and a 5 000 kVA bank at Bournville. In the last-mentioned case a spare single-phase unit will also be available.

The banks are all star-connected on the high tension side and delta-connected on the low tension side. The technical data for the two types of single-phase transformers are: 5 per cent. tappings are supplied on the L.T. side. The open-circuit watts at 15° C. are 12 500 and 9 000 W for the small and large sizes respectively.

The regulation at unity P.F. is 1·1 per cent. and 0·85 per cent. respectively. Regulation at 0·8 P.F. is 4·0 per cent. and 3·5 per cent. The reactance is 5 per cent. and 4·5 per cent. The efficiency of the large size is 98·5 per cent. at 1/1 load and 98·75 per cent. at half load, and of the small size 98·7 per cent. and 98·6 per cent.

Switchgear.

The contract for the initial installation of high tension switchgear was placed with Reyrolle and Co. The apparatus which will ultimately have to be controlled by the switchgear is as follows: seven 22 500 kVA alternators; six group feeder buses (each for 10 000 kVA; six 30,000 V 10 000 kVA transformers and trunks, to suitable distributing centres—all (including generators, transformers and group feeders) directly off the main bus bars. A view of the gear is given in Fig. 6.

The group feeder switches will each feed through reactances on to feeder bus bars, and from these latter bus bars there will run link mains to other generating stations, and ring main feeders for direct distribution to consumers, and such local supply circuits as are required for the needs of the station itself.

On referring to the skeleton diagram of switchgear connections (Fig. 7) it will be seen that the main bus bars are in duplicate and that all those oil switches which are directly on these bus bars are provided with duplicate isolating switches, by means of which the oil switch may be put selectively on to either set of bus bars.

All the oil switches at present installed on the main bus bars are of the "M" type of Reyrolle gear, which is capable of breaking a short circuit representing momentarily 1 500 000 kVA. The alternator switches are each rated at 3 000 A continuous carrying capacity. There are no potential transformers direct on the main bars (these being placed on the generator side of the generator switches and on the load side of the other switches); thus one source of risk is avoided. The nine switches on the feeder bus bars are of the Reyrolle A.2 draw-out armour clad type, and are automatic and of 500 000 kVA rupturing capacity.

Trunk Connections.

The 30 000 V 10 000 kVA trunk connections between the Nechells permanent station, the Summer Lane station and the Bournville substation are controlled, on the H.T. side, by Reyrolle "R 2" type switches, and are not without interest.

By means of the two 30 000 V 10 000 kVA trunks, the

present Summer Lane generator load will be very greatly eased, by being partly transferred to Nechells, in addition to the easement already afforded by the Nechells Temporary Station (some 20 000 kW).

The main switches ("M" type) for the 30 000 V step-up transformers have a normal rating of 1 500 A.

Group Feeder Switches.

The group feeder switches of 1 500 A capacity control the group feeder single-phase cables leading to the feeder bus bars in which cables are inserted the group feeder reactances each designed to normally carry 1 500 A and absorb 120 V. The reactances are of British Insulated and Helsby Co.'s design and manufacture.

Link and Ring Main Switches.

The "A.2" switches on the group feeder board are of a smaller breaking capacity (500 000 kVA) but are protected by the group reactances and again by the "M" group feeder switches on the main bus bars.

The whole of the foregoing switchgear is provided with electrical and mechanical interlocks in accordance with Reyrolles' standard practice, thus rendering all switches safe to handle.

Control Room Equipment.

The control room is equipped with four main sets of control boards—viz., (*a*) for the main alternators, step up transformer switchgear and the group feeder switchgear; (*b*) for the 5 000 volt ring mains and works supply, also link mains between stations; (*c*) for the low-tension a.c. supply; (*d*) for the d.c. supply. A feature of the main a.c. e.h.t. control board is the presence of an electrically operated diagram of connections of the switchgear. By this diagram the operating engineer can see at a glance the exact position of all the main "M" switches and isolating switches in the station.

Main Cables.

The whole of the main alternator cables between the alternators in the turbine room and the main oil switches in the oil switch room are single-core cables, paper insulated and lead sheathed, and of 0·5 sq. in. sectional area (six cables in parallel to each phase of machine) and were supplied by Callenders Cable and Construction Co.

A cable bridge over the River Rea is intended for the outlet of the 30 to 40 ring main 1 500 kVA feeders, and the two 30 000 V trunks the former of which will eventually carry the distribution supply to the north and east districts of the city: also for any future 30 000 V trunks (feeding the central and south and south-west or other districts).

The six single-core 0·25 sq. in. 30 000 V cables, connecting the high tension windings of the two 10 000 kVA step-up transformers with the switchgear, were supplied by Callenders, as were also the two six-core 0·185 sq. in. 5 000 V split conductor cables, connecting the Nechells "Permanent" station with the Nechells "Temporary" station.

Trunk Feeders to Summer Lane and Bournville.

The trunk feeder cables between Summer Lane and Bournville are for 30 000 V pressure at the delivery end and are of W. T. Henley's manufacture. They have the following characteristics: The cables are of 0·2 sq. in. three-core paper insulated, lead-sheathed, served armoured with a single layer of galvanised steel wires, and again served.

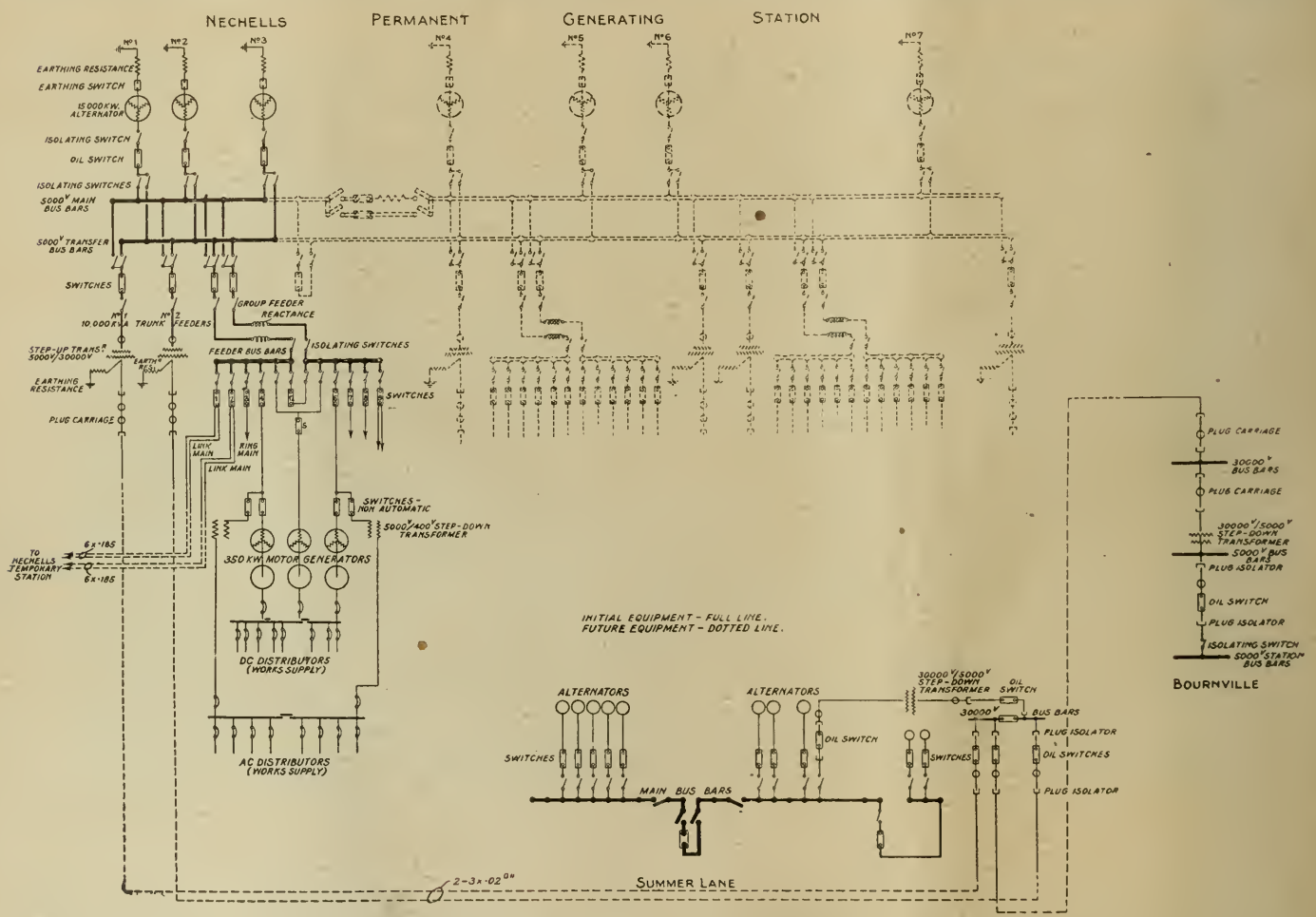


FIG. 7. DIAGRAM OF SWITCHING ARRANGEMENTS AT NECHELLS SHOWING INTERCONNECTION WITH SUMMER LANE AND BOURNVILLE.

We have to thank Mr. R. A. Chattock, city electrical engineer, Birmingham, for giving us an opportunity of inspecting and describing this interesting station.

Electricity Supply in Ayrshire.

An interesting scheme for the formation of a Joint Electricity Board for Ayrshire, consisting of representatives of the County Council and of the Burgh of Kilmarnock, has been put forward. The scheme has been formally approved by the County Council, and as the Electricity Commissioners are said to be favourable, it will probably take definite shape in a short time. In a report, Messrs. Merz and McLellan state that a joint Board would be of great advantage to the county, as it would be able to develop electricity supply on uniform lines under one management for practically the whole county. The County Council will assume responsibility for about £200 000 of capital expenditure, and as soon as the Board is formed an offer will be placed before Ayr Corporation, who will be asked to abandon the Loch Doon scheme and join the Board.

Correspondence.

"MAIN LINE RAILWAY ELECTRIFICATION."

To the Editor of THE ELECTRICIAN.

SIR,—Your leading article on this question in your issue for the 2nd instant has probably an interest for many of your readers besides myself, and I therefore crave the hospitality of your columns for a few notes on same, as well as on Mr. Roger Smith's "impressions," published in the same issue.

I may say I have no axe to grind with reference to the use of single-phase current, and therefore will content myself with saying that it seems unfortunate that the pioneers of this system have so persistently stuck to a frequency as low as 16⅔ periods, whereas I understand that there is no material additional loss in single-phase locomotives, if run at 25 periods. If they had from the beginning pronounced equally favourably for 25 periods as for 16⅔ periods, the probability is that they would have disarmed a good deal of the criticism which has been levelled at the latter, more particularly as regards the impracticability of making generators for this periodicity, and the fact that in London, Birmingham, and Glasgow, a supply at 25 periods could be obtained, would have helped their cause.

No doubt it will be said that the supply in these three cities is three-phase, but I cannot see that there is any insuperable difficulty in taking a three-phase supply off the busbars through step-up transformers, and delivering to substations in which the load may be only *partly* balanced, since the traction load would, in any case, be only a fraction of the total load.

Even in the case of Manchester, which has no 25-period supply on a large scale, I suppose that this would have been forthcoming had there been a demand for it, and it is surely not without significance that the Hell Gate Station, in New York, one of the largest and *very latest* stations in the world, generates equally both 25 and 50 periods, and is laid out with this object.

The other point which I desire to bring forward is that, while in America there has been no particular incentive, with their overhead transmissions, to cut down the frequency, from the point of view of line construction, yet, in this country, where we are almost pledged to *underground* transmission, we are cutting our own throat and precluding the use of the higher voltages, which we shall certainly endeavour to make for, by insisting upon 50 periods. The dielectric hysteresis losses at 50 periods will undoubtedly be rather serious if we ever succeed in getting up to voltages of 100 000 to 150 000 V, and special means will have to be devised for their reduction.

I know that at the moment we are carrying along merrily at 30 000 V, but it must be common knowledge to all those who have looked at all into the question of main line electrification, or of the interlinking of important cities or areas, that 30 000 V is terribly uneconomical as compared with what we might do if able to run up to 100 000 V.

Mr. Roger Smith states in his article that "with three-phase transmission it is doubtful if one generating station could economically feed to a greater radius than 25 miles." I agree that it is doubtful, *if we are limited to 30 000 V*, but I do not think it is at all impracticable to consider 50 miles if the voltage could be raised to 100 000. Hence, if this figure could be attained, the arguments which Mr. Roger Smith deduces as to the steam generating station, for the railway load alone, being too small, would be considerably weakened —if not cancelled.

The fact that 25 periods has proved no disqualification to the Glasgow and Birmingham Corporations, and the Clyde Valley Co., obtaining a very large motor load proves that there is still a great deal to be said for 25 periods as a general proposition, and the importance of being able to extend the area of operations of those stations which are *really* able to generate economically may well prove to be worth as much as a slightly reduced cost on industrial motors and on transformers.—I am, etc.,

SIGMA.

THE REMUNERATION OF TECHNICAL ENGINEERS.

To the Editor of THE ELECTRICIAN.

SIR,—I would like to draw the attention of technical engineers to the notable victory just gained by the strongest and closest Union in the world, viz., The British Medical Association. I claim that in forcing the Manchester City Council to recommend the payment of £1 700 to £2 000 per annum to their Health Officer this Association has given a wonderful lead to other unions of technical men. It is noteworthy that there have been no fireworks—no processions—very little newspaper publicity—simply a dignified protest at the low figure offered (£1 500 per annum) and then the ban.

I would like you to ask Technical Engineers what would happen if a similar situation arose in the appointment of an engineer. Just an undignified rush for the position without any reference to any representative body, and with very little consideration as to whether the position was worth more or not. And why?—Bad times. Nonsense! In times of full shops and plenty there would still be the same rush for any position offering £1 500 per annum. Yet engineers are quite as necessary as—perhaps more necessary to the common good than—the doctors. The reason is simple. There is no representative body to apply to. We, as technical engineers, are not strong enough to protest against low salaries—disgracefully low in many cases. The moulders are—members of the railway unions are—and yet we consider ourselves intelligent men. Yea, even the salt of the earth—some of us.

Surely the one instance I have cited shows the necessity of getting together and giving our society the power to assert itself and to exert its power in its members' interests, as was done by the B.M.A.

The only way this can be done is by wholehearted co-operation among technical engineers, through the medium of a society such as the Society of Technical Engineers.

TECHNICAL.

Automatic Train Stops.

The REPORT OF THE COMMITTEE appointed by the Ministry of Transport in October, 1920, to inquire into automatic train control and to examine devices under trial was published on Tuesday.

The Committee find that there is a *prima facie* case for automatic train control on British railways, and that the method most likely to suit existing conditions on British railways should supplement rather than replace existing block telegraph and signalling systems, and comprise (*a*) automatic train-stop, located at or near selected stop-signals, which shall, in the event of a train passing such signals when they indicate danger, bring the train to a standstill; (*b*) automatic warning control at distance signals, and at other places where danger from too high a speed may be anticipated.

The Committee have drawn up a series of conditions with which any acceptable system of automatic train control should generally comply. The estimated cost for the full scheme on passenger routes on which there are two or more lines in existence is:—First cost, £4 660 000; annual charge, £407 000. The Committee recommend the immediate formation by railway companies of a committee of experts to standardise track and locomotive apparatus, having regard to differences in structural and loading gauges.

The report is unfavourable to the adoption of the continuous type of control, which aims at entire and constant protection of a train at all stages. With regard to localised (intermittent) control, the Committee state that the contact type of apparatus has proved reliable after many years' operation under working conditions, and capable of withstanding satisfactorily the effects of high-speed traffic, but they cannot recommend it for British conditions.

London Electricity Supply.

It will be remembered that the Electricity Commissioners in announcing their decision on the scheme submitted at the LONDON INQUIRY, stated that they concurred generally in the technical proposals for the first stage of development, but that they differed from the promoters on the proposals for the second stage. By the alternative proposals of the Commissioners for the later stage, it was estimated to bring about "an annual saving of upwards of £1 000 000 (15 per cent.) and 10 per cent. in fuel, with all the advantages derivable from a capital station, such as availability for large railway or other supplies in bulk on favourable rates." Subsequent correspondence took place between the Commissioners and the Engineering Committee, with the result that the Commissioners have agreed that a substantial modification must be made in the figures for comparative purposes with a consequent substantial reduction in the estimated saving between the Commissioners' proposals and those of the promoters.

The Commissioners are of opinion that in fairness to the Engineering Committee this should be made known to the promoters. They, nevertheless, adhere to their conclusion that their alternative proposal to supplement existing stations during the *second* stage by capital stations (if the rate of growth estimated by the promoters is realised) will result in substantial economy compared with a further comprehensive extension of existing stations. The impression which appears to have arisen that the Commissioners desire to fetter the engineers of the future Joint Authority by proposals made now for dealing with the demands during the second stage of development, is unwarranted. The consent given by the Commissioners to the County of London Electric Supply Co. to construct a station at Barking with an installation of 100 000 kW. is "for the needs of the County Co.'s own statutory obligations only." Whether or not that station will hereafter be made a capital station for wider purposes is a matter for consideration by the future Joint Authority in the first instance and for subsequent approval by the Commissioners.

The "Empire" High Tension Fuse.

A considerable amount of thought has recently been given to the problem of limiting the area of disturbance caused by a short-circuit on a high tension network. As a result much protective apparatus has been devised, and schemes, both complicated and simple, have been evolved with the object of ensuring that the faulty portion shall be cut out with accuracy and speed, and that the sound portions shall be left in circuit. One of the ways of doing this, which at least has the merit of simplicity, is that well-known device, the fuse, of course specially designed and constructed for the conditions which are present on high tension networks.

"Empire" Fuse.

A fuse of this kind which seems to fulfil all the essentials is the "Empire" S. and C. high tension fuse. This, we are informed, is the result of many years actual experience under working conditions in the United States, and we are therefore interested to learn that the British rights of manufacture have been exclusively secured by Electric Control, Ltd.

Constructional Details.

As our illustrations show, the construction of the "Empire" S. and C. high tension fuse is quite simple. It consists of a strong glass tube of the same strength and quality as used for high pressure steam gauges. Inside the tube there is a spring, one end of which is connected to a brass ferrule, the other end being fixed to the fuse wire, which passes through a cork and is connected to another short wire fixed to the top ferrule.

Between the cork and the spring, and fixed to the latter, is a funnel-shaped liquid director. The glass tube is filled with a non-inflammable liquid which has a dielectric strength of 250 000 V per in.

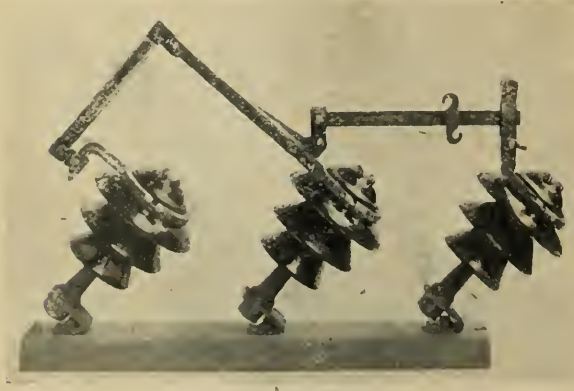
Instead of the ferrule type of contact, the fuses for the larger currents are fitted with knife blade contacts as shown in Fig. 2.

Operation of the Fuse.

The operation of the fuse is as follows: The melting of the fuse wire releases the spring, which instantaneously contracts, and thus introduces a large gap into the circuit. Simultaneously the liquid extinguishes the arc and thus interrupts the flow of current, the rapidity of its action being accelerated by the liquid director, which is drawn down by the spring, and thus causes the liquid to be forced directly on to the moving terminal. The length of the fuse depends on the voltage, and the size of the different parts on its continuous current capacity.

The large gap and high dielectric strength of the liquid gives, it is claimed, a factor of safety equivalent to several hundred thousand volts.

It can be seen at a glance when an "Empire" S. and C. fuse has blown, owing to the closed spring leaving a large clear space. Fuses



Knife Blade Contacts.

mounted on outdoor pole installations can easily be detected by the linesman from the ground, which, in addition to saving a great deal of time, reduces the danger to life to a minimum.

Tests show that these fuses will clear short circuits without causing the circuit breakers to trip. To take a particular example, on the A fuse successfully opened a short circuit of 1 170 A in 0·013 sec. Other important points are that the fuses always open on the zero point of the current curve and no danger has been experienced or anticipated from the glass container breaking.

Electric Power Supply in East Norway.

H.M. Minister at Christiania has informed the Department of Overseas Trade that the Commission, appointed by the Storting in 1918 to investigate the question of a National Scheme for the supply of electricity to the whole of Norway, has agreed on temporary recommendations for the power supply of East Norway. The recommendations have not been published, but in a *communique* to the Press, it is stated that the Committee are of opinion that to furnish an efficient supply of electricity to East Norway the district must be treated as a unit. The main source of power for the district will be the Nore power station, of which the construction should be continued. In the meantime, the Raanaasfos power station has been finished, but is not under full load. The Mrkfos-Solbergfos scheme will be completed in 1924, and will yield about 40 000 kW. There will be about 20 000 kW further available from the Rjukan station.

The new power is said to be comparatively expensive. The economic situation indicates that the increase in the consumption of power will not be very great during the next few years. The level of prices is falling and large constructional operations which can be postponed should not be pressed, but, in view of the prevailing unemployment, work should be continued on the Numodal Railway and on the Nore scheme, in which wages form the chief expense, while orders for pipe lines and machinery as well as the construction of the power station should be postponed. Considerable amounts of power can, however, be acquired at comparatively little cost by the regulation of the Glommon and Numedalslaagen operations, which also call for a comparatively large staff of men, but do not require so much in the way of material.

The power not sold in the district should be distributed by the State to convenient places within the various counties, and should be offered at a price of Kr. 150 per kW per year, decreasing to Kr. 125 as the regulation of the Glommen progresses. When the Nore power station comes into use the price should be reduced to the tarifi in force for that station. The price proposed does not apply to the Rjukan power. As, however, the Rjukan power line will, in the view of the Commission, retain a permanent value, this installation need not be written off as quickly as was the original assumption. It is also proposed that the price for this power when delivered at Kongsberg should be reduced to Kr. 125 per annum.

German Scientific Instruments.

Final evidence was taken on Monday by the Board of Trade Committee which is inquiring into the request of British manufacturers of optical and other scientific instruments for protection under the Safeguarding of Industries (Part II.) against German competition.

Major A. G. Church, general secretary of the National Union of Scientific Workers, said there was great difficulty in obtaining British scientific instruments of the more uncommon type. Research and teaching institutions considered that they were being badly treated under the Act, and he quoted Sir J. J. Thomson in support of the statement that Part I. had greatly increased the difficulties of research. Witness regarded research as a key industry which should be entitled to protection against the present Act. He gave particulars of various institutions in which researches had been delayed or abandoned.

The results of the Act were: Increased costs, waste of time on preparation of materials which would be more profitably spent on research, and spoilage of work owing to restrictions put upon importation of glass and laboratory ware of the requisite standard and quality. The Act had been characterised as a "nasty German device for ruining British industry." Scientific workers feared that British manufacturers did not realise the essential importance of improving the quality of their wares, and protection against outside competition would inevitably tend to things being left much as they are.

Mr. S. Segal said that since the introduction of the 33⅓ duty his business of scientific instrument importer had dropped by 60 to 70 per cent. The production of cheap-grade opera and field glasses was almost totally a French industry, and the trade in those had disappeared since the duty had been levied.

Sir Arthur Colefax, K.C. (for the applicants), announced that it was their intention to withdraw the claim with respect to electrical apparatus.

Mr. Inskip, K.C., M.P., submitted on behalf of the opposing firms that the present conditions in the industry were largely due to temporary post-war influences. Some manufacturers had over-produced during the post-war boom and the policy had proved disastrous when the slump came. The evidence given did not establish the points which the Committee had been asked to consider.

Sir Arthur Colefax submitted that German catalogue prices of many firms were purely fictitious. By reason of the depreciated currency with which the low cost of manufacture was bound up German goods were sold here at prices with which we could not compete. He did not believe research would suffer to any appreciable extent, and, on the other hand, national interests and employment might be assisted.

Railway Companies' Power Supplies.

The inquiry by the ELECTRICITY COMMISSIONERS into the proposals of the S.E. and C. Railway Companies and the West Kent Electric Power Company to erect generating stations and supply the electrical energy for working certain of the lines of the S.E. and C. Companies, and also an offer of the County of London Electric Supply Company to supply the railway companies' requirements from their proposed Barking station was concluded on the 15th inst.

Mr. R. H. HOUGHTON, chief electrical engineer to the L.B. and S.C. Railway Company, said the company had 22·4 route miles or 69·6 single track miles of their system electrified. The annual consumption was 16 080 000 units, purchased from the London Electric Supply Corporation. The electrification of another small section of 5·8 route miles, or 25·6 single track miles was in hand. A scheme had been prepared for the electrification of the whole suburban system, which included 101 route miles, or 400 single track miles. The electrical energy required was over 200 million units per annum and the maximum demand would be 63 000 kW. The supply at present was at 6 700 V. If the complete suburban scheme were carried out the voltage would be changed to 11 000. The electrification at present went to Selhurst, but the company had a scheme before the Ministry of Transport which would go as far as Coulsdon. There was also a scheme for electrifying to Cheam. They had found the supply from the London Electric Supply Corporation perfectly satisfactory.

County of London Company's Offer.

The Hon. EVAN CHARTERIS (for the County of London Electric Supply Co.) read the offer of the company to the South-Eastern Railway Company. The County Company would supply electrical energy to the South-Eastern Company at a periodicity of 50 and a pressure of 33 000 V, the supply to be sufficient to deal with a railway load of 30 000 kW; the County Company would pay the increased cost of motor generators as compared with rotary converters and transformers, the full supply to be available within three years from June 30, 1922. The South-Eastern Company would pay for the supply on a fixed annual rental equal to 7·4 per cent. (4·5 per cent. interest, plus 2·9 per cent depreciation) on the estimated capital cost to the South-Eastern Company of the Angerstein's Wharf station and the transmission mains from that station, or such other rate of interest and depreciation as the Commissioners might fix.

The South-Eastern Company would pay the actual local rates paid by the County Company in respect of 45 000 kW of plant at Barking, and also the actual local rates incurred by the County Company in transmission mains in respect of a capital value of £65 000; the South-Eastern Company to pay as a running charge the cost per unit other than the fuel cost estimated by the South-Eastern Company's witnesses for operating their station, with a minimum equivalent to 25 per cent. of the said operating and maintenance cost for a load of 29 000 kW; the South-Eastern Company to pay as a fuel charge the actual cost of fuel incurred by the County Company on the basis of 20 000 B.Th.U. per unit sent out from Barking at 33 000 V; the County Company would allow a rebate on the fuel cost of half the difference between the coal consumption per unit sent out from Barking at 33 000 V and 20 000 B.Th.U.; as a further rebate the County Company would allow 4 per cent. on the running charges and coal bill on account of the decreased operating efficiency of motor generators; for all extensions of the South-Eastern Railway Company's electrification the County Company undertake to supply electrical energy on similar lines as above, and the South-Eastern Company agree to take such additional supply. There would be arbitration, strike, coal and land clauses, and the period of agreement would be for a minimum of 25 years.

Economy of Combined Stations.

Mr. C. H. MERZ said there was an enormous saving of expenditure on distribution in the case of a combined station. The creation of separate stations for railway supply was a retrograde step. If a separate station were erected for railway purposes consideration should be given to the question how far it could eventually be brought into a general system. The proposed S.E. and C. station would be on a wrong site to supply an industrial load and it would have the wrong periodicity. He estimated that the result of supplying the railway demand from a station for combined purposes would be a saving of £483 000 in capital expenditure, and there would also be considerable saving in operating cost. The saving would be some £19 000 per annum, apart from fuel. In a general system there would be a gradual increase in coal economy by the introduction of improved plant, whereas a railway power station would not gain by improvements in the electrical industry until its original plant was written off. Suppose one took a ten years' load on a big combined system, and every year 50 000 kW of plant were added to the system, ten years hence the system would have grown to 250 000 kW, the last 50 000 kW installed might be 15 or 20 per cent. more efficient than the first 50 000 kW, and the last 50 000 kW would probably turn out 40 per cent. of the total output. On the North-East Coast there were about 300 000 kW of plant, and not more than 120 000 kW was of the most economical type. The railway company had no opportunity of improving unless they extended the electrification of their line. In the case of the North-Eastern Railway, the railway company got the benefit of improvements. Half the total charge for energy was based on the coal costs. A similar arrangement would be made between the County of London Company and the South-Eastern. From the technical point of view the Belvedere site was a good one, but a connection between the north and south sides of the river would have to be made sooner or later, and it would be cheaper to supply from the Barking station.

Engineer's Evidence.

The County of London Company were some months ahead of the other parties from an engineering point of view. It was proposed to generate at Barking at 50 cycles, but they would supply to a railway company at the periodicity they wanted. He was not sure that the County Company would not make more money by supplying at 25 cycles, but from the point of view of the general utility for London 25 cycles was wrong. The life of generating plant came to an end in 15 or 20 years, and the system could then be altered, but that did not apply to transmission and distribution. When transformers, motors, motor generators and rotary converters were put down at a certain periodicity it was almost impossible to change. He thought 25 cycles would be inconvenient for the railway company as it would not be the right periodicity for lighting and industrial purposes along the company's route. There was a considerable saving in cost of transformers. He thought it was essential that 50 periods should be standardised for the London district. In the offer made by the County Company the cost of motor generators, the extra cost of transmission and the construction of a tunnel under the river had been taken into account. The company had a demand of 30 000 kW, and 45 000 kW was a conservative estimate of the industrial demand in 1926. To deal with that and a railway load of 30 000 kW the most economical way would be to install four 35 000 kW turbo-alternator sets.

The Barking Station.

The Commissioners had only authorised 100 000 kW of plant at Barking. The 35 000 kW sets would be tandem sets—with two generators. If the company were restricted to 100 000 kW he would advise that four 25 000 kW sets should be installed. The actual saving which he estimated on the power station, compared with the railway company's figures, was £625 000, and after deducting transmission and £16 000 for extra cost of motor generators, the saving would be £483 000. He was only crediting the South Eastern with three cables. The reserve cables would be available for their supply as well as for general supply. Pooling the reserve meant a saving in capital cost. Each cable would carry 16 000 kVA. The use of 50 cycles had a bearing on the cost of the cable network as the cables used to supply the railway could be interchanged with the other cables for the County Company's own transmission. It might be possible in a large station to effect considerable economy by low temperature carbonisation of a portion of the coal. A commercial plant for that purpose was nearing completion on the site of the Dunston power station.

Sir JOHN SNELL and Sir HARRY HAWARD expressed the opinion that the offer of the County of London Company should be translated into a definite charge per unit so as to make it comparable with the South-Eastern cost and the West Kent figures. Sir Harry also said it should be shown whether the proposed charge was an economical charge from the point of view of the County Company and what bearing it had on the amount which a Joint Authority would have to pay to the company when it took over the station.

Mr. CHARTERIS promised that figures showing the capital and running cost to the County Company should be supplied to the Commissioners.

Replying to a suggestion by Mr. CLODE that the allowances made in his figures did not cover all the extra cost to the County Company, Mr. Merz said there would be no additional switchgear—the switchgear would be rather simpler. The County Company were prepared to indemnify the railway company in the event of current not being ready when the line was equipped for electric working.

Replying to Sir JOHN SNELL, witness said the County Company's offer amounted to about 0·481d. per unit in the first stage, and after that stage they would share with the railway company the benefit of improvements in regard to consumption of fuel.

Position of London Companies.

Mr. W. F. FLADGATE, chairman of the Charing Cross, West End and City Electricity Supply Co. and of the London (Electricity) Joint Committee, said the engineering scheme put before the Commissioners last year had never been departed from as far as the nine companies comprising the Joint Committee were concerned. It was always contemplated that they would get the railway load. They contemplated the erection of a power station in due course, but not in the first stage unless they had the railway load. The London Electric Supply Corporation could supply 30 000 kW to the S.E. and C. Companies by extending their present station, but a new station would be required to supply the S.E. and C. ultimate load and the L.B. and S.C. load. They had not yet been informed by the L.B. and S.C. that they wanted the additional supply. He thought the London companies should be allowed to group themselves into one joint electricity authority. The improvement of the supply in London could then be commenced at once. He saw no difficulty in the supply being given to the railway companies by June, 1925, by either the West Kent, the County of London or the London Electric Supply Corporation. He was not at the moment

prepared to say his companies could do the business cheaper than the West Kent or the County of London Company.

Gas Company Claims Protection.

Mr. Seager Berry (for the South Metropolitan Gas Company) said certain sections of the Kent Electrical Power Act, 1906, the Electric Lighting Act, 1909, and the London Electric Supply Act, 1908, provided that the railway companies (unless a Special Order were obtained) could only use electricity taken from an authorised undertaker for traction and carriage lighting. If the S.E. and C. Companies got the powers they asked for they could use their energy for any purpose, and they could take from the gas company the best customers amongst the railway companies' tenants. He asked that a proviso to prevent this should be imposed if the railways took power from an outside undertaker.

After the conclusion of the evidence, counsel for the various parties addressed the Commissioners. For the Conference of Local Authorities, Mr. Turner asked for the insertion of a purchase clause should one of the companies obtain the right of supply.

Concluding Proceedings.

Mr. Craig Henderson, on behalf of London County Council, said the West Kent Company's application was really an application by the parent company, the South Metropolitan Electric Light and Power Company. If the station was authorised the latter company would transfer its main source of supply to Belvedere, which would have a serious effect on the position of the purchasing authority in London. There would be nothing to prevent the West Kent Company supplying the South Metropolitan Company with current for distribution in the London area. The Commissioners had constituted a certain electricity district, which included the County of London, and their scheme was that it should be administered by a Joint Authority, representing all interests, municipal and company. The West Kent Company's proposal undermined those foundations, and if it were carried through the L.C.C. would have to reconsider their position as the purchasing authority. He asserted the County of London Company and the West Kent Company were allied companies, in the sense that Sir Harry Renwick was a director of both, and the County Company made their offer at the eleventh hour when they thought the West Kent Company's case was falling. The L.C.C. favoured the railway company's application in preference to the other schemes, although they recognised the desirability of supplying for traction and other purposes from a combined station.

Mr. Charteris (for the County of London Company) contended that under section 11 of the 1919 Act the Commissioners could give consent to the County Company to increase their Barking station to 140 000 kW. The Company's 1905 Act gave power to supply energy for traction.

Mr. Tyldesley Jones (for the West Kent Company) said the company were not seeking to take away any railway load from a Joint Authority or any London authorised undertaker, because none of them (with the exception of the County Company) had offered to cater for it. The main point was, could they supply at a cheaper price than the South-Eastern Company could supply themselves? The West Kent Company's offer was to supply at 0·575d. in the initial stage, subject to a rebate clause and deductions under the efficiency clause. That was less than the cost at which the railway company could generate and when they reached the stage when the maximum demand was 29 000 k.W., the output of 89 million units and the load factor 35, the price would be 0·555d. He was advised that the railway companies' estimates were too low. It was dangerous to put the transformers in the turbine house and proper provision for their housing would increase the expenditure; also the interest of 3 per cent. on capital during construction was too low.

Demand for Separate Traction Station.

Mr. Clode (for the S.E. and C. Companies) said there was every expectation of combining the S.E. and C. and the L.B. and S.C. supplies and also assisting the general requirements by supplying surplus energy. Until the present inquiry not a single offer had been made of a supply at a price as low as the cost at which the railway companies could supply themselves, and they could not see that the prices now quoted were any lower. He asked the Commissioners to use their discretion and approve the railway companies' scheme even if, in their judgment, either of the other supplies offered were very slightly lower in price. There would be considerable reductions in cost if the railway companies supplied surplus energy. If they supplied 10 million surplus units, the cost of the railway power became 0·361d. at Lewisham, if they supplied 20 million units it was 0·354d., and if 40 million, 0·339d. If anything had to be added to the railway companies' estimates for the site of the station it could only be £7 000, as the whole of the 39 acres (of which the station would occupy 20) cost £13 500. His figure of 0·339d. per unit compared with the West Kent figure of 0·493d. if the thermal efficiencies were levelled up. The South-Eastern and Chatham were on the eve of a great change of their system, and he did not see how they could hand themselves over to the joint stock company and the private company who were putting forward the Belvedere proposal. Why should they place themselves in their hands for 60 years? What was the advantage of putting the generating station and the electrification in two different hands? In the case of the County of London Company he did not know what figure he could take for comparison, but he asked the Commissioners to approve the railway companies' proposals which would not disturb in any way the scheme for the Joint Authority in London.

Electricity Supply in Liverpool.

Last week an inquiry was held into the application of Liverpool City Council for a Special Order to authorise the extension of their electricity supply area to Bootle, Waterloo-with-Seaforth, Litherland and Great Crosby. The inquiry lasted seven hours and was held by Col. T. C. Ekin.

The Deputy Town Clerk (Mr. E. W. Pierce) appeared for the Corporation, and the Town Clerk of Bootle and the clerks of the other three authorities and of the Mersey Docks Board also supported the application. There was some opposition by dissenting Bootle ratepayers; and applications were made by Mr. J. Lias, for the Municipal Employees' Council; and Mr. W. Arthur Jones, for the Electric Power Engineers' Association.

In opening the case for the Corporation, Mr. Pierce said the proposed order would extend the Liverpool area of supply from 21 219 acres to 27 313 acres and there would be an additional population of 136 000. When the Corporation acquired the electricity undertaking in 1896, the city consumption was 1½ million units, and that had grown to 88 million units. After negotiations an agreement had been made with Bootle, an important borough to the north of the city, and evidence would be given to show that the agreement was very fair to Bootle. Litherland had obtained a Provisional Order, expiring in 1942, and that order, which had been transferred to Bootle, would be extended to 42 years. The company which supplied Waterloo-with-Seaforth and Great Crosby had an order with 16 years to run. The company had been bought out at the amount of the actual paid-up capital, and its order extended to 42 years. The Mersey Docks and Harbour Board had given unqualified approval to the application. With regard to the opposition from workers, the employés at both stations would be absorbed at not less than their present wages.

Mr. Harold Dickinson, city electrical engineer, gave technical details of the scheme. He said the £7 500 per year paid to Bootle could be applied either in relief of rates or in reduction of the charge to electricity consumers. Liverpool would not make a net profit of £5 000 yearly by the arrangement. The agreement with Bootle was influenced by the fact that Bootle was threatening Liverpool with an action because Liverpool had extended its supply into the Bootle area through the Dock Board mains.

Advantages of Unified Supply.

Mr. Frank C. Wilson, chairman of the Liverpool Corporation Electricity Committee and of the conference of Merseyside electricity authorities, said he was convinced that all Bootle consumers would reap an advantage by taking supply from Liverpool. Bootle was protected as to the prices of electricity for lighting and other services. The whole port would gain by an economical supply of electricity to the entire dock estate.

Mr. James Scott, chairman of the Bootle Electricity Committee, considered the Liverpool and Bootle district an ideal area for the development of manufactures and commerce by electric energy. The fixed subsidy of £7 500 annually was preferable to a subsidy varying according to profit and loss. Waterloo and Crosby would gain through the proposed Liverpool supply. Liverpool could make £4 000 a year out of the Bootle supply more than Bootle could make.

At the close of Liverpool's case, Mr. Lias and Mr. W. Arthur Jones submitted in writing proposed clauses for the protection of the workmen and staff at the Bootle and Waterloo electricity works.

The legal representative of the Bootle objectors having addressed the Inspector, Mr. Pierce replied for Liverpool and said the amalgamation of the Liverpool and Bootle electricity undertakings and the payment by Liverpool to Bootle of £7 500 yearly, were both "for all time." None of the manual workers would suffer in wages, but would gain in prospects.

Electricians' Tools.

The "Enox" saw frames shown in the accompanying illustrations are among the latest products of Frys (London) Ltd.

Fig. 1 shows a frame suitable for bench use in works where ordinarily the bulk of the material would be cut in a machine.

Fig. 1

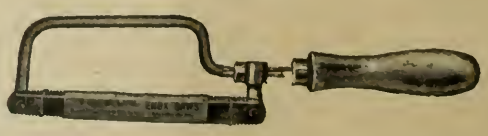


Fig. 2

This frame cuts material up to 1 in. It is also useful for electricians to carry in their tool kits.

The frame shown in Fig. 2 can be used in the same way as that in Fig. 1, but has the additional advantage of being a handy size for small work. The firm have called it the "Tool Makers' Frame," as with it dies can be cut up more quickly than in the usual way.

Electrical Situation in Uruguay.

An interesting article by Mr. H. D. Bindon, A.M.I.E.E., on Uruguay as a market for electrical goods, appears in a recent issue of the Journal of the British Chamber of Commerce in Uruguay. The country is mainly agricultural, and there is not, apart from the requirements of the electricity undertakings of the cities and provincial towns, much demand for big power units or for motors with a rating above 100 h.p. The generating plant of the city of Montevideo is state owned; electricity is generated at one main steam station near the water's edge by turbo-alternators, and three-phase (50 cycle) h.t. current is delivered by underground cables to sub-stations throughout the city, supply being given at 220 V for light and power. The two Montevideo tramway companies (Sociedad Comercial de Montevideo, a British-owned company, and Compañia Transatlantica, a Spanish company of German origin) have their own d. c. generating stations.

Prohibitive British Prices.

In the provinces, except in a few isolated cases, alternating current at 220 V is supplied. There is little or no water power in the Republic, but steam and oil engines are much used. Hitherto, few electrical goods of British manufacture have been sold in the country, as the prices were too high, but large quantities of wiring materials have come from Germany, Italy and the United States. The flexible lamp cords and insulated wire are in many cases of an inferior quality, and for ordinary house lighting most of the cord and insulated wire sold is rated as 500 V. A high percentage of house wiring is done by means of flexible cord strung on small porcelain insulators. Tumbler switches are unknown (and are considered unsafe by municipal authorities, etc.). Practically the only type of switch adopted is the "Hart" snap switch, of American manufacture. For steel conduit wiring, until recently nearly all fuse and jointing boxes were of wood impregnated with tar or suchlike, and no attention was paid to the earthing of conduit or fittings. On the other hand, wood casing is strictly prohibited, but Bergman insulated brass or tin tubing is used extensively.

With regard to house lighting fittings, there is a demand, since the introduction of period decoration, for corresponding fittings, highly ornamental brass fittings being used. These are largely manufactured in South America from the original French patterns, and the home manufacturer cannot compete with these cheaply made articles, though he scores in the higher class fitting, finished in oxidised silver or copper, etc. Highly decorative glassware is also much used in conjunction with lighting fittings. The screw type of lamp-socket is commonly used; in fact, outside railway and tramway companies the bayonet type of socket is unknown.

Demand for Small Domestic Appliances.

While electric cooking is not considered very much, such articles as portable stoves, coffee pots, tea kettles, toasters, irons, etc., are much in demand. These articles mainly come from the United States and are not only unique in design but are well made, with provision for the easy renewal of heating elements. Mr. Bindon states that of late the home manufactured articles of this class are not only very expensive but of poor construction, coupled in many cases with antiquated ideas. Only recently an important home manufacturer sent out, amongst other things, a large quantity of electric irons, badly nickel-plated, fitted with non-heat resisting handles of composite material, combined with the old type of heating element built of round wire mounted on micanite instead of pure mica. These irons were circulated by the firm's representative amongst several of the most important local electrical supply shops, with the result that the manufacturer soon lost his reputation in Uruguay, and it will be more difficult for him to get his goods into the market in future. Many home manufacturers, who are anxious to get a footing in the country, will persist in sending out the wrong class of goods, and in many cases catalogues printed in English which the native buyer does not understand.

All incandescent lamps come from Holland, Germany or the United States, and Mr. Bindon inquires why we cannot manufacture a lamp suitable for export, and if not, why not? He suggests that we are too conservative in many of our ideas and that we forget that what is suitable for the requirements of the Northern Hemisphere may not be suitable for the Latin-American Republics.

Wiring Regulations in Quebec.

In the Province of Quebec, a strong REACTION seems to have set in AGAINST SLIP-SHOD WIRING METHODS and ineffective inspection of installations. As a result of representations by the Electrical Co-operative Association it has been decided to allow in future only a single service entrance for any one class of electricity service in new public buildings. The rule, as well as other regulations, have been adopted by the Fire Underwriters' Association, and became effective on the 1st inst. In cases where a building is already wired and additional apparatus is installed arrangements must be made to connect the new work to the existing service, increasing the capacity of this if necessary. If the present service does not comply with the specifications a new service of sufficient capacity for both the old and the new loads should be installed.

The new regulations dealing with earthing and general installation work are somewhat similar to British practice, as exemplified in the Wiring Rules of the I.E.E., the Phœnix Fire Office, etc.

Gas Wail from Birmingham.

The Birmingham Gas Committee were recently asked to report on the possibility of (*a*) narrowing the present margin between prices charged to small and large consumers and (*b*) charging the same price for gas, irrespective of the purposes for which it might be used. In a long report the Committee state that there is every justification for differential charging, and point out that after Midsummer, 1915, the price to large consumers was advanced more rapidly than to small consumers. In future revisions of prices the difference would be narrowed so that the increases over 1915 would become more nearly equalised.

There was a two-fold justification for the lower rates granted for gas supplied for power and industrial heating, viz. (1) the great advantage gained by having a regular day load, summer and winter alike, and (2) the more important factor of competition by electricity, oil furnaces and producer gas plants. The Gas Department for a long time past had very serious competition with electricity for power purposes, and the Electric Supply Committee have been authorised for many years past to charge much lower prices to manufacturers than to ordinary users of electricity, and that applied particularly to those taking h.t. current, where the price to-day was a little over a penny per unit, compared with the maximum rate for l.t. current of 6d. per unit. The justification for that had always been the necessity for obtaining a day load, and that was just as important from the point of view of the gas undertaking, as without it storage accommodation greatly in excess of the present storage would have to be provided.

Henley Wiring System.

The photograph illustrates a showcard, 15 in. by 10 in., which W. T. HENLEY'S TELEGRAPH WORKS Co. have produced to help electrical contractors to get business with the Henley Wiring System.

The showcard is produced in nine colours by the lithographic process and forms an attractive and neat advertisement,

THE NEW SHOWCARD.

The lettering "Electricity in your Home" is outlined in blue on the original card. In the reproduction the blue has, of course photographed white and has given the letters a "run-together" appearance. On the original they are, however, quite distinct The firm will be pleased to send contractors one or more of these cards on application.

Parliamentary Intelligence.

Telephone Development.

The House considered in Committee on Friday a resolution declaring it expedient to authorise the issue out of the Consolidated Fund of such sums, not exceeding in the whole fifteen million pounds, as were required for the further development of the telephone system and to authorise the Treasury to borrow money, by means of terminable annuities or by the issue of Exchequer Bonds, for the issue of such sums or the repayment thereof to the Consolidated Fund; and to provide for the payment of the terminable annuities or of the principal of and interest on any such Exchequer Bonds out of moneys provided by Parliament for Post Office services, or, if those moneys were insufficient, out of the Consolidated Fund.

Mr. KELLAWAY (Postmaster-General), who moved the resolution, said the sum of fifteen millions of capital expenditure proposed would, it was estimated, last till the end of April, 1924. Recalling the history of the telephone system, he pointed out that after the Government took it over they were almost exclusively occupied till the end of 1914 in putting it into proper condition, and could devote little time or money to extension. Then from 1914 to 1918 no development was possible. It was not until the beginning of 1919 that the engineering department was able to devote its attention to the development of the system. In 1919–20 £3 230 000 was proposed out of telephone capital for the development of trunk lines, exchanges, etc., of which amount £2 647 000 was actually spent. In 1920-21, out of a proposed expenditure of £6 884 000, £5 866 000 was spent, while last year out of £9 032 000, £7 438 000 was spent. For the present financial year the proposed capital expenditure amounted to £9 250 000, of which sum £2 760 000 was for the provision of new trunk lines and the completion of trunk lines now under construction. A sum of £5 740 000 was for new exchanges and the extension and improvement of existing exchanges, and £750 000 for sites and buildings.

Underground Trunk Lines.

The main object was that the whole of the trunk lines in this country should be no longer in the air, but underground, the advantage of which would be enormous. There was also included in this year's programme an amount of £504 000 for new underground cables. This included two long routes from Leeds to Edinburgh and from Worcester to Bristol. The former would complete the provision of the main routes for underground communication between London and the North of England and Scotland, while the latter would complete the underground communication between Birmingham, Bristol, and South Wales.

There was an item of £1 537 000 for the provision of new and the extension of existing switchboards.

There was still a very heavy programme of building work to be carried out in the near future, owing to the exhaustion of many exchanges and the approaching exhaustion of others. Estimates had been secured for a programme of work for the next five years which amounted to £35 700 000.

The number of new subscribers connected during the twelve months was 71 500, and the number of new instruments connected, including extensions of existing installations, was 134 000. The number of new subscribers for April was the second largest on record, and for May was the largest on record. Taking the country as a whole, the average time taken to get a reply from the telephone operator on a local service was six seconds from the moment when a subscriber removed the receiver from its rest. On the trunk underground cable the delay between Manchester and London had been decreased from twenty-one minutes to eight minutes. The Telephone Department was greatly indebted to the work of the Select Committee. He had not been able to adopt all of their recommendations, but he had adopted most of them.

After a short discussion, to which Mr. Kellaway replied, the resolution was agreed to, and reported to the House.

German Insulators for India.

In the House of Commons last week, Colonel Wedgwood asked the Under-Secretary of State for India whether any contract for insulators had recently been given out; if so, had the order been given to firms in this country; and, if not, when it was expected that the order would be placed?

In reply, EARL WINTERTON said the High Commissioner for India, who controlled purchases for, and under the orders of, the Government of India, had informed him that no contract had recently been made for the supply of insulators. He had, however tenders in hand for a supply of those articles, and the lowest acceptable offer (having regard to price, delivery and other relevant considerations) was that of a firm in this country for insulators of German manufacture. The contract was about to be placed accordingly.

To a question put on Monday by Mr. FINNEY, who inquired whether advertisements were appearing in German papers for tenders for porcelain and glass insulators,

Earl WINTERTON stated that the High Commissioner for India had informed him that he had not hitherto found it necessary to advertise directly in Continental papers.

Merchant Ships' Wireless Service.

Colonel Hurst asked the President of the Board of Trade last week whether he was aware that some 800 certificated wireless operators, mostly ex-service men, had been discharged by wireless companies since the institution of watchers on cargo ships; and whether, as the danger of failing to notice distress calls had been enhanced by the change, he would consider the desirability of abolishing wireless watchers in the Mercantile Marine and of re-employing certificated operators in their stead?

In reply, Sir W. MITCHELL-THOMSON said the main cause of the unemployment among wireless operators was the general depression in shipping which affected all classes of officers and men of the Mercantile Marine. Pending the results of the inquiry into the loss of the s.s. "Egypt," he was not in a position to say whether there was any failure in the wireless service on the occasion of her loss.

West Kent Electric Company.

Mr. GILBERT asked the Parliamentary Secretary to the Ministry of Transport (House of Commons, June 19) whether the representatives of the West Kent Electric Company, whose application for permission to erect a capital generating station at Erith was now before the Electricity Commissioners, had an interview with the Commissioners on the subject towards the end of last or the beginning of this year; if he would state whether the interview was an official or private one; if shorthand notes of the proceedings were taken; and if it was the custom of the Commissioners to grant such interviews to all applicants who had to appear before them at public inquiries?

Mr. NEAL: I understand that the Electricity Commissioners have had more than one interview with representatives of the company. These interviews were of a semi-official nature, and shorthand notes were not taken. It is the custom of the Commissioners to grant interviews if by so doing they can advance the public interest.

Wrexham Generating Station.

Mr. GILBERT asked the Parliamentary Secretary to the Ministry of Transport whether the Wrexham Corporation had applied for consent to extend their generating station; whether the Electricity Commissioners had refused to sanction such extension and had called upon the corporation to take what further power they required from the North Wales Power Company; whether the latter company had quoted a price of £6 a kW and 75d. a unit, which was the maximum price which they were allowed to charge; and whether, in view of the attitude taken up by the power company in the matter, the Commissioners proposed to reconsider their decision withholding consent to the extension of the Wrexham undertaking?

Mr. NEAL: The hon. Member has been misinformed. The consent asked for by the Wrexham Corporation was granted by the Electricity Commissioners. I understand, however, that the Corporation subsequently decided to obtain a bulk supply and are in negotiations with the company.

The Electricity Supply Bill.

We regret to notice that opposition to this Bill is still being organised, not only by a group of the power companies, but by some of the local authorities. We had hoped that the amendments made in the House of Lords would have placated the opponents of the measure, but, judging by the amendments to be moved in the committee stage in the House of Commons, this is far from being the case. Apparently the local authorities are going to move for the insertion of a proviso to Clause 15, with the object of precluding the powers and duties in connection with a municipal electricity undertaking, which is transferred under a scheme of reorganisation, being given to a company unless so determined by the majority of the local authority representatives upon the Joint Electricity Authority. This seems to be quite unnecessary as the matter is one to be dealt with in the respective schemes.

Telephone Subscribers (Deposits).

In reply to a question by Mr. Hurd, the POSTMASTER-GENERAL (Mr. Kellaway) stated in the House of Commons on Thursday last that the total amount held on deposit on March 31, 1922, was £1 441 000. The deposit usually represents two-thirds of the credit given for calls, and the present system of payment is more favourable to subscribers than the previous arrangement, under which all local calls were paid for in advance and trunk calls, against which a deposit was held, monthly in arrear. Deposits are required, not merely as security, but in order to finance the service during the period for which credit is given.

Rhondda Valley Telephone Facilities.

In reply to a question by Mr. Wm. John, the ASSISTANT POSTMASTER-GENERAL (Mr. Pike Pease) states that a scheme is being considered for a central telephone exchange to serve Treorchy, Treherbert and Pentre, provided a suitable site can be obtained.

Private Bills.

TORQUAY CORPORATION (ELECTRICITY) BILL passed its second reading in the House of Commons on Monday, and on Tuesday AYR BURGH (ELECTRICITY) BILL also passed its second reading.

As no petitions have been lodged against the Bill to authorise the LONDON ELECTRIC and CITY and SOUTH LONDON RAILWAY COMPANIES to raise additional capital, amounting to £3 500 000 for improvements and extensions, it will now proceed as an unopposed measure.

Electricity Supply.

Of Blackpool's electricity surplus of £14 322, £4 000 is being set aside for relief of rates, £6 000 is being placed to reserve, and £2 000 devoted to a working balance, £2 228 being carried forward.

A " Death's Head and Cross Bones " illuminated electric sign has been put into position in the PORT OF DUBLIN to indicate the spot where an electric cable runs from one side of the Liffey to the other.

Following the adverse balance of £924 on the account of WITNEY electricity undertaking for the year ended March 31 last, the Urban Council have decided to call in May and Hawes, consulting engineers, to inspect the works and accounts, and to advise the Council of any alteration they would suggest in connection with the management, prices, extension of output, etc.

Over 4 500 persons visited the HACKNEY ELECTRICAL DOMESTIC LABOUR AIDS EXHIBITION, the net cost of which was £470. The main object of the Exhibition, which took place at a period when trade was slack, was to introduce cooking, etc., by electricity into the homes of residents, and already definite arrangements have been made for the installation of 51 cookers. Many direct sales took place from Exhibition stands, including cooking appliances, vacuum cleaners, immersion heaters, fittings, and washing machines.

The inhabitants of NORTH HOUGHTON and CASTLETOWN are very anxious to have electricity supply, and they have, therefore, asked the Sunderland Rural Council to finance a scheme. Though the Sunderland Gas Company has undertaken the laying of gas mains the people are unanimous in their demand for electricity for lighting and domestic purposes, as it is considered cleaner, better and safer. The people are prepared to defray the cost by instalments. It was also mentioned that, for street lighting the cost would be £4 000, and for domestic supplies about £2 000, but an electrical engineer has been asked to prepare further particulars.

New Schemes and Mains Extensions.

SUNDERLAND Electricity Committee have authorised extensions of mains at a cost of about £1 200.

The Electricity Commissioners have given sanction to ST. ANNE'S Council to borrow £26 050 for electricity purposes.

KIRKBURTON Urban Council has consented to overhead cables being used in parts of the town by the Yorkshire Electric Power Co., and has decided to ask the company to submit a scheme for public lighting.

The North Wales Power Co. has offered to supply BANGOR Corporation with a bulk supply of electricity at £6 per k.W. of maximum demand with a minimum of £2 000 per annum plus ¾d. per unit.

In connection with the proposed purchase of the OSWESTRY Electric Light and Power Company by the Town Council, Mr. W. M. Selvey has been instructed to make a valuation of the undertaking for the Council.

CALNE Town Council has instructed the Gas Committee to consider the question of establishing electricity works in connection with the gas undertaking, and the advisability of applying for a Provisional Order for electric lighting.

BLACKPOOL Electricity Department have made a start with their scheme of extensions, which are estimated to cost £169 000. The Tramways Committee have received tenders for the construction of a new switch-room annexe for e.h.t. switchgear.

It has been decided that from the date of the termination of its agreement with the Bury Corporation at the end of the present calendar year, the RADCLIFFE Council shall obtain its bulk supply of electricity from the Lancashire Electric Power Company.

SUNDERLAND Electricity Committee has been canvassing certain districts of the town for new consumers with the result that considerable extensions of mains have been authorised to meet the demand, the total cost being estimated at £5 954, which is to be borne out of capital account.

PORTSMOUTH Town Council have approved of the Finance Committee making a loan of £91 000 from the corporation sinking funds at £4 10s. per cent. per annum (free of income tax), to the Electric Light Committee, repayable by instalments of principal and interest within a period of eleven years from March 31 last.

The NORTHWOOD ELECTRIC LIGHT AND POWER Co. are extending their distributing mains to Ducks Hill Road, Jacketts Lane and Copse Wood in the Northwood district, Sharps Lane, Manor Road, Church Avenue, King Edward Road and High Street in Ruislip and Elm Avenue and Lime Grove in the Eastcote district.

BANGOR Corporation recently applied to the Electricity Commissioners for sanction to a loan of £4 000 for supply mains, services, etc. Permission has now been received to borrow £3 768, £232 being deducted as representing the amount which would have been repaid had the loans been sanctioned at the time of expenditure.

WHITEHAVEN Town Council have received sanction to borrow £3 500 for services, and £2 800 for extension of the mains to the Council houses, at Bransty. They have also decided to oppose the application by the Cumberland Waste Heat Owners' Co. for a Special Order to empower the company to supply electricity in the urban districts of Egremont and Cleator Moor.

Last week the Tynwald Court heard the petition of DOUGLAS (ISLE OF MAN) Town Council for sanction to borrow £62 000 for carrying out the work authorised by the Douglas Corporation Electric Light and Power Act, 1921. The petition was strongly opposed by the Attorney General, on the ground that Douglas had now got a debt of £636 000, which was too heavy for a town of its size.

Alteration of Charges.

A revised scale of charges has been adopted by WEST BROMWICH electricity department.

BRIERFIELD Urban Council have fixed a flat rate of 7d. per unit, net, for electricity used by cinemas.

NELSON Electricity Committee have decided to reduce their charges for lighting by ½d. and for power ¼d. per unit.

MAIDENHEAD Town Council has reduced the charge for electricity for lighting from 10d. to 9d. per unit as from June 30.

CARLISLE Electricity Committee has reduced the ordinary charges for electricity from 80 to 60 per cent. above pre-war rates.

The increase of 100 per cent. in electricity charges which was made some time ago by SHREWSBURY Town Council is to be reduced to 75 per cent. as from this month's readings.

ROTHERHAM Town Council has fixed, as from July 1, a minimum charge of 10s. for electricity for any quantity consumed in any one quarter up to 20 units.

TONBRIDGE Urban Council has decided to reduce the charge for electricity for private lighting by 2d. per unit as from October 1, and for street lighting by 50 per cent.

The charges for electricity for lighting at LOWESTOFT are to be reduced as from July 1, by ½d. per unit, and the discount for both power and lighting increased to 5 per cent.

CREWE Town Council has reduced the price of electricity by 12 per cent., and has applied to the Electricity Commissioners for permission to erect an overhead cable to Sydney.

PORTSMOUTH Town Council has reduced the price of electricity for lighting to 7d. per unit for the first 5 000 units per annum, 6¼d. from 5 000 to 7 500, 6d. from 7 500 to 10 000, 5¼d. from 10 000 to 20 000, and 4⅜d. beyond.

RUSHDEN and District Electric Supply Co. have reduced the charge for electricity for power by ½d. per unit. For lighting, a scale has been introduced for the benefit of large users at 10d. per unit for the first 200 units per quarter and 8d. beyond.

NORTHAMPTON Electric Light and Power Co. has reduced the charge for electricity for power by another ½d. per unit, and that for lighting by 1d. per unit, with additional reductions to large users by the introduction of the following scale :—8d. per unit for the first 200 units per quarter and 6d. beyond. The rates for hired motors have been further reduced by 10 per cent.

The new electricity charges at ST. ANNES for this quarter are as follows : Lighting : 7d. per unit net, or maximum demand rate 8d. and 5d., cinemas and signs, 4½d. ; motors, heating and cooking, up to 500 units per quarter, 2d. net ; over 500 and under 5 000 units, 1¾d. per unit, less 10 per cent. ; over 5 000 and under 10 000 units, 1½d., less 15 per cent. ; over 10 000 units, 1¾d. per unit, less 25 per cent. The charge for current for street lighting is 3½d.

From this month's meter readings the flat rate of charging at MANCHESTER will be reduced from 7½d. to 7d. a unit, and on the sliding tariff the fixed charge remains as at present, but the units consumed will be at 2½d. instead of 3d. The ordinary power rates have been reduced by about ½d. a unit, and now vary from 3·25d. to 1·4d. Special consumers, with a coal clause in their agreements, will benefit from the reductions in coal, in addition to 15 per cent. reduction in the war percentage additions. The question of allowing discounts has been postponed for the present.

The WESTMINSTER Electric Supply Corporation announce that from the midsummer quarter's readings a reduction of ½d. per unit will be made on all units in excess of 1 000 used in any one calendar year for lighting purposes. From the date of the midsummer quarter's readings, therefore, the charges will be as follows :— Lighting : For the first 1 000 units used in any one year, 7½d. per unit ; for the next 3 000, 6½d. ; for all units used in excess of 4 000, 5d. Heating, cooking and motors : If taken through a separate meter, 1½d. per unit. The above rates are subject to a minimum charge of 10s. per quarter.

Chagford and Devon Electric Light Company have notified CHAGFORD consumers of their intention to increase the lighting charges after the June quarter by 2d. per unit. A protest against the increase, which brings the charges up to 1s. per unit, is being made and the Parish Council, whose contract with the company terminates in November, have asked the company whether they propose making a corresponding increase in the charge for street lighting. The Council are considering approaching the Ministry of Transport with a view to ascertaining whether, under the local circumstances, such an increase would be justified.

D

Municipal Accounts.

The PLYMOUTH electric trams are paying and doing well according to the engineer's return for the financial year ended March 31st. The income amounted to £169 994, and from the motor 'buses £30 061. The expenditure left a gross surplus of £32 399 on the former, and £3 884 on the latter. After payment of capital charges there remained a net profit of £11 863 on the trams, and a loss of £1 542 on the 'buses, leaving a balance of £10 321, which it has been decided to place to the reserve fund. During the four weeks ended June 3 the passengers carried on the trams numbered 2 182 070, and the receipts were £14 827, compared with 1 746 076 passengers and £11 742 receipts in the corresponding period of last year.

The total income of LOWESTOFT ELECTRICITY DEPARTMENT for the past year amounted to £42 268 compared with £39 803 in the previous year. Working expenses were £30 932, a decrease of £6 652. The gross profit amounted to £11 335 compared with £2 219. After providing for interest and sinking fund charges (£10 942) there remained a credit balance of £393, compared with a loss last year (if sinking fund charges had been met) of £7 314. The income for the TRAMS for the year (£22 115) showed a decrease of £2 180 but working expenses also decreased by £3 652. After allowing for interest and sinking fund charges (£5 533) there was a deficiency of £2 158, a decreased deficiency of £808 as compared with last year.

For the year ended March 31 there was a surplus of £44 564 on the MANCHESTER electricity department. Interest and sinking fund charges on the new generating station at Barton and the high tension mains therefrom were met out of revenue. The total income was £1 429 995, and the expenses (exclusive of depreciation) £977 102. The decrease in business during the year, due to trade depression, was 21 per cent., the annual sales totalling 158½ million units, compared with over 199½ the previous year. The average price paid for fuel fell 1s. 4d. a ton, and the fuel consumed rose 0·03 lb. per unit sold. The efficiency of the distributing system equalled 84·77 per cent., the quantity absorbed in the mains and distributing stations being 15·23 per cent., an increase of 3·44 per cent. on the previous year. The increase was mainly due to the reduced sales during the year on the large consumers' accounts. Good progress has been made with the lighting of the various housing estates, and work has been completed on the inhabited portions at Anson, Blackley, Catterick Hall, Clayton, Gorton Mount and Wilbraham Road. The electric lighting of several streets has been carried out, thus completing the scheme of electric lighting so far sanctioned for the main thoroughfares.

During the past year OLDHAM electricity undertaking has made a profit of £1 403, compared with £3 836 in the previous year. At a meeting of the Electricity Committee last week, the chairman (Alderman Hardman) said that they had an adverse balance of £1 900 to overcome on the first two quarters, and had been afraid they might be obliged to increase the rates. He thought they would all regard the outcome as very satisfactory, particularly as they had had to pay so much for coal. The increase in units sold over the previous year had been approximately 4 millions. He expected that during next year they would have an increase of 22 millions. He thought that at an early date they would have to consider what to do with the prospective profit. They had been getting some prices from other towns, and at a future meeting the committee would be asked to consider a scale of reduction in prices for electricity. In wages, they had had an increase of £2 000 to meet, and in materials for distribution another £2 000. This all had to come out of the revenue. The interest on sinking fund and loan came to £39 000, as against £24 000 the previous year, again showing a considerable increase in the costs against the undertaking. The revenue was about £20 000 more than in the previous year. The total number of units sold was 862 546, as compared with 435 068. The number of cwts. of coal used was 24 268, against 23 005, and the amount of coal used per unit generated 2·50 lb. against 4·45. The efficiency was put at 79·38 per cent., as compared with 75·18 per cent.

The annual report of BURTON electricity undertaking shows that a gross profit was made of £36 235. After meeting the loan charges and other items, the surplus remaining was £19 812, compared with £12 611 last year. Of this surplus, £14 812 has been allocated to the renewals fund, and £5 000 to rate fund. The amount of the renewals fund at March 31, 1921, was £3 346; the income during the year (amount transferred from revenue account £14 812, and contributions under agreement, etc., £425) £15,237; making a total of £18 583; which, less excess capital expenditure of £13 570, left a balance remaining at March 31, 1922, of £5,013. The total capital expenditure, including £69 373 during the year, is £274 552, of which £54 189 has been provided out of revenue. The net outstanding debt at March 31 was £153 002. The total number of units sold was 8 157 743, compared with 7 132 945 last year, an increase of 1 025 698 units. The power supply shows an increase of 866 159 units on last year. The H.P. in motors connected has increased by 964 during the year, the total now being 9 195. The total costs have decreased from 1·588d. per unit to 1·434d., or 9·7 per cent. The total maximum load of 3 490 kW was reached on December 16, 1921, and represents an increase of 790 kW. It is interesting to note that the gross income of the undertaking on December 31, 1894, the first year of the works' existence, was £529, the working expenses £844, and a gross loss of £315 was made.

Electric Traction.

WEST BROMWICH Corporation have applied to the Ministry of Health for sanction to a loan of £75 000 for the reconstruction of the tramway track.

WOLVERHAMPTON Corporation have decided to commence work on the general renewal of the tramway track, and a tender (at £3 871) has just been accepted for renewing the Waterloo Road route.

The first section of the new electric tram service on the Leberton-Granton route in EDINBURGH was officially inaugurated on Tuesday by Lord Provost Hutchison by the breaking of a broad ribbon stretched across the street at the old border line which formerly separated Edinburgh from Leith.

SUNDERLAND Town Council has approved a scheme submitted by the Tramways Committee for the establishment of a retirement fund for members of the traffic staff. Subject to a certificate of exemption under the Unemployment Insurance Act, 1920, being granted by the Ministry of Labour, a fund will be established by which the Corporation and the employees will each contribute 10d. per man per week. The retirement allowance will be reckoned at 50 per cent. of the wage for the time being in operation for motormen. The Corporation is not to be liable to contribute in any one year more than 20 per cent. above their present contribution under the Unemployment Insurance Act, 1920, in respect of tramway employees. The Corporation unanimously approved the scheme in principle, and the final drafting of the scheme will be proceeded with, subject to official sanction.

The scheme for the construction of an EAST-TO-WEST railway in NORTH LONDON has been revived in a modified form. The projected line would connect the Great Northern, Great Eastern, Great Central and Great Western Railways. Probably the line, if constructed, will be equipped electrically. It would be twenty miles in length, connecting the joint railway of the G.W. and G.C. Companies near Denham, with the G.N. main line, near Wood Green, and the G.E. line at the adjoining Palace Gates terminus, skirting *en route* many towns and villages, including Watford, Elstree and Chipping Barnet. No doubt such a line would be extremely useful, and would increase the transport facilities in North London. It would also enable trains to proceed from the north to the south of England without coming into London. Direct rail communication between the northern and north-western suburbs would be given, and it would enable the Eastern Group of railways to run circular suburban passenger services from and to their respective termini.

Personal and Appointments.

Professor A. S. BUTLER, M.A., has resigned the chair of Natural Philosophy at St. Andrew's University.

Keighley Tramways Committee recommend the Council to appoint CAPTAIN C. JACKSON of Sheffield to the post of tramways manager.

MR. W. H. DURRELL, assistant electrical engineer, Eastern Bengal Railway, has been appointed to officiate as electrical engineer of the railway.

MR. A. G. WARREN is appointed to officiate as electrical inspector to the Indian Government in the United Provinces, *vice* Major H. C. C. TUFNELL, resigned.

Barnes (Surrey) Urban Council have fixed the salary of the electrical engineer, Mr. C. S. DAVIDSON, at £1 000 per annum, to include bonus, as from June 1. His previous salary was £952.

Wimbledon Town Council has made a grant of £75 to MR. W. J. OSWALD, chief assistant electrical engineer, for the services rendered by him as acting chief electrical engineer from February 1 to May 31.

MR. F. J. FOXLEE, district electrical superintendent of the Bengal-Nagpur Railway, is on six months' leave and Mr. D. KERRIDGE, district electrical superintendent, Khargpur, is officiating in his place.

Southport Town Council has appointed Mr. W. T. GANN principal assistant to the electrical engineer (Mr. E. Moxon) at a commencing salary and bonus of £469 a year, to be increased by two annual increments to £580.

Mr. A. J. BRIDGE informs us that he has left the service of Metropolitan Vickers Electrical Company, Manchester, to take up the appointment of manager of the Publicity Department of The Brush Electrical Engineering Company, Loughborough.

Owing to ill-health Mr. W. R. RENDELL has decided to resign the general managership of the Metropolitan Electric Supply Co. in the autumn. He has held the position with great success since the commencement of 1916, and his resignation has been accepted with regret by the Board.

In connection with the forthcoming retirement of Mr. J. DYER LEWIS, H.M. Divisional Inspector of Mines in charge of the South Wales Division, Mr. J. M. CAREY, at present serving as a senior inspector in that Division, has been promoted to take Mr. Dyer's place, and Colonel J. A. S. Ritson has been appointed a senior inspector in place of Mr. Carey.

Business Items, etc.

The address of the hon. secretary of the Sheffield and District Wireless Society (Mr. L. H. Crowther) is now 18, Linden Avenue, Woodseats, Sheffield.

The COMMERCIAL-CABLE COMPANY announces the removal of its administrative and central operating offices to the Mackay House, 27–33, Wormwood-street, E.C.2.

Mr. I. STEPHENSON, junr., announces that he is continuing the business of his father, the late Mr. I. Stephenson, electrical engineer, of 36 and 37, Flowergate, Whitby.

The address of the MINES Department is now Dean Stanley Street Millbank, Westminster, S.W.1. Telephone No.: Victoria 9310 Telegrams: Minindust, Vic., London.

Owing to the engineering and shipbuilding disputes, the departure of the s.s. BRITISH TRADE has been somewhat delayed, but we are informed that the ship will sail at an early date.

Mr. J. E. Sayers announces that he has taken into partnership Mr. Thomas G. Crum, who has been his assistant for several years. The business will now be carried on under the firm name of JAMES E. SAYERS AND CO., consulting engineers and electricians, Ocean Buildings, 190, West George Street, Glasgow.

KENNEDY AND DONKIN have removed to new offices at Broadway Court, 8, Broadway, Westminster, London, S.W.1. The new offices are situated on the fourth floor of the building, which is midway between St. James's Park Station and Victoria St eet. The telegraphic address, " Kinematic, Vic., London," will remain unaltered, but the telephone number will be Victoria 3601 (3 lines).

In these days accurate and up-to-date information is essential, especially for engineering firms. Though the technical journals supply, or endeavour to supply the needful, there are so many of these to be perused if one is to make sure that nothing important is missed. Time and opportunity are often lacking for this laborious task, and consequently any system which eliminates some of the work should be welcome. The LEFAX SYSTEM claims to have solved the problem, for they publish selected articles, boiled down to essentials, in a standard loose-leaf form, self-indexed and classified for filing in filing boxes or cabinets. The sheets are also punched for insertion in the pocket firm. Standard engineering tables and data, as well as blank forms, are also supplied. The British agents for the system are Norman and Hill, 54, Holborn Viaduct, London, E.C.1, who will supply further particulars.

Obituary.

By the death of FREDERICK WM. SANDERSON, headmaster of Oundle School, science loses an ardent disciple and education a man of original mind. Mr. Sanderson was the author of several elementary text-books on electricity, mechanics and geometry.

We regret to announce the death of Mr. F. R. REEVES, who was for many years secretary, and later secretary and general manager of Crompton and Co., Ltd. Subsequently he became managing director of the Sevenoaks and District Electricity Co., and he was also a director of the Calcutta Electric Supply Corporation and two or three British provincial supply companies. Mr. Reeve was 79 years of age.

The death is announced from New York of Mr. GEORGE GRAY WARD, vice-president of the Commercial Cable Co., in his 78th year. Mr. Ward, who was born in Hertfordshire and educated privately at Cambridge, entered the Electric Telegraph Co. In 1865 he joined the Egyptian Government Telegraph Service and was stationed for about three years at Alexandria, and in 1869 he accepted a position with the first French Atlantic Cable Co. Returning to England in 1874, he joined the Direct United States Cable Co. as superintendent, but in 1884 he accepted the post of commercial secretary and general manager of the Commercial Cable Co. In 1890 he was relieved of the position of secretary and elected vice-president of the company, and in 1902 he was made chairman of the Board.

Mr. Ward displayed great activity in organising the Commercial Cable Company's system and in laying its cables; upon the extension to Japan being completed in 1906, he was decorated by the Emperor with the Order of the Commander of the Rising Sun. Mr. Ward was instrumental in laying the New York-Hayti cable in 1896 and had much to do with connecting Portugal directly with America, via the Azores. He also rendered valuable assistance to the Deutsche Atlantische Telegraphen Gesellschaft in establishing the direct communication which formerly existed between Germany and the United States, and upon the completion of the Emden-New York cable in 1900 the ex-Kaiser conferred on him the Royal Order of the Royal Prussian Crown of the Second Class. Mr. Ward was vice-president and general manager of the Commercial Pacific Cable Co., a vice-president of the Postal Telegraph Co., vice-president of the Mackay Companies, and a director of several other companies. He was also a member of the New York Chamber of Commerce and of the American Institute of Electrical Engineers, and local hon. secretary and treasurer of the Institution of Electrical Engineers.

Institution Notes.

The annual conversazione of the INSTITUTION OF CIVIL ENGINEERS will take place at 8.20 p.m. on Tuesday next at the Institution offices.

The following officers have been elected for the 1922–23 session of the RÖNTGEN SOCIETY:—*President*, Sir Humphrey Rolleston; *Vice-Presidents*, Professor Sir William H. Bragg, Professor Sir Ernest Rutnerford, A. E. Barclay; *Hon. Treasurer*, Geoffrey Pearce; *Hon. Secretaries*, E. A. Owen, Russell J. Reynolds.

The BRITISH ENGINEERING STANDARDS ASSOCIATION have issued their revised specification (No. 7, 1922) of insulated annealed copper conductors for electric power and light. It contains the information as to sizes, tests, standard thicknesses of dielectric, etc., given in the 1919 edition, with the addition of a new size of cable 0.03 sq. in. in area. Standard thicknesses for cab tyre sheathing have also been incorporated. The Association have also issued Specification No. 152, which is a metric edition of No. 7. One additional size of cable of 1.5 sq. mm. area has, however, been included as this is a size commonly used in countries using the metric system. Copies of the specifications may be obtained from the Association, 28, Victoria Street, London, S.W.1, price 1s. 2d. each.

Miscellaneous.

The BRITISH INDUSTRIES Fair will be held as usual next year, from February 19 to March 2, but the Birmingham section will have a more comprehensive display of mechanical plant.

Mr. Herbert W. Sullivan is seeking leave TO AMEND DRAWINGS forming part of the specification of LETTERS PATENT No. 166 970, for " Improvements in or relating to duplex and like telegraphic systems."

The CONFERENCE which had been arranged to take place on Wednesday, between all the ENGINEERING UNIONS and the Engineering Employers' Federation, to discuss the employers' demand for a reduction of the war bonus, has been postponed.

The staffs of the EASTERN AND ASSOCIATED TELEGRAPH COMPANIES have sent a cheque for £1 000 to St. Bartholomew's Hospital for maintaining a bed in memory of the late Lady Denison-Pender, wife of the chairman of the companies, Sir John Denison-Pender.

It is announced that the BOILERMAKERS AND IRON AND STEEL SHIPBUILDERS' SOCIETY have agreed to accept the terms agreed upon between the Engineering and the National Employers' Federation and the other trade unions concerned on the 2nd inst. The dispute is, therefore, now terminated.

The current number of the " DECIMAL EDUCATOR " includes reports of the meeting of the National Chamber of Trade, which passed a unanimous resolution advocating the adoption of the high-value penny; American views of the " Easy Stage " proposal (a modification of which is fully set out), and of the progress of the U.S.A. metric bill.

An inquiry was opened on Tuesday by the Board of Trade Committee into the complaint of DUMPING VULCANISED FIBRE in this country. After taking some evidence, the Committee decided to adjourn the inquiry indefinitely. A difficulty was experienced in dealing with the case owing to fluctuations in the market price since the complaint was lodged.

Last week's issue of the " Manchester Guardian Commercial " was the third of the series of special numbers on RECONSTRUCTION IN EUROPE. Mr. J. M. Keynes, the general editor of the series, has assembled a most valuable collection of articles on the Genoa Conference, on the problem of Austria, together with an exhaustive survey of the present position and prospects of the textile industries of Europe. Among the contributors are Mr. Keynes, Signor Nitti, Baron d'Estournelles de Constante, and Prof. Cassel.

At a meeting in connection with the " SAFETY FIRST " movement, held at the Institution of Mechanical Engineers last week, Mr. A. Stevenson Taylor, Home Office Senior Engineering Inspector, stated that in 1920 nearly £6 000 000 was paid in compensation for industrial accidents, and he was convinced that by proper teaching of workers and employers a great number of those accidents were preventible. In the same period 1 400 fatal accidents were reported under the Workmen's Compensation Acts and 140 000 accidents of all classes occurred.

Education Notes.

The foundation stone of the new EAST MIDLAND UNIVERSITY at Nottingham was laid last week by Viscount Haldane, who announced that an anonymous donor had sent him a cheque for £100 000 towards the endowment of the University. An appeal for support was made to large manufacturers and employers of labour, as true scientific knowledge could never be an enemy.

The University Court of ABERDEEN UNIVERSITY have asked the Committee on Engineering to confer with the governors of Robert Gordon's Technical College on the question of the creation of a school of higher education in engineering, including the foundation of a Chair of Engineering in the University. Professor C. Niven has resigned the Chair of Natural Philosophy as from October 1 next.

Imperial Notes.

PORT ELIZABETH (S. Africa) Municipal Council have recently placed contracts with British firms for additional generating plant of the value of about £52,000.

LITHGOW (N.S.W.) Council have placed an order with Ramsay, Sharp and Co. for electricity generating plant for supplying electricity in the centre of the town. Orders for mains and a h.t. transmission line to the Oakley Park Colliery are still to be given out.

Mr. Butters, manager of the Government hydro-electric department, has made proposals for supplying electrical energy in bulk to ZECHAN (Tasmania) Municipality, and the payment of £1 184 per annum for ten years to cover interest and sinking fund on the Council's present electrical plant.

According to the "Industrial Australian and Mining Standard," the Electric Supply Co. of Victoria has offered to arrange for the distribution in Ballarat and adjacent districts of the electrical energy supplied from the Morwell coalfields, provided the municipalities undertake to meet financial obligations required for converting plant and mains, and also if an extension of its present lease be granted, or that the undertaking be purchased by the municipalities at the expiration of the existing lease. Further negotiations are pending between the councils, the Electricity Commissioners and the company. The company has asked £500 000 as the price at which it would be willing to part with the present plant.

The NEWCASTLE (N.S.W.) City Council and Chamber of Commerce have again been urging the Government to grant facilities for the electrification of the district tramways. In reply to a recent deputation, the Chief Commissioner of Railways (Mr. Fraser) said the Commissioners had repeatedly endeavoured to get money for the electrification of the Newcastle tramways, but their application had been refused each time. They needed £1 100 000 for the work, and it was no use starting unless they felt sure that there would be sufficient money to continue the work. It was no use tinkering, as had been done in Sydney with the proposed electrification of the railways. The provision of electric railways in Sydney was urgent, and if funds were found for that the Government might consider it equally fair to provide funds for Newcastle.

SYDNEY (N.S.W.) Electricity Committee have decided to postpone the question of erecting a new power station and to enter into negotiations with the Railway Commissioners for the supply of electricity in bulk. The Council would want a supply as cheaply as they can generate it themselves, and the agreement would be terminable by either side on five years' notice. A new power house would cost the Council from £1 000 000 to £1 250 000, and it would have to be ready in five years time, but the Commissioners can give a supply whenever it is required. There is a good deal of opposition to the proposed agreement, some members maintaining that the Council could generate current as cheaply as the Commissioners. Already nearly £5 000 000 capital has been expended on the undertaking, and the Council is, it is claimed, as well able to find the money for extensions as the Commissioners.

Foreign Notes.

A PROVISIONAL TELEGRAPHIC CONVENTION has been made between FINLAND and RUSSIA, was signed on the 13th inst., and came into force this week. Telegraphic connection between Finland and Russia has, therefore, been resumed over the Helsingfors-Moscow and Viborg-Petrograd lines, and the Finnish Government will not oppose the establishment of telegraphic communication between Northern Norway and Northern Russia over Finnish territory.

The use of ELECTRICITY for FARM WORK is steadily expanding in the United States. Apart from the extension of transmission lines from urban centres, there is an increasing demand for independent generating plants. These latter are usually petrol-driven sets, though there are also a number of small water-power stations. It is estimated that there are already over 300 000 of these independent plants in use, and the number is rapidly increasing. Electricity is employed for lighting the farm house and adjacent buildings, and for a great variety of power purposes. Owing to its convenience and efficiency, electricity is rapidly displacing rival forms of power.

The order for the 80 freight locomotives required by the PARIS-ORLEANS RAILWAY, to which we referred in our issue of June 9, (p. 698), has been placed with the Société Oerlikon and the Société de Construction des Batignolles, both in Paris. These locomotives are each for a one hour rating of 1 720 H.P. The Société Oerlikon is to supply and erect the electrical equipment, while the Société de Construction des Batignolles deals with the mechanical part. Except in the case of the five first locomotives, which will be completed at the works of the Ateliers de Construction Oerlikon and will serve as models, the whole electrical equipment will be built in France, to the Oerlikon design, at the works of the Société Oerlikon. The locomotives are intended for goods trains and are to be capable of hauling a load up to 1 200 tons; but they are also to be suitable for passenger service, in which case a speed of about 68 miles per hour must be attainable. The locomotives are equipped with four motors wound for 1 500 V d.c. and having each an output of 430 H.P. measured at wheel rim.

Wireless and Telegraph Notes.

The West India Committee announce that a system of wireless telephony has been successfully established in the TURKS AND CAICOS ISLES (B.W.I.), Grand Trunk now being connected with the South Caicos and Salt Cay, distances of twelve and eight miles respectively.

A senseless and stupid outrage was perpetrated on Sunday at the VALENCIA (co. Kerry) cable station of the Western Union Telegraph Company. During the night some masked and armed men forcibly entered the station and smashed several instruments, doing damage to the extent of £3 000.

A further meeting in connection with WIRELESS BROADCASTING was held last Friday at the General Post Office. The Postmaster-General was present, and representatives of the twenty-three firms who attended the conference held a month ago. The proceedings were private, and the manufacturers are holding a further conference among themselves this week.

An agreement was recently made between the Italian Government and the Eastern Telegraph Company for the re-opening of the submarine CABLE BETWEEN TRIESTE AND CORFU. The new company have agreed to give special facilities for the transmission between Italy and Egypt of State and Press telegrams, as well as between Italy and Eritrea, Abyssinia and Italian Somaliland.

Catalogues, Price Lists, &c.

RONALD TRIST AND CO., specialists in sand-blast machinery, have published in pamphlet form, a reprint of a paper on "Sand-Blasting," by Mr. E. L. Samson, read before the Institution of British Foundrymen (London Branch) last February. The paper is fully illustrated and gives much useful information.

"Tips on Odd Jobs about the House" is the latest publication of the RAWLPLUG CO., and without doubt will prove most popular. The booklet is attractively produced with dainty little marginal illustrations in blue, showing various household fixtures and the Rawlplug tools required to repair minor defects, or to put up the fixtures.

The importance to business men of the DICTOGRAPH TELEPHONE SYSTEM is clearly shown in an illustrated booklet just published by Dictograph Telephones, Ltd. One of the great advantages of this system is that there is neither mouthpiece nor earpiece to hold, and conversations can be carried on easily and clearly if the speaker is as much as 15 ft. away from the instrument.

ISENTHAL AND CO. have just published a new pamphlet (Section 2) dealing with their regulating resistances. The new publication gives illustrations and particulars of the company's field regulators for back of board (B.O.B.) mounting, dimmers for incandescent lighting, resistance units, load and standby resistances, meter calibration resistances, arc regulators, etc.

SIMPLEX CONDUITS, LTD., have just issued a new illustrated price list (No. 909) comprising Section T. of their manufactures (light and heavy gauge conduits, couplers, normal and sharp bends, circular junction boxes, ceiling rose and pendant fittings, porcelain connectors, screwing tools, etc.). The firm's original intention was to publish this catalogue on January 1, but owing to the extreme instability of prices at that time, its issue was postponed until June 1. Even now the prices of conduit have been omitted from the list and printed on a separate card, in order that they may be revised when necessary and that the section may not be obsolete within a few weeks of its appearance.

We have received from the GENERAL ELECTRIC COMPANY a copy of a new edition of their electric light supplies catalogue, in which all prices have been revised to present day level. Numerous illustrated descriptions with dimensions, weights and prices are given of distribution boards, cutout boards, branch switches, "H. and H." snap switches, wall plugs, ceiling roses, lampholders, flashers, etc. A handy catalogue of ELECTRICAL MEASURING INSTRUMENTS has also been issued by this Company. It is an abridged edition of section M of their complete catalogue, and covers switchboard ammeters and voltmeters of both round and sector patterns, pedestal type, instruments and portable instruments, "Salford" testing sets, meggers, etc., the prices of which have been revised to date.

The business of VERDUN CUTTS & CO., electro-metallurgists, of Fargate, Sheffield, has been converted into a private limited liability company. The business was started about twelve years ago by Verdun O. Cutts and during that time the firm have designed and erected many complete electro-metallurgical works and plant. They have carried out work for clients in Great Britain, the Colonies, India, on the Continent and in China and Japan, and they have also done a good deal of original work in the design and operation of plant for the production of steel, non-ferrous metals and alloys, ferro-alloys, precious and rare earth metals, artificial abrasives, etc.

Companies' Meetings, Reports, etc.

British Electric Traction.

The twenty-sixth ordinary general meeting of the British Electric Traction Co., Ltd., was held on Friday at the Holborn Restaurant, London, Mr. J. S. Austen (the Chairman) presiding.

The chairman in moving the adoption of the report and accounts, said :—We propose to ask you to-day to sanction the payment of a dividend of 4½ per cent., which compares with 4 per cent. paid last year. There may be some among you who will ask why we are to-day paying an increased dividend when our earnings are only about the same as they were last year. Our answer to that is that we believe that our income is more stabilised and is becoming still more stabilised, and that consequently we are justified in going rather nearer to our limit than we have done before. With your permission I will explain as simply as possible exactly what we have done during the past year. We have earned this 4½ per cent. which we propose should be paid, and in addition we have earned a sum of about £31 500. That sum of £31 500 we propose to dispose of by putting £14 000 to reserve and by adding to our carry forward a sum of about £17 000. The net results are almost exactly the same as those of last year, but, although there has been very little change in the result among the component parts which make up the whole, there have been some very material changes. It is not necessary to specify them, but I may say that we have had increases on some investments aggregating about £41 500, but against that we have had losses on others amounting to £40,000. These sums, as you see, are very considerable, but it is only to be expected that in a company like this, with a multitude of different investments, the gains as a rule will meet the losses, and in good years surpass them.

Current Year's Prospects.

It is difficult to draw any general conclusion from these results, but perhaps it may interest you if I summarise what the various branches of our business are doing at the moment. Our main business may be divided into three classes—namely, tramways, electric power and electric lighting. With regard to the tramways, during the current year up to date there is a falling-off in receipts. It may not be quite safe even to try to specify what that falling-off is, but perhaps it will give you a general idea, if I say 20 per cent., which naturally is a serious amount ; but against that the tramways can set a very considerable saving in expenses. On the whole, I should doubt if the general results from tramway working during the present year will be so good as they have been in the past. Then we come to electric power, and there it is obvious that owing to the engineering strike, depression in trade, and so on, there will be a decrease. With regard to electric lighting, however, which includes the use of electricity for domestic purposes, that received a stimulus during the war, and up to the present there has been no setback, and I do not think that any setback is coming. There is a fourth portion of our business and that is the omnibus business.

Subsidiaries' New Issues.

During the year two of our subsidiary companies have made new issues of capital ; one is the Shropshire Power Co., which made a very successful issue, and the other is the British Automobile Traction Co., which was not so favourably received by the public. Those of you who have taken the trouble to examine our list of investments will have found that we have during the year increased that list by a number of investments of what I may call a general nature. Since the close of the year we have still further increased those investments, and I think it is probable that by the time you get the next report we shall have very considerably increased that list. In that connection I may say that it will probably be advisable to alter the form in which we at present show our investments, which is not altogether satisfactory.

It is the present intention of the directors, if circumstances are satisfactory, to declare an interim dividend upon the stock about December next.

With regard to the immediate prospects, it is really very difficult in a company like this, with such a variety of undertakings, to forecast exactly what one is going to do. I prefer to touch on the dividend question. I have now had two years' experience of this company, and I am pleased to say that with that experience my regard for the company has increased. It has been the business of my life, mainly, to build up trust companies, and in every case the result has been satisfactory, and I can see no reason why we should not have steady progress in this company.

Mr. Emile Garcke (deputy-chairman), seconded the resolution, which after a brief discussion, was carried unanimously.

Madras Electric Supply Corporation.

At the annual meeting of this company, last week, the chairman, Mr. James Gray, stated that, owing to the delay in installing additional converting plant, the number of new consumers was not as high as usual, but the total connections and the gross revenue were more than maintained in consequence of several large power consumers having come on to the company's mains. With the exception of the tramways, which were affected by the strike in the early part of 1921, increased supplies of current were provided all round. The gross revenue increased by £11 091, but the working expenses showed an increase of £12 297, due to the higher cost of fuel and to a readjustment of salaries between the company and the tramway company. The adjustment of exchange showed a debit of £19 739 instead of a credit of £1 254, so that there was a total reduction of £22 199 compared with 1920. Their application to the Government of Madras a few years ago to increase the rate for current for lighting and fans on a combined circuit from 4 annas to 5 annas was absolutely necessary. They were indebted to the Government for removing the restriction of three years from August 1, 1919, during which the increase was to operate, and the position now was that any revision of the tariff would be subject to the ordinary provisions of the Indian Electricity Act, under which all Indian electric supply companies operated.

After payment of the preference dividend there was a balance of £30 356, which would be applied in paying a dividend on the ordinary shares of 8 per cent. (tax free), paying additional remuneration to the directors, and after placing £5 000 to reserve, a sum of £9 728 would be carried forward. The expenditure on buildings and machinery amounted to £29 071, representing chiefly a new water tube boiler and three new sub-stations. Expenditure on mains (£21 217) included new high tension feeder lines in various parts of the area. The debenture stock sinking fund reserve and general reserve fund showed substantial increases and now more than covered any depreciation on investments. The sum provided for depreciation and renewals for 1921 was £15 000, bringing the total to £67 319. In consequence of the strike in the early part of 1921, the results from the tramway were less satisfactory than formerly, and the dividend on the ordinary shares was reduced from 8 to 5 per cent., tax free.

To meet continuous demands for supplies of current additional generating and converting plant was being supplied. The additions included a water-tube boiler, one 5 000 kW turbo-alternator and additional rotary converters aggregating 3 000 kW. To provide the funds the Board took advantage of issuing £200 000 7 per cent. second debentures.

Mr. John G. B. Stone, who seconded the motion for the adoption of the report and accounts, said he had paid a visit to Madras. He found their relations with the Government and the Municipality were of the most cordial kind. He came away with the feeling that they had now a body of men whom it would take a very great deal to bring out on strike again. The trouble they were going to have was to meet the demands. The demand for both light and power was growing at a very rapid rate. There was one peculiarity in Madras which did not exist in many places, and that was the use of the fan, even in winter, practically without ceasing by day and even by night. During the day there was not only the heat to deal with, but the use of fans kept the mosquitoes off. As to their use at night he found that if he did not have the fan going, even in spite of mosquito curtains, the mosquitoes got in sometimes. There was not a great deal of industrial power at present in Madras, but that was probably due to the fact of there being no really cheap power available. Now that the company was in a position to offer cheap power, his impression was that they would find that their power load would grow very much.

Whitehall Electric Investments, Ltd.

Presiding at the annual meeting of Whitehall Electric Investments, Ltd., on Tuesday, the Hon. Clive Pearson (chairman of the company), in moving the adoption of the report and accounts, said that over a period of years Lord Cowdray, through one of his companies, the Whitehall Securities Corporation, Ltd., had acquired a controlling interest in various electrical companies in Mexico supplying certain large cities and their surrounding districts with light and power, and operating the tramway system in such cities. These enterprises were remodelled, and had been built up over many years into good properties ; they had been nursed through Mexico's troublous times, and were now in an established position, with steady earnings and good additional prospects still before them. An opportunity arose at the end of the war of purchasing from the Public Trustee the share control of the English company owning and operating the tramways and the power and light distribution system in Santiago, a city of 500,000 people, and the capital of Chile, which company had been controlled for some years before the war by the A.E.G. At the time of this purchase it was known that very considerable sums would have to be spent on extensions in order to develop the properties to their fullest extent, and to embrace not only the city of Santiago, but also the rich territory stretching to Valparaiso, the chief port of the country. It was, therefore, determined to form the Whitehall Electric Investments, Ltd., and to transfer to it the whole of the debentures and shares in the different electrical companies, both Mexican and Chilian, giving in exchange only ordinary shares in the Investment company, and to issue debentures and preference shares of this company to provide the cash required for the extension work.

A Fine Field for Business.

Upon acquiring the Chilian properties a complete examination of the position showed the existence of a very fine field for a large and satisfactory business. It was found that the development of considerable additional hydro-electric power was essential, and remodelling and extensions were required, both of the tramways in Santiago and the light and power distribution system. To provide the additional water power a controlling interest was obtained in and amalgamation effected with the Cia. Nacional de Fuerza Electrica, a company which had been formed and into which Chilian Nationals subscribed over half a million cash for the purpose of developing hydro-electric power at Maitenes, some thirty miles outside Santiago. The Cia. Chilena was thus inaugurated as the owners of hydro-

electric developments, and of a very large system of trams and light and power distributing facilities. It was earning a large immediate income in a field very favourable for the investment of additional capital to extend its activities. When the Maitenes water power development was completed the company would be enabled to fulfil the important contract it had entered into for the supply of power to the Government railways, the electrification of which was already in hand.

The Position in Mexico.

With regard to Mexico, in spite of all its misfortunes, political and financial, during the last nine years—it still continued one of the richest countries in the world with an unlimited future. Mexico had a population of some 15 000 000 of people, whose capacity for work and whose reputation for honesty must be regarded quite apart from the relatively small number of people who constitute the disturbing factor in the country. To enable the factories to work they required the services of the great utility companies for the supply of electric light and power. It was a noteworthy fact that during the whole of the disturbed period little or no damage had been done to any electric power and light plant throughout the Republic. The demand for the supply of electric energy was constant and growing. Referring to the company's Mexican investments, the chairman said the Tampico Company was formerly an English company, now in voluntary liquidation, owing to English income-tax. The port of Tampico had grown largely in the last few years, due to the oil industry having developed so materially in the district, and while there was a temporary lull, their profits for 1922 would not be as large as those of 1921, the company's record year, there seemed to be no reason why the earnings of this company should not before long again equal the 1921 figures, and, in fact, exceed them. So far as they were able to judge there was no reason why—in addition to the payment of its debenture interest and sinking fund, and dividend on its preference shares—it should not earn a reasonable dividend on its ordinary shares for the current year. The Puebla Company, which operated in the city of Puebla—the centre of the cotton industry in Mexico—was a Canadian company which was formed many years ago. The company supplied power over a large district, and Puebla was probably one of the best-lighted cities in the world. The water-power station at Tuxpango was now developed for 17 000 H.P., and was capable of developing 17 000 more. The total horse-power at present developed by the company at its three stations—Tuxpango, Portezuela, and St. Augustin was 26 000. The outlook for this company was good, and the earnings ought steadily to increase.

Electric Construction Co.

In the course of his address at the annual meeting of the ELECTRIC CONSTRUCTION Co. last Thursday Mr. Philip E. Beachcroft, who presided, said that the accounts submitted showed a reduction in net profit of only £425 compared with that of the previous year—a satisfactory result having regard to the prevailing conditions. The net revenue for the year amounted to £82 684, and after payment of various dividends £22 072 remained to be carried forward. In the balance sheet the item of properties, patents and goodwill stood at £350 705. Since the accounts were made up a careful valuation had been completed, from which it was evident that the value of buildings, plant and machinery and other fixed assets exceeded the amount in the balance sheet. The properties for many years had been maintained out of revenue at a high state of efficiency, and provision for depreciation had also been liberal. The directors, therefore, considered that the reference to patents and goodwill in the balance sheet should in future be eliminated. Orders since the beginning of the new financial year were 50 per cent. greater than in the corresponding period last year. Whether the improvement would be maintained he could not say, but the discontinuance of the engineers' strike should give the trade of the country a considerable impetus. Dealing with the general situation, the chairman said that, before the country could recapture its export business, lower costs of production were essential, and these could only be obtained by a lower standard of wages and salaries, by a lower margin of profit, and by increased output. Above all, there must be co-operation between capital and labour, for without it all efforts would be in vain. To that end he would counsel the adoption to a far greater degree than hitherto of the piecework system, which was not now regarded by labour with the same antagonism as formerly. If it were adopted, labour would procure week by week the fruit of its own effort without being dependent on profits, which were not ascertained for many months. An abstract of the accounts was given in our issue of June 9.

Anglo-Argentine Tramways.

Presiding at the annual meeting of the ANGLO-ARGENTINE TRAMWAYS Co., last week, Sir George A. Touche (the chairman) said he feared that the report for the year might have been received with some disappointment by the shareholders. Their total receipts were less by £135 000, and their total expenses more by £107 000. In 1920 the receipts from all sources were £4 413 164. In 1921 they were £4 277 600, a difference of £135 564. In his address last June he called attention to the manner in which the revenue for 1920 had benefited by the favourable exchange and the large credit for income tax, owing to the heavy payments for arrears of dividend on the first preference shares, and explained that such credits were windfalls not likely to recur. The difference in exchange alone represented a larger sum than the difference in net receipts, while income tax accounted for nearly as much as the reduction in receipts from all sources. The par rate of exchange for the Argentine gold dollar on London was 47·58d. Their remittances for the year totalled nearly £1 000 000, at an average rate of 45⅛. In 1920 the average rate was 58·89d, and they had thus lost heavily on the exchange.

When they separated the traffic receipts from the other credits there was some ground for encouragement. In his report a year ago the general manager estimated an increase of 5 per cent. in 1921. This estimate had proved accurate. The traffic receipts in 1920 were £4 000 741 ; in 1921 they were £4 203 369, an increase of £202 628. The traffic receipts were the backbone of their undertaking. Last year they carried nearly 90 000 000 more passengers than in 1916, and they ran nearly 7 000 000 more miles.

The total expenditure for the year amounted to £3 305 081, against £3 198 028 in 1920. Traffic expenses were £1 223 358, or £65 093 in excess of the previous year. Of this £57 218 represented increases in wages. Traction expenses were £644 724. These were governed by the cost of fuel. The traffic expenses in 1920 were £812 693. The sum of £433 481 was paid to the Municipality of Buenos Ayres for taxation. It consisted principally of the percentages on traffic receipts payable under the terms of the company's concession. The balance carried to the net revenue account was £972 519. They had paid the current year's dividend on the first preference shares, £176 000, leaving £143 531 undistributed. This enables them to satisfy 12 months arrears on the second preference shares to December 30, 1917, requiring £137 500, and left to be carried forward to 1922 £6 031. They had already paid one-half of this second preference dividend, and now recommended the payment of the second half. It was a question whether they should pay a full year's dividend on the second preference shares, or only a half-year's dividend. To pay the full year it was necessary to encroach, to a small extent, on the amount carried forward, which was reduced from £15 884 to £6 031. It went against the grain to do this, but the Board felt it to be desirable to prevent the arrears on the second preference shares from increasing. There were still four years of dividend in arrear on these preference shares, while the ordinary share capital of £3 250 000 had received no return since 1914. This was not a satisfactory position. The business should be self-supporting on a commercial basis. The city was supplied with the finest tramway service in the world. The gain to the Tramway Company was very disappointing. The present tariff arrangement was authorised in 1920, and was subject to review in 1923.

United River Plate Telephone.

At the annual meeting of the UNITED RIVER PLATE TELEPHONE Co. on Tuesday, the Chairman (Sir Frederick Green, K.B.E.), after an analysis of the report and accounts (given in our last issue), stated that they were paying a final dividend of 5 per cent. on 324 000 ordinary shares, making (with the interim dividend) a total of 8 per cent. for the year, and a dividend of 5 per cent. on 108 000 ordinary shares, both tax free, leaving £38 705 to be carried forward, against £38 367 in the previous year. He was sorry to say the Government had not yet given them permission to make the moderate increase in rates for which they petitioned in the spring of 1919. That attitude on the part of the Government, failing, as they thought, to recognise the present high costs of working a telephone business had been unfortunately reflected in the accounts, for there was no balance available for the usual reserve appropriation. The necessity for an increase was constantly being urged upon the authorities, and they would also lose no opportunity of bringing home to the Government and the public that although the company was only too anxious to provide all the telephone facilities needed, they were unfortunately unable to embark upon further considerable extensions until increased rates were forthcoming.

Extensions and Additions.

During the year they had completed extensions to many of their common battery manual exchanges, to the Rosario automatic exchange and to several magneto exchanges, as well as having opened two additional automatic installations in the City of Cordoba and one in Rosario. Most of that equipment was ordered shortly after the armistice, but manufacture had been slow, and it was only in the current year that they would reap the full benefit of that expenditure. The new plant had enabled them during 1921 to connect 13 672 new stations, making the total number connected 97 274, against 83 602 at the end of 1920. There were still a large number awaiting service, and they regretted that until the automatic exchanges were opened they should be able to do but little towards reducing the number. Last July they came into possession of the important Bahiense system, operating in the City of Bahia Blanca and neighbourhood, and they were now engaged in consolidating the system with their own. It had not, however, been possible yet to connect that south-western part of the Province of Buenos Aires to the Federal capital, though they hoped to be able to do so before long, and also other systems which were at present isolated. Though trade conditions in the Argentine were not of the brightest, the outlook from a telephone point of view was most encouraging, as was evidenced by the large number of the public still awaiting service. Notwithstanding the question of rates, their relations with the National Government and the Provincial Governments and the various municipalities continued to be cordial. The deputy chairman (Mr. Percy Cross) would leave for Buenos Aires in August, accompanied by Mr. Dawbarn, the London manager.

Sir John Gavey, whose health had made it necessary for him to relinquish the position of deputy chairman, retained his seat on the Board. With regard to the current year, he said they did not anticipate considerable difficulty in maintaining the dividend on the present capital; but the Argentine Government must recognise that the company could not embark on further extensions requiring fresh capital, having regard to increased wages and the high cost of material, unless adequate rates were permitted.

Globe Telegraph and Trust.

Sir John Denison-Pender, G.B.E., K.C.M.G., presided over the 49th ordinary general meeting of the Globe Telegraph and Trust Co., Ltd., on Tuesday and expressed his pleasure at being able to submit figures which exceeded those of last year. They were in no way due to a windfall, or any transitory cause. The year's total receipts, after deducting working expenses, amounted to £330 146, an increase over last year of £42 374. The directors recommended a final dividend of 3s. per share on the preference shares, making 6 per cent. (less tax), for the year, and of 5s. per share on the ordinary shares, making a total of 10 per cent. net. The company were thus paying the same rate of dividend to their ordinary shareholders as they did last year, but whereas last year they found it necessary to draw upon their reserve fund for contingencies to the extent of £10 000, this year not only did they not require to borrow anything from that fund, but they actually carried forward a surplus of over £20 000. The arrangement entered into about two years ago between the British Government and the Direct United States Cable Co. was supposed to expire on March 31, 1923, when their company would receive about £6 per share for its holding in that company, the shares having cost them £5 4s. 9d. each. When they received the money (about £90 000), they would be able to repay the £60 000 they had had to borrow owing to the fact that 6 000 of their new shares were held and not allotted, and they would have about £30 000 to invest. The income from their American investments showed a reduction in each instance, but in no case was that due to any diminution in the rate of dividend paid. On the other hand, they now received the benefit of a full year's dividend on their investment in the new issues of stocks and shares of the Eastern, Eastern Extension, and Western Union Telegraph Companies. That increase alone amounted to over £58 000, and entirely dwarfed the small losses referred to. While many first-rate industrial concerns which had held investments for many years past had been setting aside sums to meet depreciation, the present value of their company's securities showed an appreciation of over £2 000 000.

The report and accounts were unanimously adopted, and at an extra-ordinary general meeting new articles of association were approved.

Benn Brothers, Ltd., recommend a second interim dividend at the rate of 2½ per cent. per annum on account, payable on July 1.

Callender's Share and Investment Trust propose to pay an interim dividend of 4 per cent. (at 8 per cent. per annum), less tax.

The Aluminium Corporation proposes to increase its 6 per cent. first debentures from £250,000 to £500,000, and to redeem them in 1941 at a premium of £5 per cent.

The Canadian General Electric Company have declared a quarterly dividend of 1½ per cent. for the three months ending June 30, 1922, on the common stock.

The directors of the Barnsley and District Traction Company have declared a dividend of 15 per cent. on the ordinary shares for the past year. An issue is being made of 20 035 ordinary shares at par.

The net profit of the Para Telephone Company for 1921 was £2 482, plus £8 605 brought forward, making £11 087. A further dividend is announced of 3 per cent., making 6 per cent., free of tax, carrying £4 457 forward.

The accounts of Veritys Ltd. for 1921, after providing £2 783 for depreciation, show a net loss of £3 002, plus £6 300 for interim dividends paid during the year. After deducting credit balance of £1 656 brought in, a debit balance of £7 646 remains to be carried forward.

A special dividend of one-half per cent. has been declared on the common stock of the Manila Electric Corporation for the quarter ending June 30, payable on the 1st prox., and making with a regular quarterly dividend of 2 per cent. already announced, a total of 2½ per cent., or $2.50 per share.

The net profit of James Keith and Blackman Company for the year ended March 31 was £20 481. After providing for debenture interest and allowing for depreciation and reserves, with £12 575 brought in, the total is £33 056. It is proposed to pay a dividend on the ordinary shares of 7½ per cent., tax free, carrying forward £15 944.

The Victoria Falls and Transvaal Power Company announce a final dividend of 4 per cent., less tax, on the preference shares, making 10 per cent. for 1921 (the same), and also a dividend of 3 per cent., less tax, on the preference shares on account of 1922. The dividend on the ordinary shares for 1921 is 5 per cent., less tax (the same).

The net receipts of the Shropshire, Worcestershire and Staffordshire Power Company for the past year were £95 153. After deduction of administration and general expenses, debenture and loan interest, and adding £16 183 brought in, there remains £41 083. The directors propose dividends on the 7 per cent. preference and 6 per cent. preference shares for the year, leaving £27 272 to carry forward.

At the meeting of the Yorkshire (Woollen District) Electric Tramways, Ltd., last week, it was reported that the receipts for 1921 totalled £124 330. Deducting all expenses, including repairs and maintenance, debenture and other interest, and setting aside £15 000 to renewals fund, there remains £8 881, plus £9 356 brought in, making £18 237. It is proposed to place £5 000 to reserve and to carry forward £13 237.

The profits of Waygood-Otis, Ltd., for the year ended March 31, after providing for depreciation, amounted to £77 360 (against £83 069), and £27 980 was brought forward. A sum of £40 000 has been placed to reserve, £5 000 to pensions fund, and the directors propose a final dividend of 5½ per cent. on the ordinary shares, making 8 per cent. for the year, and a bonus of 2 per cent. A sum of £22 340 is carried forward. The dividend was 9 per cent. for the previous year.

The profit of Head, Wrightson & Co. for the year ended April 30, after providing for taxation, amounted to £51 163 (against £63 033), while £19 028 was brought forward. After providing for debenture interest, preference and interim dividend on the ordinary shares, etc., and placing £20 000 (against £30 000) to reserve for general purposes, there remains £27 889. A final dividend is proposed on the ordinary shares at the rate of 5 per cent., making 7½ per cent., less tax, for the year (the same), the amount carried forward being £16,544.

The report for 1921 of Richardsons, Westgarth and Company shows a profit, after providing for estimated liabilities to the Government, of £305 207, compared with £155 635 for 1920. The directors recommend the payment of two years' dividend on the preference shares up to April this year, and of 8 per cent. on the ordinary shares. The sum of £50 000 has been set aside for the development of the new department for the building of Diesel engines, £50 000 has been placed to reserve, £45 000 has been written off for depreciation, and £54 785 carried forward. The directors state that the financial position of the company is better and stronger than ever before in its history.

The report of Kidderminster and District Electric Lighting and Traction Company for 1921 shows that the net receipts of the lighting undertaking, including dividends, were £4 848, plus £35 brought forward, making £4 884. After deducting administration and general expenses and interest on temporary loans, there remains £2 888. The directors propose to pay a dividend of 2½ per cent. on the ordinary shares for the year, carrying forward £213. Kidderminster and Stourport Electric Tramway Company made a profit, after providing for renewals, of £2 149, plus £114 brought forward, making £2 264. A dividend at the rate of 3½ per cent. on the share capital absorbed £2 002, carrying forward £262.

Mr. F. A. Govett presided over the annual meeting of the Zinc Corporation last week, and stated that as he was not very hopeful of a rapid improvement in world conditions and he regarded it as the duty of the Board to preserve the company's resources as far as possible. They had an option to acquire about one-sixth interest in the Australian rights of the Elmore process, and they had recently acquired, at a depreciated price, about 45 000 shares in the parent company, the Chemical and Metallurgical Corporation. On the whole, they had confidence in the future of this branch of their industry. As to the Electrolytic Company, the full plant was expected to be in operation by next year, and the profits were estimated as likely to be sufficient to pay from 12½ to 15 per cent. on the ordinary stock which their company held.

The net profit of Edmundson's Electricity Corporation for the year ended March 31 last, after providing for income tax, mortgage and note interest and debenture stock charges, amounts to £31 369, as compared with £16 053 for 1921. With the balance of £14 143 brought forward the total profit available is £45 512, of which the directors propose to pay £30 000 in respect of dividends (and arrears) on the cumulative preference shares and a dividend of 3 per cent. on the non-cumulative preference shares, leaving £15 512 to be carried forward. During the year £56 100 of the 6½ per cent. three year notes have been paid off at a premium of £280 10s., leaving £18 000 outstanding. The directors intend to redeem these remaining notes when they fall due for repayment next February. In the meantime, they have arranged with the trustees to accept Government Bonds in lieu of prior lien debenture stock as collateral security for the notes, and the prior lien debenture stock has accordingly been released and cancelled.

The report of the South Wales Electrical Power Distribution Co. for the year ending December last shows that the units sold amounted to 46 533 098, a decrease of 10 510 540, as compared with the previous year. This decrease is attributed largely to the three months' coal strike and also to difficulties with the plant which have now been remedied. The commercial side of the

undertaking is operated by the Treforest Electrical Consumers' Co., and after payment of all working expenses there is a credit balance from that company of £35 294, which, with £4 417 brought forward, makes available a balance of £39 711. Deducting the interest on the two classes of debenture stock of the company and depreciation on the new plant, £3 653 remains to be carried forward. The directors state that the agreement between the company and the Treforest Electrical Consumers' Co. has been revised, and that the company's Bill adjusting the ordinary share capital and containing other provisions advantageous to the shareholders has been passed by the House of Lords and read a second time in the House of Commons. Mr. W. Gascoyne Dalziel, chairman of the company, since 1907, has resigned the chairmanship, to which Mr. Westgarth Forster Brown has been elected. Mr. Dalziel still remains a member of the board.

The working of LISBON ELECTRIC TRAMWAYS, LTD., for the past year, after deducting interest and amortisation due on the debentures of the "Companhia Carris de Ferro de Lisboa" and after the payment of £24 415 interest on and redemption of debentures of the Lisbon company, and also payment of London expenses and directors' remuneration, shows a loss of £29 184. To this sum is added the balance of loss brought forward from last year, £19 271, which gives the sum of £48 455 to be carried forward to the debit of next year's profit and loss account. During the past year the tramways have carried 83 626 312 passengers with receipts of Esc. 11 102 068, as compared with 80 567 940 passengers and receipts of Esc. 6 088 286 in the preceding year. The working of the tramway was again adversely affected by the stoppage and restriction of the service owing to strikes and other disturbances. The rate of exchange at the beginning of the year stood at 6⅜d. per Escudo and at the close of the year had fallen to the low figure of 4 7/16d. This materially increased the working expenditure and especially the cost of all supplies purchased outside Portugal. No increase in the fares was obtained during the period under review, although constant applications were made both to the Government and the Camara, in view of the operating losses. A Commission was appointed in July last by the Portuguese Government to inquire into the matter, but its recommendations were not carried out as the Camara withheld its approval, and it was not until the present year that an agreement was at last concluded, to enable an increase in the tariffs to be made, which it is hoped will put the company's future operations on a sounder basis.

New Companies.

E. N. Bray.

E. N. BRAY, LTD. (182 489).—Private company. Reg. June 15. Capital, £3 000 in £1 shares. Electrical engineers, contractors and manufacturers, etc. First directors: E. N. Bray, E. S. Dawn and R. C. Court. Secretary: E. S. Dawn. Solicitors: Warrens, 5, Bedford Square, W.C.1.

Johnson, Savage & Co.

JOHNSON, SAVAGE AND CO., LTD. (182 492).—Private company. Reg. June 15. Capital, £500 in £1 shares. Electricians, mechanical engineers, suppliers of electricity, etc. Provisional directors: R. M. Johnson and E. M. Savage. Secretary: E. M. Savage. Reg. office: 1, Argyle Street, Oxford Circus, W.1.

Electrico.

ELECTRICO, LTD. (182 506).—Private company. Reg. June 16. Capital, £6 000 in £1 shares. Manufacturers of and dealers in electrical goods, etc. Permanent directors: E. Brontman (man. dir.), A. E. Glassey, F. R. Ozzard, H. Kirby and J. Brewer. Sec.: H. G. Perrett. Reg. office: 105, Old Christchurch Road, Bournemouth.

British Radiophone.

BRITISH RADIOPHONE, LTD. (182 427).—Private company. Reg. June 13. Capital, £2,500 in £1 shares. Manufacturers of and dealers in apparatus of all kinds relating to wireless telephony and telegraphy; to deal with land and submarine telegraphs, etc. First directors: N. de M. Watsham and A. H. S. MacCallum. Reg. office: 33, King-street, Covent Garden, W.C.

Dundee Electrical Repairs Co.

DUNDEE ELECTRICAL REPAIRS CO., LTD. (12 256).—Private company. Reg. in Edinburgh June 12. Capital, £3 000 in £1 shares. To carry on the business of repairing all classes of electrical plant and machinery, etc. First directors: W. Brand, W. A. Andrew, T. Innes, J. P. Andrew, and J. Taylor. Secretary: Wm. A. Andrew. Reg. office: Graham Street, Dundee.

R. Bennett.

R. BENNETT, LTD. (182 399).—Private company. Reg. June 12. Capital, £1,500 in £1 shares. To adopt an agreement with R. T. Bennett; to lease property and to erect thereon buildings: to contract for the supply of heating apparatus, electric light and bell installations, etc. Permanent directors: R. Bennett and G. P. Barnes. Reg. office: Colliers Water Lane, Thornton Heath.

W. H. Sugden & Co.

W. H. SUGDEN AND CO., LTD. (182 446).—Private company. Reg. June 13. Capital, £2 500 in £1 shares. To adopt an agreement with W. H. Sugden, and to carry on the business of electrical, mechanical and general engineers, etc. First directors: W. H. Sugden (permanent managing director), and Mrs. D. E. Sugden. Secretary: H. C. Mundy. Reg. office: Glenny Road, Barking.

Bedford Electrical & Radio Co.

BEDFORD ELECTRICAL AND RADIO CO., LTD. (182 405).—Private company. Reg. June 12. Capital, £1 000 in £1 shares. To acquire business of electrical engineers, builders, house decorators and automobile engineers carried on by A. J. E. Osbourn, and to carry on the business of electricians, manufacturers and repairers of or dealers in mechanical and electrical appliances, etc. First directors: A. J. E. Osbourn and C. T. Morris. Reg. office: 22, Campbell Road, Bedford.

Evered & Co.

EVERED AND CO., LTD. (182 412).—Private company. Reg. June 12. Capital, £50 000 in £1 shares. To acquire all or part of the undertaking and assets of Evered and Co., Ltd., of London, Birmingham and elsewhere, and to carry on business of the brass-founders, coppersmiths, hardware merchants and factors, manufacturers of electric light and power fittings and apparatus, lamps, metal work, etc. Directors: J. H. Wilson, H. E. Wilson, E. A. Wilson and S. Evered.

Loco and Auto Economy Accessories.

LOCO AND AUTO ECONOMY ACCESSORIES, LTD. (182 377).—Private company. Reg. June 9. Capital, £10 000 in £1 shares. To acquire from Harvey and Spencer and A. H. Emons, certain existing sales rights, to manufacture and deal in machinery, apparatus and implements and to carry on the business of mechanical engineers, electricians, founders, etc. The Directors are: A. H. Emons, L. C. Harvey, and F. B. Spencer. Secretary, W. Peskett. Reg. office: 25, Victoria Street, Westminster, S.W.1.

Specialities (Liverpool).

SPECIALITIES (LIVERPOOL), LTD. (182 418).—Private company. Reg. June 12. Capital, £2 000 in £1 shares. To take over the whole or part of property, assets and goodwill of H. F. Kerley and Winifred E. Kerley, trading at 45, Seel Street, Liverpool, as the Electrical Specialities Co., and to carry on the business of manufacturers, importers and exporters of and dealers in electric lamps, shades and electrical accessories. Permanent directors: H. F. Kerley (managing director), and Winifred E. Kerley.

Verdun Cutts & Co.

VERDUN CUTTS AND CO., LTD. (182 419).—Private company. Reg. June 12. Capital, £10 000 in £1 shares. To acquire business of a consulting and contracting engineer and electro-metallurgist carried on by V. O. Cutts at Sheffield, as Verdun Cutts and Co., and to carry on the business of electrical and mechanical engineers, founders, etc. Directors: C. A. Longbottom (chairman), V. O. Cutts (permanent man. director), D. Flather and D. E. Beardshaw. Secretary: A. E. Cutts. Reg. office: Town Hall Chambers, 87, Fargate, Sheffield.

Sir William Prescott & Sons.

SIR WILLIAM PRESCOTT AND SONS, LTD. Reg. June 15. Private company. Nominal capital, £10 000 in £1 shares. To acquire, work and otherwise deal with contracts and property of all kinds, including railways, rolling stock, tramways, British and Colonial contracts, electrical generation, traction and supply. Signatories to the Memorandum of Association: Sir William Henry Prescott, Sir L. Stanley Johnson. First directors: Major Sir William H. Prescott (chairman), Lieut.-Col. A. E. Prescott (vice-chairman), Sir L. Stanley Johnson, Dr. R. Marshall, and R. S. Prescott. Reg. office: 146, Bishopsgate, E.C. File number: 182 482.

Claim for Electric Lamps.

In the Shoreditch County Court, the Weston Electric Lamp Co. sued Mr. Evans, of Llanelly, to recover £2 5s., the price of six 250 V lamps.

A preliminary defence was raised that the contract was made in Llanelly, and that therefore the Shoreditch Court had no jurisdiction, but Judge Cluer held that he must have that proved as a fact.

The solicitor for the defendant said his client considered it inadvisable to waste time and money in coming to London, and plaintiffs' manager proved the receipt of the order and the despatch of the lamps on December 12. It was not until March that they heard anything from defendant, who then said that he had never had the goods. Judgment was given for plaintiffs for the amount claimed, and costs.

Foundry Trades Exhibition.

At this Exhibition, which is being held at the Bingley Hall, BIRMINGHAM, from June 15 to 24 inclusive, practically every phase of foundry plant is being shown. About 1 000 tons of machinery are installed and between 300 and 400 H.P. is supplied to the working exhibits. There are 120 exhibits, which include electric furnaces, moulding machines, foundry equipment, refractories, etc.

Interesting features of the Exhibition are the competitions for foundry employees in core-making, moulding and pattern-making, and in an annexe a cinema hall is established for the purpose of exhibiting appropriate films. VICKERS, LTD., who claim to be pioneers in the use of cinematography for illustrating their manufactures, show five films, all made by the photographic department of the firm. These are: Vickers' Sheffield peace products: (1) motor car chassis frames, etc.; (2) crucible steelfoundries, etc.; Barrow shipbuilding works, (3) launch and trials of a battleship, airship R.80, Vickers aircraft, etc.; (4) Vickers' Ward End (Birmingham) works during war; and (5) Wolseley works during war.

Tenders Invited and Accepted.

UNITED KINGDOM.

PORTSMOUTH BOARD OF GUARDIANS, June 28:—Electrical fittings for three months. Particulars from the Clerk, Mr. H. C. Morrell, St. Michael's Road.

COMMISSIONERS OF H.M. WORKS, June 30.—Incandescent electric lamps. Particulars from the Controller of Supplies, H.M. Office of Works, King Charles Street, Westminster, London, S.W.1.

GLASGOW CORPORATION, June 30.—Electric wiring and fitting of Belvedere Hospital, London Road. Specifications, etc., from the City Electrical Engineer, 75, Waterloo Street, Glasgow.

MANCHESTER ELECTRICITY COMMITTEE, June 30.—Two 3 000 kVA three-phase weather proof type transformers and two 3 000 kVA three-phase indoor type transformers. Specifications from Mr. F. E. Hughes, Town Hall, Manchester.

THE COMMISSIONERS OF HIS MAJESTY'S WORKS, July 4.—(1) Electrical and (2) mechanical engineering labour in daywork. Forms of tender, etc., from the Contracts Branch, H.M. Office of Works, Westminster, S.W.1.

CHEADLE AND GATLEY URBAN DISTRICT COUNCIL, July 10.—a.c. meters (2½ to 20 A) and m.d. indicators (3 hectowatts to 5 kilowatts). Particulars from Mr. C. H. Wordingham, 11, Mosley Street, Manchester, or 7, Victoria Street, Westminster, London, S.W.1.

EDINBURGH CORPORATION, July 11.—Wheels and axles for 50 electric tramcars. Specification, etc., from the Tramways Manager, 2, St. James Square, Edinburgh.

AUSTRALIA.

COMMONWEALTH OF AUSTRALIA, June 23.—Telephone and telegraph instruments and parts, switchboard, wire, etc. Particulars from Supply Officer, Room 101, Australia House, Strand, London, W.C.

COMMONWEALTH OF AUSTRALIA, June 30.—Telephone and telegraph instruments and parts, wire protector apparatus, subscribers' equipment. Particulars from Supply Officer, Room 101, Australia House, Strand, London, W.C.

COMMONWEALTH OF AUSTRALIA, July 7.—Telephone subscribers' equipment. Particulars from Supply Officer, Room 101, Australia House, Strand, London, W.C.2.

POSTMASTER-GENERAL'S DEPARTMENT, MELBOURNE. July 11*.—4 000 pairs of protectors (Schedule No. 26); covered wires (Schedule No. 21); telephones, calling dials and switches (Schedule No. 34).

COMMONWEALTH OF AUSTRALIA, July 14.—Telephone subscribers' equipment. Particulars from Supply Officer, Room 101, Australia House, Strand, London, W.C.2.

AZORES.

MUNICIPAL AUTHORITIES OF PONTA DELGADA IN THE AZORES, July 3.*—Hydro-electric plant for supplying electric light and power to the city.

BULGARIA.

DIRECTORATE GENERAL OF BULGARIAN RAILWAYS AND PORTS, June 30.—*Electric travelling platforms for locomotive repair shops.

INDIA.

HIGH COMMISSIONER FOR INDIA, July 14.—(1) Cable, underwater, unarmoured, single wire, brass taped, G.P.; (2) cable, five wire, V.I.R. insulated and lead sheathed; (3) braided wire for crossings over power circuits. Particulars from the Director General, India Store Department, Belvedere Road, Lambeth, S.E.1.

SOUTH AFRICA.

A specification has been received from H.M. Senior Trade Commissioner at JOHANNESBURG in connection with a call for tenders issued by the Rand Water Board for the supply of electric cable, junction boxes, etc., and may be inspected at the Department of Overseas Trade on application to Mr. Fagan, Room 49.

AYLESBURY TOWN COUNCIL have accepted the tender of the British Thomson-Houston Co. for a turbo alternator at £10 302.

DOUGLAS (Isle of Man) Town Council has accepted the tender of Siemens Bros. and Co. for underground mains and accessories at £8,234 4s.

BLACKPOOL Town Council have accepted the following tenders:—The General Electric Co., switch gear cubicles; Peter Brotherhood Ltd., the erection of a cooling tower in connection with the town's electricity extensions.

LONDON COUNTY COUNCIL have accepted the tender of the English Electric and Siemens Supplies, Ltd., for the supply of electric lamps for the ensuing 12 months. The contract covers the supply of Siemens traction type lamps for tramcar lighting throughout the L.C.C. system, standard vacuum and gas filled lamps, and automobile lamps.

* Particulars from the Department of Overseas Trade.

Arrangements for the Week.

FRIDAY, JUNE 23rd (to-day).

INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

9.30 *a.m.* Meeting of the Council in the Grand Theatre, Wolverhampton.

10.30 *a.m.* Annual general meeting in the Grand Theatre, Wolverhampton.

Afternoon. Visit to Wolverhampton Corporation Electricity Generating Station, Commercial Road, when the president (Mr. S. T. Allen) will personally welcome members.

PHYSICAL SOCIETY OF LONDON.

5 *p.m.* At the Imperial College of Science, South Kensington, London.

1. "An Experiment on Molecular Gyrostatic Action," by Mr. J. W. Fisher, B.Sc.

2. "On the Viscous Properties and Molecular Dimensions of Silicane," by Prof. A. O. Rankine, D.Sc., and Mr. C. J. Smith, B.Sc.

3. "The Pressure-Gradient in Liquids Flowing through Cones," by Mr. W. N. Bond, M.Sc.

4. Demonstration of "a Mercury-Drop Method of Producing Visual Effects by means of Sound," by Dr. E. E. Fournier d'Albe.

MONDAY, JUNE 26th.

SOCIÉTÉ DES INGÉNIEURS-CIVILS DE FRANCE (BRITISH SECTION).

5.30 *p.m.* At the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1. Paper on "The Rhine Lateral Canal," by Monsieur A. Antoine.

TUESDAY, JUNE 27th.

THE INSTITUTION OF CIVIL ENGINEERS.

8.30 *p.m.* At Great George Street, London. Annual Conversazione.

Electrical Imports and Exports.

IMPORTS.—The following are official values of electrical machinery, apparatus and material imported into this country (*a*) during May, 1922, and (*b*) the aggregate figures from January 1 to May 31, with increase or decrease compared with corresponding periods of 1921:—

Electrical machinery, (*a*) £98 991 (increase £5 369), (*b*) £549 503 (increase £156 808); telegraph and telephone cables, submarine, nil; other than submarine, (*a*) £2 675 (decrease £3 480), (*b*) £14 831 (decrease £28 668); telegraph and telephone apparatus, (*a*) £18 932 (decrease £9 395), (*b*) £70 562 (decrease £83 245); other electrical wires and cables, rubber insulated, (*a*) £10 565 (increase £9 451), (*b*) £47 949 (increase £36 213); with other insulations, (*a*) £4 733 (decrease £7 195), (*b*) £23 687 (decrease £31 240); carbons, (*a*) £4 010 (decrease £4 534), (*b*) £15 909 (decrease £33 619); glow lamps, (*a*) £10 748 (decrease £15 250), (*b*) £73 893 (decrease £52 828); arc lamps and electric searchlights, (*a*) £7 (decrease £2), (*b*) £72 (decrease £5 572); parts of arc lamps and searchlights (other than carbons), (*a*) £663 (decrease £2 250), (*b*) £4 215 (decrease £4 750); batteries, (*a*) £5 972 (increase £8 426), (*b*), £119 487 (decrease £10 438); meters and electrical instruments (commercial and scientific) and electricity meters, (*a*) £8 862 (decrease £6 074), (*b*) £27 862 (decrease £72 134); switchboards, (*a*) nil (decrease £3 115), (*b*) £1 519 (decrease £2 872); other electrical goods and apparatus, (*a*) £40 977 (decrease £2 044), (*b*) £216 967 (decrease £205 671). Total of electrical machinery, apparatus and material (other than uninsulated wire), (*a*) £207 155) decrease £27 488), (*b*) £1 074 859 (decrease £365 147).

EXPORTS.—The exports of electrical machinery, apparatus and material (*a*) during May, 1922, and (*b*) from January 1 to May 31, with increase or decrease compared with corresponding periods of 1921, were as follows:—

Electrical machinery, (*a*) £296 287 (decrease £163 338), (*b*) £2 183 170 (increase £45 977); including railway and tramway motors, (*a*) £9 031 (decrease £24 644), (*b*) £67 739 (decrease £48 532); other generators and motors, (*a*) £153 872 (decrease £97 777), (*b*) £1 155 325 (decrease £23 667); and electrical machinery unenumerated, (*a*) £133 384 (decrease £40 897), (*b*) £960 106 (increase £118 176); telegraph and telephone cables, submarine, (*a*) £25 765 (decrease £781 325), (*b*) £131 036 (decrease £1 350 935); other than submarine, (*a*) £43 172 (decrease £84 903), (*b*) £250 721 (decrease £485 208); telegraph and telephone apparatus, (*a*) £161 564 (decrease £10 078), (*b*) £869 542 (increase £121 579); other electrical wires and cables, rubber insulated (*a*) £50 277 (decrease £61 962), (*b*) £245 781 (decrease £523 035); with other insulations, (*a*) £63 784 (decrease £127 514), (*b*) £484 810 (decrease £546 798); carbons, (*a*) £4 889 (increase £1 755), (*b*) £20 347 (decrease £26 423); glow lamps (*a*) £32 730 (decrease £14 068), (*b*) £168 850 (decrease £69 590); arc lamps and searchlights, (*a*) £589 (decrease £2 333), (*b*) £3 843 (decrease £3 055); parts of arc lamps and searchlights (other than carbons), (*a*) £1 948 (increase £1 677), (*b*) £3 886 (increase £592); batteries, (*a*) £47 037 (decrease £24 871), (*b*) £194 940 (decrease £168 880); electrical instruments (commercial and scientific) and electricity meters, (*a*) £20 583 (decrease £26 144), (*b*) £155 071 (decrease £51 321); switchboards, (*a*) £8 251 (decrease £7 575), (*b*), £147 301 (increase £61 908); other electrical goods and apparatus, (*a*) £92 141 (decrease £82 508), (*b*) £511 136 (decrease £565 675). Total of electrical machinery, material and apparatus, other than uninsulated wire, (*a*) £849 017 (decrease £1 394 187), (*b*) £5 370 434 (decrease £3 560 864).

COMMERCIAL INTELLIGENCE.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

BERG, J. AND CO., 169, City Road, E.C., electrical accessories manufacturers. £16 5s. 7d. April 21.

BRASON AND FINDLEY, 34, Laygate, South Shields, electrical engineers. £15 2s. 10d. April 19.

CARTER (HUBERT D.) (BANGOR) LTD., registered office, Accountancy Offices, Castle Street, Conway, electrical contractors. £37 2s. April 20.

CARTER, T. J., 16, Durngate Street, Dorchester, electrical engineer. £14 13s. 6d. April 24.

GIBBONS, A. R., 8, The Parade, New Eltham, electrical engineer. £16 8s. 8d. April 25.

HERBERT, R., 337A, Norwood Road, S.E., electrician. £12 5s. April 7.

JERRARD, Frank, 57, Church Street, Eastbourne, electriciam. £10 13s. 10d. April 27.

NORMAN JOHNSON AND CO., Baker Street, Enfield, electrical engineers. £26 10s. 3d. April 18.

STAMFORD BRIDGE ELECTRICAL MECHANICAL ENGINEERING CO., 495, Fulham Road, engineers. £38 5s. 4d. April 4.

WOOD, Harold, Old Manor House, Oak Lane, Bradford, electrical engineer. £13 3s. 10d. April 20.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

BURKE ELECTRICAL MANUFACTURING CO., LTD., London, S.W.—Reg. June 10, debenture, to J. Bibby, 36 Kingsway, W.C., general charge.

COATES AND CO. (SHEFFIELD), LTD., electrical engineers.—Reg. June 12, £6 500 debentures; general charge. *Nil. June 6, 1922.

HINDHEAD AND DISTRICT ELECTRIC LIGHT CO., LTD.—Reg. June 12, £100 debentures, part of amount already reg.; general charge. *£4,650. August 9, 1921.

MIDLAND ELECTRIC LIGHT AND POWER CO., LTD., London, E.C.—Reg. June 10, £20 000 debentures, present issue £14 000; general charge. *£20 000. March 4, 1921.

Satisfactions.

EDMUNDSON'S ELECTRICITY CORPORATION, LTD., London, S.W.—Satisfaction reg. June 9, £100 000, reg. April 29, 1920.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Companies Winding Up.

THE CORONA LAMP WORKS, LTD. Registered office, 10, Ascham Street, Kentish Town, Middlesex. Winding up order, June 13.

GILLITT, S., AND CO., LTD. Registered office, 33, Groat Market, Newcastle-upon Tyne. Winding-up order, June 15.

Companies Winding-up Voluntarily.

SPLITDORF ELECTRICAL COMPANY OF LONDON, LTD.—H. J. Hinley, 162, Great Portland Street, London, appointed liquidator. Particulars of claims to the liquidator by July 5.

KEYNSHAM ELECTRIC LIGHT AND POWER CO., LTD. (in voluntary liquidation). Meeting of creditors will be held at 28, Baldwin Street, Bristol, on Tuesday, June 27, at 12 noon. Particulars of claims to the liquidator, Arthur Collins, 28, Baldwin Street, Bristol, by July 31.

Bankruptcy Information.

BROWN, Leslie, The Street, Frensham, Surrey, electrician. Receiving order, June 13. Creditor's petition. First meeting, June 26, 12.30 p.m., 29, Russell Square, W.C.1. Public examination, July 4, 11.30 a.m., Guildhall, Guildford.

GRIEVE, Gideon George, and MANGES, Archibald Arthur, in co-partnership at 14, West Bute Street, late 236, Bute Street, Cardiff, under the style of THE UP-TO-DATE ELECTRICAL AND MECHANICAL ENGINEERS. First meeting, June 27, 11.30 a.m., 34, Park Place, Cardiff. Public examination, July 5, 2.30 p.m., Law Courts, Cathays Park, Cardiff.

HOGG, George James (trading as F. HOGG AND CO.), 66, Waterloo Road, Smethwick, electrical engineer. First meeting, June 23, 11 a.m., Official Receiver's Office, Ruskin Chambers, 191, Corporation Street, Birmingham. Public examination, July 7, 11 a.m., Law Courts, Lombard Street West, West Bromwich.

ROGERS, Philip Marsden, Great Darkgate Street, Aberystwyth, as the LONGBRIDGE ENGINEERING CO., electrical engineer. Receiving order, June 14. Debtor's petition.

Notices of Dividends.

CAMP, William, Carr Lane, Slaithwaite, near Huddersfield, under the style of WILLIAM CAMP AND CO., electrical engineer. First and final, payable June 27, at Official Receiver's office, 12, Duke Street, Bradford.

ROTHWELL, Peter, trading at 64, Higher Bridge Street, Bolton, in partnership with P. A. Rothwell (a minor), under the style of P. A. ROTHWELL AND CO., electrical engineer. Amount per £, 6s Composition (first instalment) payable June 28, at Official Receiver's Offices, Byrom Street, Manchester.

Notices of Intended Dividends.

HALLETT, Graham Moore, 7, King Street, Frome, electrical engineer. Last day of receiving proofs, July 1. Trustee, J. P. Emett, 18, Nicholas Street, Bristol.

MAYNER, Robert Victor, 62, Harris Street, Peterborough, late Narrow Street and Wentworth Street, Peterborough, electrical engineer. Last day for receiving proofs, July 7. Trustee, J. O. Morris, 5, Petty Cury, Cambridge.

RIDGWAY, Fred (separate estate), in co-partnership with Thomas Tynan, at 21, Bowling Old Lane, Bradford, under the style of RIDGWAY AND TYNAN, electrical engineer. Last day for receiving proofs, July 5. W. Durrance, trustee, 12, Duke Street, Bradford.

TYNAN, Thomas (separate estate), co-partnership with Fred Ridgway, at 21, Bowling Old Lane, Bradford, under the style of RIDGWAY AND TYNAN, electrical engineer. Last day for receiving proofs, July 5. W. Durrance, trustee, 12, Duke Street, Bradford.

Dublin Gazette.

PORTARLINGTON ELECTRIC LIGHT AND POWER CO., LTD. A petition for winding up has been presented to the Court by Patrick Joseph Weymes, a contributory of the company. Wm. Smyth and Son, solicitors for the petitioner, 29, Lower Gardiner Street, Dublin.

Bankruptcy Proceedings.

COUPE, George Francis, 2, Spring Gardens, Stockport, Cheshire, electrical engineer. At his public examination debtor was closely questioned regarding some of his affairs, and was ordered to file a cash account from March, 1921, up to the date of the proceedings. The statement of affairs showed liabilities of £599, and there was a deficiency of £538. Debtor attributed his failure to bad trade and insufficient knowledge of the business. He commenced business as an electrical engineer in May, 1920, his father paying accounts to the extent of £100. He said that he had not sufficient experience to do the work himself, and had to rely on workmen. The examination was adjourned.

HOPKINS, John Howard (formerly trading as the ELECTRICAL MAINTENANCE CO.), 57, Castellaine Mansions, Maida Vale, W. The affairs of this debtor, who was adjudged a bankrupt on December 15 last, came before the London Bankruptcy Court on Friday on the hearing of his application for an order of discharge. The Official Receiver reported that a proof of debt for £9 562 had been lodged in respect of the only claim returned by the debtor as expected to rank. Two disputed claims aggregating £5 610 were returned in the statement of affairs as not expected to rank and no proofs had been lodged in respect of them. No available assets were disclosed by the debtor and only £9 19s. 1d. was realised. In July 1918, with a capital of £1 000, the debtor began business as an electrical engineer at 87, Shaftesbury Avenue, W.C., under the style of the Electrical Maintenance Co., and in March of the following year he was joined in partnership by one C. A. Hall, who introduced capital to the amount of £3 000 into the business

which was continued from the same address until August, 1919. It was then removed to 140, Wardour Street, W. In September 1920 the partnership was dissolved owing to disagreements between the partners and the debtor took over and continued the business and agreed to pay his late partner for his interest £5 000, payable as to £500 down and as to the balance by instalments of £40 a week. In December, 1920, a meeting of creditors was held when the debtor executed a deed of assignment but the petitioning creditor refused to join in the deed. The debts of the assenting creditors amounted to £20 000 and dividends aggregating 2s. in the £ had so far been paid. Afterwards the debtor was for a time engaged by the trustees in the realisation of the assets and he attributed his failure to lack of capital and to ignorance regarding one branch of the business. A complete set of books of account had been kept before the execution of the deed of assignment; they were in order and profit and loss accounts and balance sheets were prepared every six months from July 1918 until the date of the deed. The unsecured liability represented the claim of the petitioning creditor for cash advanced. The only offence reported by the Official Receiver was the insufficiency of the assets to pay 10s. in the £ to the unsecured creditor and the Registrar granted the discharge subject to a suspension of four weeks.

THE MAXIM LAMP WORKS, LTD., Maxim Works, Canonbury Road, Highbury, N. In this compulsory liquidation the Official Receiver has now issued a summary of the statement of affairs which discloses liabilities £11 050 of which £4 987 are returned as expected to rank, and assets £502 after providing for the claims of debenture holders and of preference creditors. A deficiency of £4 485 is accordingly disclosed with reference to the creditors while in relation to the shareholders a total deficiency of £9 485 is shown. The Maxim Electrical Co., Ltd., was formed in 1904 with the object of carrying on business as manufacturers of electric lamps. In March 1908 Mr. J. F. Poynter was appointed receiver and manager by the debenture holders in respect of their debentures for £15 000. Poynter as receiver and manager continued to carry on the business until early in 1910 with the assistance of Mr. F. Taussig, who advanced £2 000. Early in 1910 arrangements were made with the approval of the debenture holders to form a new company to acquire the assets of the old company. According to Mr. Poynter the purchase agreement provided for a purchase price of £2 220 payable as to £720 in cash and as to the balance by the allotment of 1 500 fully paid preference shares of £1 each in the new company. At the end of 1914 the company became short of working capital and borrowed from the Imperial United Lamp Co., Ltd., a sum of £1 000 for which a debenture was given. On October 18, 1915, a further debenture for £500 was issued to them as additional security. At the time that the first debenture was issued to them that company agreed to take up in future practically the whole of the company's output at a certain price, the contract stipulating that any increase in the cost of production should be borne proportionately by the Imperial Co. and providing for arbitration in the event of any dispute arising. As time progressed cost of production rose as the result of the War, but it is alleged that the Imperial Co. failed to pay the whole of their share of the increase with the result that in February 1918 the company refused to make further deliveries. The Imperial Co. thereupon began a debenture action against the company which was, however, withdrawn on the company paying off their debentures amounting to £1 500 out of moneys advanced by Mr. Poynter. Arbitration proceedings were then begun under which the company claimed £5 527 representing the difference in the price of lamps due from the Imperial Co. These proceedings lasted 18 months and eventually the award which was made in April 1920 provided that the company should pay the Imperial Co. £783 in full settlement of the latter's counterclaim for £3 731 for raw material supplied and £200 costs and should supply the Imperial Co. with 2 000 lamps a week at a certain price for a period of 18 months from January 2, 1920. Mr. Poynter says that the Imperial Co. did not take delivery under this award and in consequence the company in September, 1920, again approached the arbitrators with a claim for damages amounting to £3 500. No further proceedings were, however, instituted. The company about this time found itself burdened with a large number of lamps with little hope of disposing of them owing to the depression in trade which prevailed. On April 8, 1918, debentures for £3 000 were issued to Mr. Poynter in respect of cash advanced and personal guarantees given and subject to the bank's prior charge. Certain of these debentures were afterwards transferred and on July 28 last Mr. Poynter appointed as receiver and manager on his behalf Mr. Alfred Tosh, accountant, 75, Canonbury Road, N., and that gentleman is now carrying on the business. Mr. Poynter says that in his opinion the failure of the company is due to the unprofitable transactions with the Imperial Co. which had the effect of causing the company to incur great expense in the production of lamps which were eventually left on its hands with little prospect of disposal. The Official Receiver concurs in this view but is of the opinion that the company has been hampered by lack of working capital from its inception and that its affairs have been mismanaged. The liquidation remains in the hands of the Official Receiver

Prices of Metals, Chemicals, etc.

		Price.	Tuesday, June 20. Inc.	Dec.
Copper—				
Best Selected	per ton	£66 10 0	—	—
Electro Wirebars	,,	£71 0 0	10s. 0d.	—
H.C. Wire, basis	per lb.	0s. 10$\frac{7}{16}$d.	$\frac{1}{16}$d.	—
Sheet	,,	0s. 10$\frac{1}{2}$d.	—	—
Phosphor Bronze Wire (Telephone)—				
Phosphor Bronze Wire, basis	per lb.	1s. 2$\frac{7}{16}$d.	$\frac{1}{16}$d.	—
Brass 60/40—				
Rod, basis	,,	7d.	—	—
Sheet, basis	,,	9$\frac{1}{4}$d.	—	—
Wire, basis	,,	9$\frac{5}{8}$d.	—	$\frac{1}{4}$d.
Pig Iron—				
Cleveland Warrants	per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 S.W.G.	,,	£18 0 0	—	—
Lead Pig—				
English	,,	£26 0 0	—	—
Foreign or Colonial	,,	£24 12 6	—	2s. 6d.
Tin—				
Ingot	,,	£152 15 0	15s. 0d.	—
Wire, basis	per lb.	2s. 1d.	—	$\frac{1}{4}$d.
Aluminium Ingots	per ton	£100 0 0	—	—
Spelter	,,	£28 0 0	—	2s. 6d.
Mercury	per bottle	£11 10 0	—	£1 0s. 0d.

Sulphur (Flowers)—Ton £10 15s.
,, (Roll-Brimstone)—per ton £10 15s.
Sodium Bichromate.—Per lb. 5$\frac{1}{4}$d.
Boric Acid (Crystals). Per ton £60.
Sodium Chlorate—Per lb. 3$\frac{1}{4}$d.
Sulphuric Acid (Pyrites, 168°) per ton, £9.
Copper Sulphate.—Per ton £26 10s.
Rubber.—Para fine, 9$\frac{3}{4}$d.; plantation 1st latex, 7$\frac{1}{2}$d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MEWBURN, ELLIS & CO., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

COMPLETE SPECIFICATIONS:

145 470 SIEMENS-SCHUCKERTWERKE GES. Electric induction motors. (29/1/18.)
173 247 WADE, H. (Vanadium Corporation of America). Power control apparatus for electric furnaces. (30/6/20.)
173 251 BRYDON, S., and CUMMINGS, E. Galvanic batteries or cells. (3/7/20.)
158 217 MEYER AKT.-GES., DR. P. Alternating current meters according to the Ferraris principle. (27/1/20.) (Addition to 148 576.)
173 268 MARINO, Q. Electrolyte for use in the electro-deposition of metals and metallic alloys. (25/8/20.)
151 591 SOC. DE L'ACCUMULATEUR TUDOR. Containers of electric accumulator cells. (27/9/19.)
173 272 SIEMENS BROS. AND CO., LTD., and FERREIRA, L. DE M. G. Electric signalling arrangements for use on railways and for other purposes. (27/8/20.)
173 278 TAYLOR, A. M. Means for and methods of earthing the neutral point of three-phase systems. (30/8/20.)
173 284 WESTERN ELECTRIC CO., LTD. (Western Electric Co., Inc.). Ringing-arrangement for carrier wave-signalling system. (16/9/20.)
151 610 NEGROMANTI, A. Device for heating by electricity. (19/9/19.)
173 291 CROMPTON AND CO., LTD., and JONES, W. F. Electric resistances. (22/9/20.)
173 292 CROMPTON AND CO., LTD., and JONES, W. F. Electric resistances. (22/9/20.)
173 293 CROMPTON AND CO., LTD., and JONES, W. F. Electric rheostats or resistances. (22/9/20.)
151 929 SIEMENS AND CO., GEB. Process for the manufacture of sliding and pressure contacts for electric purposes. (30/9/19.)
163 675 VICLET, R. A. L. Dynamo-electric machine commutators and like electrical apparatus. (21/5/20.) (Patent of Addition not granted.)
173 316 BRITISH THOMSON-HOUSTON CO., LTD., and WEDMORE, E. B. Protective devices for alternating current electric distribution systems. (28/9/20.)
173 317 WALL, T. F. Alternating current generators. (28/9/20.) (Cognate application, 6 205/21.)
173 320 BRITISH INSULATED AND HELSEY CABLES, LTD., BAYLES, E. A., and HIGHAM, H. Electrical condensers. (29/9/20.)
173 329 BOOTH, A. C., and WILLMOT, A. S. Telegraph keyboard perforators. (30/9/20.)
156 096 COOLIDGE, W. D. X-ray apparatus and methods. (9/7/20.)
173 363 GENERAL ELECTRIC CO., LTD., and TRIPPE, C. F. Vacuum or low-pressure bulb electron-discharge apparatus. (16/10/20.)
173 368 BOOTH, A. C., and WILLMOT, A. S. Mechanism for providing feed-holes to the paper-tape of telegraph perforating instruments. (20/10/20.)
158 224 GRAF, A. Switches for electric installations. (26/1/20.) (Patent of Addition not granted.)
173 402 RAPHAEL, F. C., and EDISON SWAN ELECTRIC CO., LTD. Means for bonding metal-covered electric cables and wires. (22/11/20.)
173 404 TIMMINS, R. Electric fuse contact embodying a method of holding or clamping fuse wire. (24/11/20.)
155 819 PLATSCHICK, B. Mounting of brush-holders upon electric motors. (24/12/19.)
173 413 IGRANIC ELECTRIC CO., LTD. (Cutler-Hammer Manufacturing Co.). Electric motor controllers. (30/11/20.)
154 906 BOSCH AKT.-GES., R. Magneto-electric ignition machines. (3/12/19.)
173 419 DAVIS, W. J. Electrical connectors. (13/12/20.)
173 442 COOK, J. W. Portable accumulators. (3/2/21.)
173 450 OLIVER, A. L. Electric blasting-fuses. (7/3/21.)
168 583 WESTINGHOUSE BRAKE AND SAXBY SIGNAL CO., LTD. Control of electrically-operated fluid-compressors. (31/8/20.)
164 756 SIEMENS-SCHUCKERTWERKE GES. Air-removing apparatus adapted for use with mercury vapour rectifiers and like devices operating with a permanent high vacuum. (15/6/20.)
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173 535 MEI, P. Sparking-plugs for internal-combustion engines. (25/6/20.)
146 175 SIEMENS-SCHUCKERTWERKE GES. Asynchronous electric motors. (30/3/16.)
146 176 SIEMENS-SCHUCKERTWERKE GES. Asynchronous electric motors. (12/1/17.) (Addition to 146 175.)
146 242 SIEMENS-SCHUCKERTWERKE GES. Asynchronous electric motors. (30/3/16.)
173 530 MICHIGAN SPARK PLUG CO. Electric ignition plugs. (31/1/19.)
147 037 SCHRÖTER, F. Electric-discharge apparatus. (23/1/18.)
148 132 BRITISH THOMSON-HOUSTON CO., LTD. Electron-discharge apparatus. (28/10/15.)
148 322 HUTH GES., DR. E. F. and LOEWE, DR. S. Method of tuning direct-coupled transmitting-apparatus for wireless telegraphy. (18/9/15.)
173 549 SATTERTHWAITE, A. Automatic switch which is particularly suitable for electric hoists. (20/7/20.)
173 556 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Induction motors. (5/8/20.)
150 352 LEVY, L. Anti-parasitic selecting and receiving system for telegraphy and telephony with or without wires. (25/8/19.) (Addition to 133 306.)
173 568 TAGGART, J. SCOTT-, and FARLEY, G. G. Construction of thermionic valves as used in wireless signalling systems. (3/9/20.)
151 611 HOLST, DR. G., OOSTERHUIS, DR. E., and NAAMLOOZE VENNOOTSCHAP PHILIPS' GLOEILAMPENFABREKEN. Process for removing gas residues and for purifying inert gases in electric vacuum tubes, incandescent lamps, and the like. (23/9/19.)
173 606 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Electric inductance apparatus. (4/10/20.)
173 613 WATKINSON, J. Resistance switches for controlling the intensity of electric currents. (5/10/20.) (Cognate Application, 21/12/21.)
173 621 CREED, F. G., and CREED AND CO., LTD. Circuit-controlling apparatus suitable for use in wireless telegraphy. (8/10/20.)
173 629 MIDGLEY, A. H., and VANDERVELL AND CO., LTD., C. A. Electric-starters for internal combustion engines. (14/10/20.)
173 633 AUTOMATIC TELEPHONE MANUFACTURING CO., LTD., WEBSTER, P., and MERCER, R. Telephone systems. (18/10/20.)
173 638 SHANNON, W. H. Portable electric lamps. (19/10/20.)
173 641 AUTOMATIC TELEPHONE MANUFACTURING CO., LTD., and SAVIN, J. Telephone systems. (21/10/20.)
155 568 AUTOMATIC TELEPHONE MANUFACTURING CO., LTD. Measured service telephone systems. (13/12/19.)
173 643 WATSON, E. A., and M-L MAGNETO SYNDICATE, LTD. Distributors for high-tension ignition apparatus. 21/10/20.)
173 648 MCKENZIE, HOLLAND, AND WESTINGHOUSE POWER SIGNAL CO., LTD., and PEARCE, W. A. Electric relays. (25/10/20.)
173 649 ROBINSON, H. Magnetic circuit of electrical motors and dynamos. (25/10/20.)
173 657 IGRANIC ELECTRIC CO., LTD. (Cutler-Hammer Manufacturing Co.). Thermally-controlled circuit interrupters. (2/11/20.)
173 660 CHESHIRE, H., and SUMMERHAYES, V. Electrical heating units. (11/4/20.)
173 661 BARKER, A. J. Self-acting locking lamp-holder for incandescent electric lamps when same are inserted. (4/11/20.)
173 669 DANSON, R. J. Trolley heads for electrically propelled vehicles. (12/11/20.)
173 671 OLDHAM, O., OLDHAM, G., and OLDHAM, J. Galvanic batteries. (15/11/20.)
173 674 THORNTON, A. A. (Ignition Co. of America). Spark-plug. (22/11/20.)
154 936 OESTERREICHISCHE SIEMENS-SCHUCKERTWERKE. Method of controlling continuous current motors. (29/1/16.) (Divided Application on 145 589.) (Addition to 145 589.)
157 331 STALHANE, O., and KRING, O. O. Electric connecting plugs. (27/11/18.)
168 600 BOUDOU, G. Electric apparatus for the permanent waving of the hair. (26/3/20.) (Divided Application on 160 746.)
146 294 QUICK ACTION IGNITION CO. Magneto-electric generators. (17/2/16.)
173 793 LATOUR, M. Thermionic-tube amplifying devices. (7/7/20.)
147 760 LATOUR, M. Multiplex telegraph and telephone systems. (25/6/15.)
147 855 REICHENHEIM, DR. O. Wireless telegraph receivers. (10/9/15.)
147 856 KOSSEL, W. Electric discharge tubes. (23/12/16.)
147 882 SIEMENS-SCHUCKERTWERKE GES. Dynamo-electric machines. (15/6/18.)
148 184 KOSSEL, W. Electric discharge tubes. (1/3/17.)
148 525 GES. FÜR DRÄHTLOSE TELEGRAPHIE. Production of oscillations by high vacuum tubes having heated cathodes. (30/4/19.)
148 971 GES. FÜR ELEKTROMECHANISCHE TELEPHONAPPARATE. Circuit arrangements of automatic telephone exchanges. (10/1/14.)
148 891 GES. FÜR DRÄHTLOSE TELEGRAPHIE. Generator of electric oscillations consisting of a thermionic tube in return coupling connection. (7/8/17.)
149 213 HUTH GES., DR. E. F., and LOEWE, DR. S. Thermionic valve amplifiers and generators. (4/7/17.)
149 218 LOEWE, S. Thermionic receiving apparatus for wireless signalling. (18/4/18.)
149 663 EBNER, A. Electrically-driven talking-machine. (12/7/20.) (Convention date not granted.)
173 800 BRITISH ELECTRIC TRANSFORMER CO., LTD., and ROOTHAAN, J. Electric transformers. 14/7/20.)
173 807 ALEXANDER, A. E. (Newsprinter Corporation). Printing-telegraph receivers. (9/8/20.)
173 812 WILD, L. W., and BARFIELD, E. P. Electric furnaces. (11/8/20.)
150 961 GOUIN, P., and ROESEL, E. Alkaline storage batteries. (10/9/19.)
173 832 BRYDON, S., and JOHNSON, S. Wireless telegraphy. (13/9/20.)
151 935 BOSCH AKT.-GES. R. Means for securing machines such as dynamo-electric lighting-machines for cycles and the like. (2/10/19.)
158 865 RAMONEDA, C. Manufacture of frames for polyphase dynamo-electric machinery. (10/2/20.)
151 999 BRITISH THOMSON-HOUSTON CO., LTD. X-ray apparatus. (29/10/13.)
173 848 FREI, F. Electric immersion heaters. (5/10/20.)
152 032 MAAG, F. Eleceric heating-devices. (8/10/19.)
173 859 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Electric welding apparatus. (7/10/20.)
173 865 VENTIHETA (UNITED KINGDOM), LTD., and OGLE, P. J. Electric heating and ventilating apparatus. (8/10/20.)
173 868 RICHARD, A. Insulators for the suspension of high-potential electric lines. (8/10/20.)
173 869 AARONS, S. E., and SMITH, A. P. Hand-tools for electricians and the like. (8/10/20.)
173 873 SIMPSON, J. Electrical indicating-apparatus for indicating the opening or closing of electrical contacts and the sequence in which the contacts were opened or closed. (9/10/20.)
152 683 CORDES, H. G. Radio interference preventers. (21/10/19.)

APPLICATIONS FOR PATENTS.

June 6, 1922.

15 633 C. A. COLEMAN. Automatically lighting electric street lamps.
15 636 R. SIMPSON. Magnetos.
15 681 F. B. COX. Automatic electric switches.
15 690 J. R. LAIRD and G. PATE. Insulated cable.
15 709 A. REYROLLE AND CO., B. H. LEESON and W. D. OWEN. Alternating current transformers.
15 710 D. H. BRAYNE. Selective switches for electric inductances, etc.
15 730 J. A. SLEE. Primary batteries.
15 737 M. J. RAILING and C. W. SAUNDERS. Electric camp fittings.
15 744 H. D. NYBERG. Galvanic cells.
15 749 INTERNATIONAL ELECTRIC Co. and F. R. BALDOCK. Central battery exchange telephone systems and switchboards.
15 750 H. BARON (Aldendorff). Electric switching apparatus.
15 751 B. T.-H. Co. and A. S. FITZGERALD. Electro-responsive devices.
15 765 G. W. HUMPHRY. Insulating and protecting wires or cables.
15 767 SKYWING AIRCRAFT CORPORATION. Electric ignition devices. (1/12/20, U.S.)

June 7, 1922.

15 808 W. H. SMITH. Instrument for distributing audibility of wireless speech, etc.
15 817 J. B. BIGNAMY and H. R. HEWLING. Wireless tuning inductances.
15 830 B. T.-H. Co. and R. D. GIVEN. Controllers for electric circuits.
15 845 WESTERN ELECTRIC Co. Telephone systems. (16/6/21, U.S.)
15 852 ALLGEMEINE ELEKTRICITATS GESELLSCHAFT. Apparatus for driving talking machines. (25/6/21, Germany.)
15 857 STERLING TELEPHONE AND ELECTRIC Co. and F. CLARK. Telephone receivers.
15 859 W. T. HENLEY'S TELEG. WCRKS Cc., H. W. BREEZE and H. S. WHEELER. Electric switches.

June 8, 1922.

15 884 G. PELLETIER and F. PELLIN. Electric resistances. (8/6/21, France.)
15 902 W. H. BROOK. Wireless telephone advertising cabinets.
15 918 L. M. PERKINS. Electric generators.
15 926 M. WEBBER, LTD., and R. S. C. BALL. Semi-automatic electric lighting systems.
15 935 G. R. JUDGE and R. A. STOREY. Electrical transmission of photographs, etc.
15 937 MARINE MOTOR MACHINERY Co. and A. O. KOLSTAD. Electric central apparatus.
15 942 G. F. CRITCHLEY and A. PEEL. Transmitting and receiving apparatus.
15 953 R. R. R. SARAFIN. Means for exciting alternators, motors, etc.
15 969 JOHNSON AND PHILLIPS and C. J. H. STEVENS. Means for gripping cables in junction boxes, etc.
15 972 B. GUEST. Wireless receiving systems.
15 978 E. C. R. MARKS (Soc. Anon. Appareillage Theco). Protective mount for fixing electric meters.
15 980 AKT. GES. BROWN, BOVERI AND CO. Gas-tight leading in insulating bushes for metal vessels of mercury vapour rectifiers. (8/6/21, Switzerland.)
15 981 C. F. ELWELL, LTD. and B. E. G. MITTELL. Connections of aerials to wireless receivers or transmitters.

June 9, 1922.

16 018 O. W. WALKER. Wireless telegraph and telephone apparatus.
16 050 SIEMENS BROS. AND CO. and D. A. CHRISTIAN. Telephone systems employing selecting devices.
16 052 W. WATSON. X-ray grid for radiography, etc.
16 061 E. HABANN. Thermionic tubes. (24/6/21, Germany.)
16 062 E. HABANN. Thermionic valves. (14/10/21, Germany.)
16 066 METROPOLITAN VICKERS ELECTRICAL CO. and E. A. BINNEY. Control of electric motors.
16 068 L. N. REDDIE (Office Meccaniche Italiane). Electric measuring instruments.
16 075 C. CONRADTY. Current collector bow for electric vehicles. (13/2/22, Germany.)
16 088 AUTOMATIC TELEPHONE MANUFACTURING CO. Telephone systems. (22/7/21, U.S.)

June 10, 1922.

16 112 W. A. ANDERSEN. Predetermining time of actuating apparatus by electric currents.
16 117 A. P. WELCH. Rheostats for controlling filaments of vacuum tubes.
16 157 B. T.-H. Co. (G. E. Co.). Incandescent lamps.
16 158 B. T.-H. Co. and A. P. YOUNG. Telephone receivers, etc.
16 161 TELEGRAPHIE GES. SYSTEM STILLE and C. STILLE. Telephone relays.
16 162 ENGLISH ELECTRIC CO. and L ROTHERA. Controlling gear for motors.
16 164 N. N. OGLOBLINSKY. Deflector for magnetic compass (11/1/21, France.)

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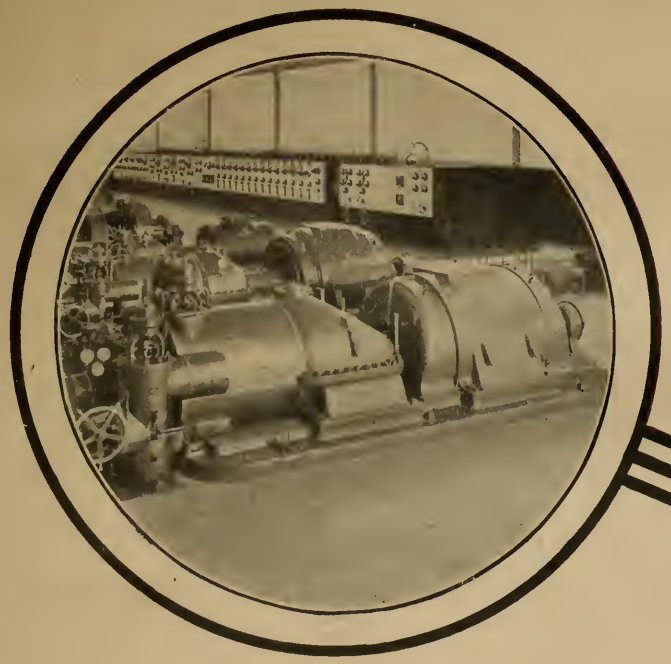

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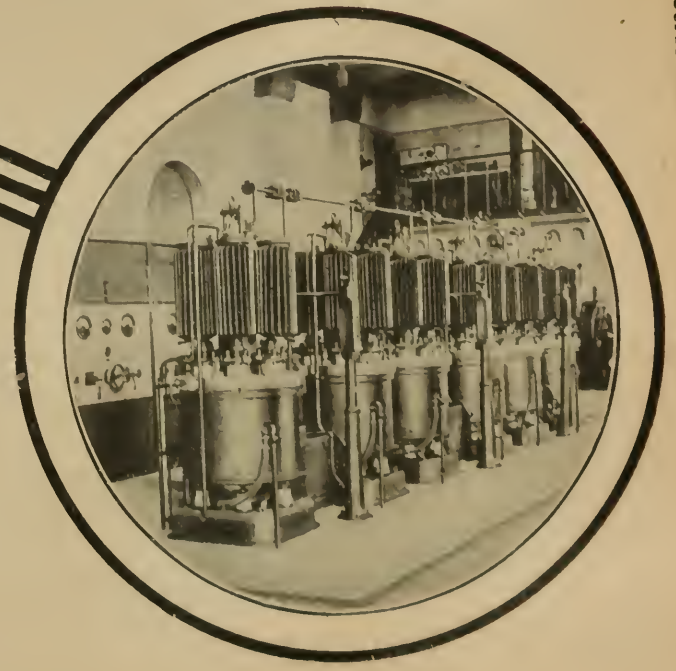

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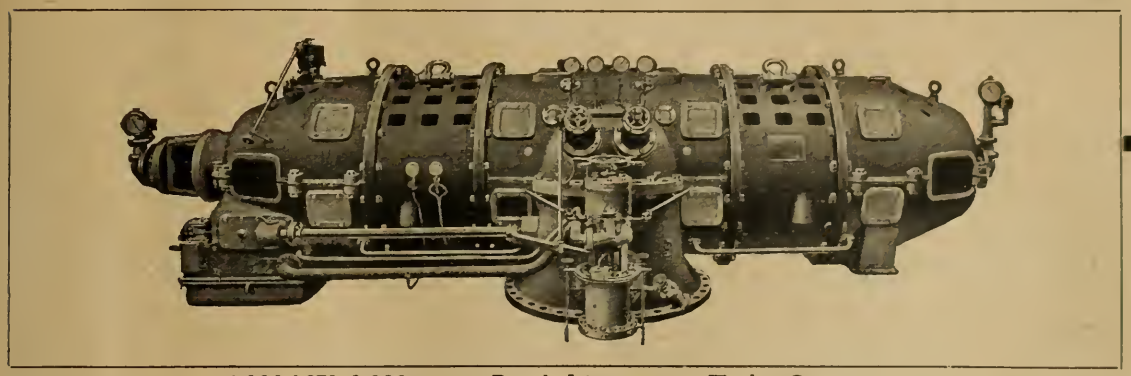

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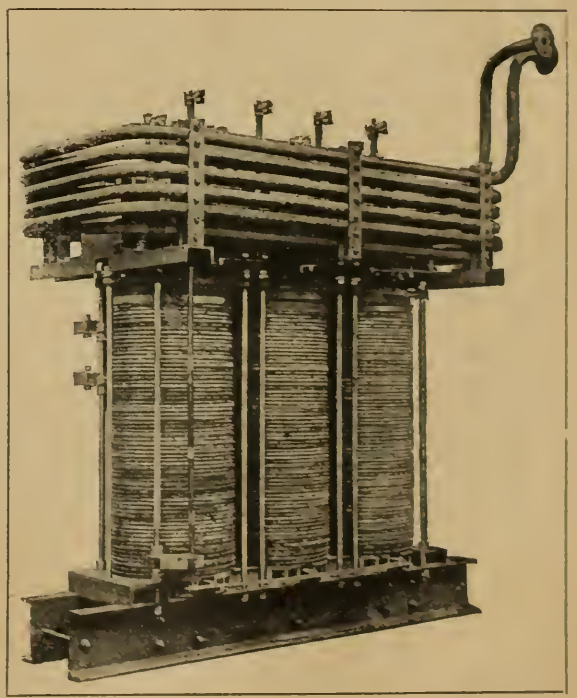

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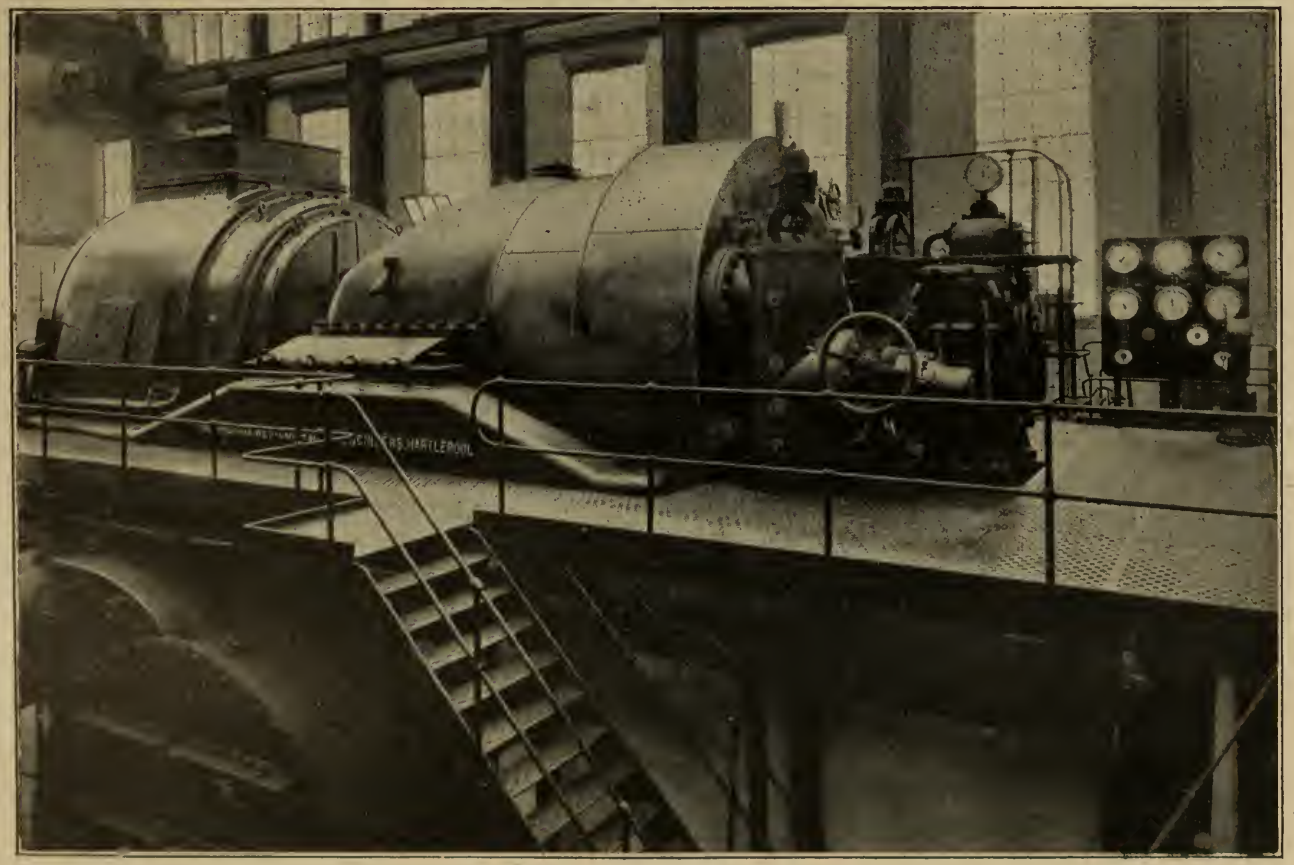

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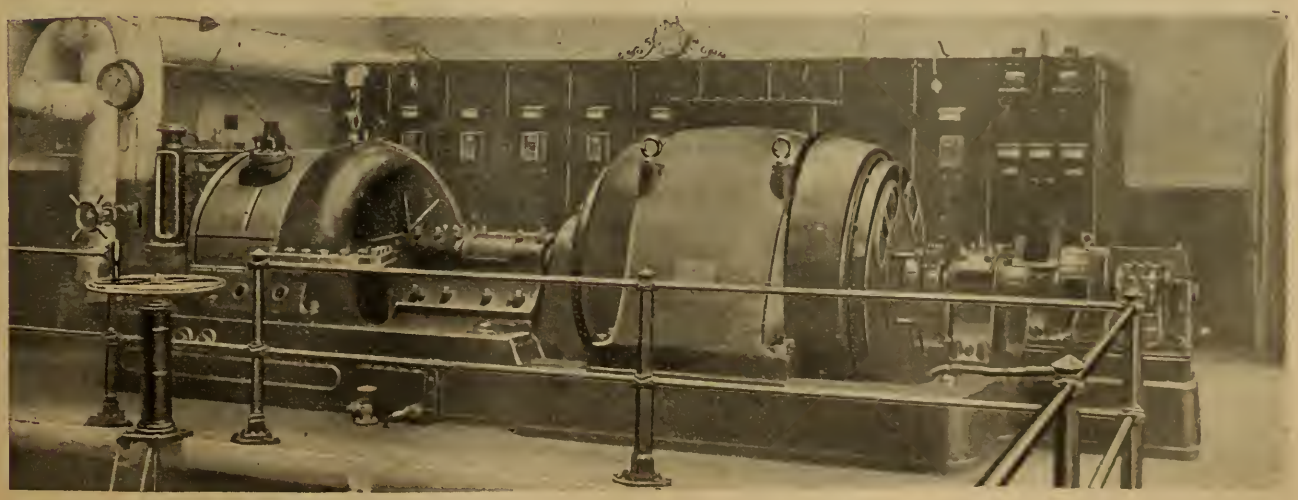

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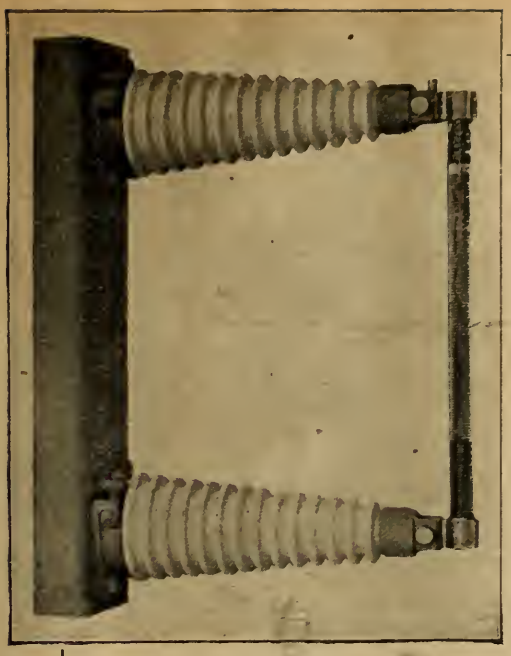

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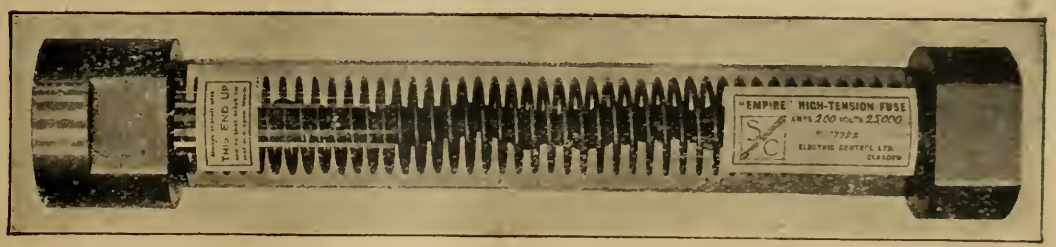

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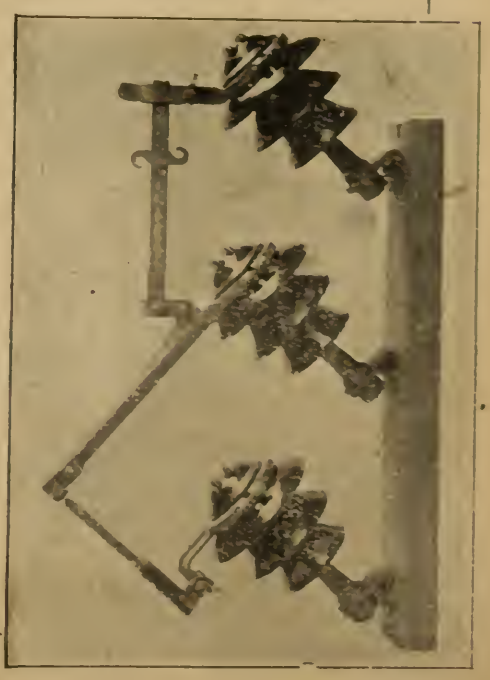

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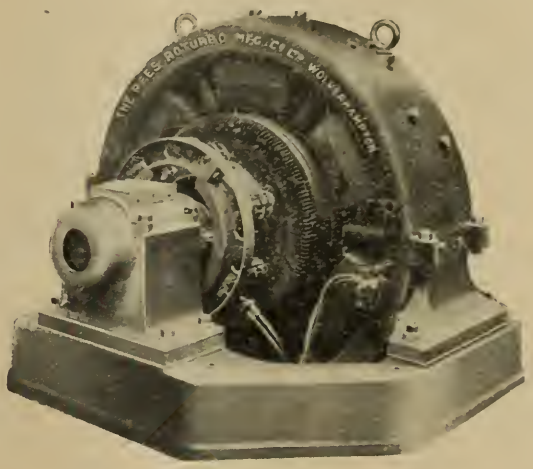

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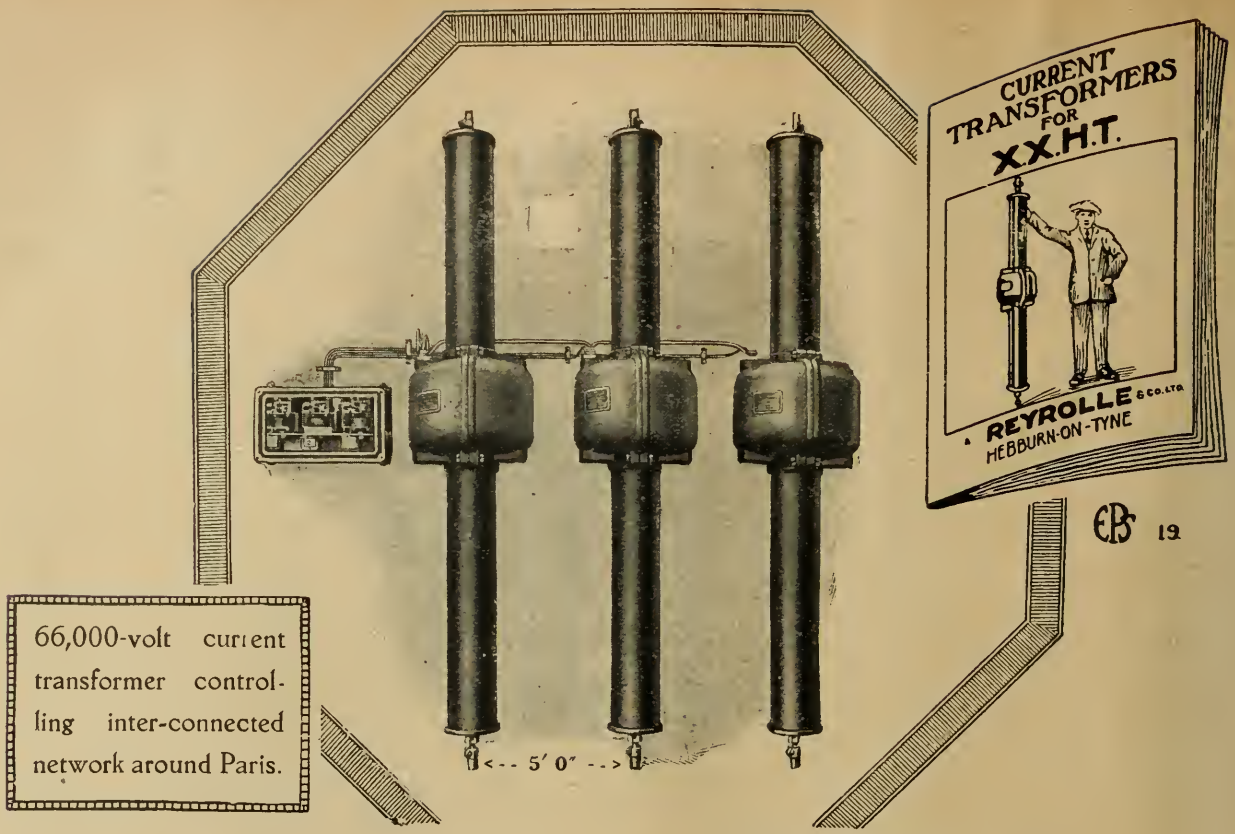

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Tenders should be addressed to the Clerk of the Council and delivered at the County Hall, Westminster Bridge, S.E.1, not later than four p.m. on Monday, July 24, 1922. No tender received after that time will be considered.

The Council does not bind itself to accept the lowest or any tender.

JAMES BIRD,
Clerk of the London County Council.

WIRE TINNED COPPER. Schedule 31, August 15. CABLE SWITCHBOARD SILK AND COTTON COVERED. Schedule 35, August 22. AUTOMATIC COMMON BATTERY TELEPHONE EQUIPMENT, TOGETHER WITH ALL ASSOCIATED EQUIPMENT, INCLUDING EQUIPMENT FOR USE AT SUBSCRIBERS' PREMISES. Schedule 39 and 40, October 17. PROTECTOR APPARATUS. Schedule 563, August 9.

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THE Patentee of certain "Improvements in apparatus for transforming, and especially for rectifying, alternating or polyphase currents," No. 102 977, already in successful operation on the Continent, desires to procure the commercial working of the invention in the United Kingdom, and with that object is prepared to grant licences to suitable British Manufacturers and to furnish them with all necessary information and assistance. Enquiries may be addressed to Mr. G. G. M. HARDINGHAM, Clun House, Surrey Street, London, W.C.2.

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THE Eastern Extension, Australasia and China Telegraph Company, Limited. The Share Register of this Company will be closed from the 1st to the 8th July, both days inclusive. By Order, F. E. HESSE, General Manager, Electra House, Moorgate, London, E.C.2. June 22, 1922.

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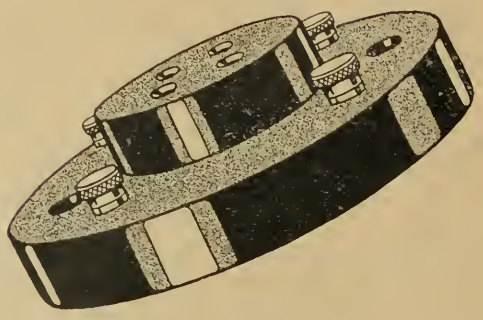

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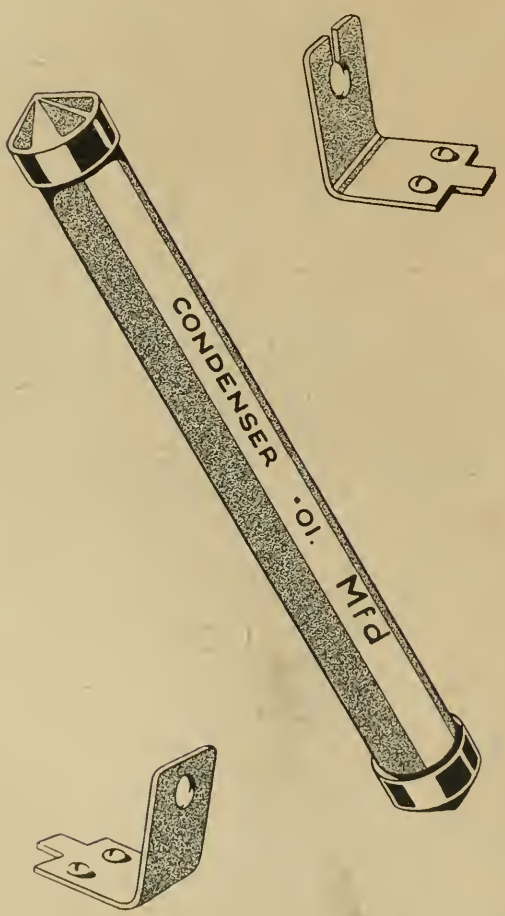

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CONTENTS.

Notes of the Week.

The First Electricity District Authorised.

THE second inquiry into the scheme for the South East Lancashire Electricity District proved to be formal, only occupying a couple of hours. The brevity and comparatively harmonious character of the proceedings are to be attributed to the fact that the engineers, led by Mr. S. L. PEARCE, had agreed upon a policy which, while it confers the local autonomy desired in the district, gives useful powers of co-ordination of both supply and expenditure. The new Advisory Board will not have much to do or say except to advise and recommend, but in the course of time, as the good effects of co-operation manifest themselves, we have no doubt its influence will grow, and it may lead to a closer association of the various supply authorities —even to the formation of a Joint Electricity Authority.

Railway Companies' Frivolous Opposition.

THE only objection to the formation of the Advisory Board came from the railway companies serving the district, though we cannot see any substance in their demands. The Midland Company objected to the compulsory supply of statistics, but as all railways are so accustomed to the preparation and supply of statistics there can be no real grievance in having to supply a few extra figures relating to the generation and use of electricity. The opposition of the North Western Company was to the Commissioners having the right to accept any recommendation of the Advisory Board. This sounds somewhat like objecting to the principles of the Electricity (Supply) Act of 1919 and to the powers of the Commissioners, and will, we hope, receive speedy justice. The Town Clerk of Manchester asked for the insertion of clauses authorising the payment of pensions to retiring officials and to enable members of the new Board to be paid for loss of remunerative time while engaged on the affairs of the Board. As practically the whole of the useful work to be done will be performed by the Committee of Engineers, we hope that the Commissioners will consider this matter very carefully and will hesitate to set up what may be a dangerous precedent for using public funds in an improper way.

Substation Practice and Performance.

IT is unfortunate that circumstances, avoidable and unavoidable, combined to cut short the discussion on Mr. R. A. CHATTOCK's Paper at the I.M.E.A. Convention last week. For when it withered in its early prime it showed every prospect of becoming a valuable contribution to those eternal problems: the comparative advantages of alternating and direct current for distribution purposes and the economic value of providing sufficient plant to keep the supply going in every conceivable circumstance. Short as the discussion was it showed, however, that the consensus of opinion is against Mr. CHATTOCK on the second of these two points. He, it will be remembered, preaches and practices direct current distribution combined with every precaution to ensure continuity of supply in the strictest interpretation of the term. The natural corollary is, therefore, not only an unusual proportion of spare converting plant in the substations, but a battery capable of maintaining the supply for two hours.

Some Disadvantages of the Substation Battery.

NOW a battery is at best an inefficient piece of apparatus for such a purpose. It is costly in itself, £35 per kW is the figure mentioned in the Paper, and it adds to the costs of the land, buildings, and switchgear involved in the

substation construction. If it is to be used entirely in emergency it is a form of over-insurance which cannot be recommended, and, if it is to be employed as a part of the ordinary substation plant, its work can be better done in other ways. It is significant to note that though Mr. CHATTOCK has been using batteries in substations for some years, and that though in 1914 his policy was commended it has never been widely followed; and is now almost universally condemned.

Moving Towards A.C. Distribution.

THIS condemnation is due to a greater cause than any defect inherent in the battery itself: the accelerated movement towards alternating current distribution, combined with a desire to get away from complications and approach simplicity in power station practice. The lot of the supply engineer saddled with a direct current system is therefore not a happy one, though he is offered methods of overcoming his difficulties which are worth examination. In making a choice it will be necessary for economic reasons to take risks rather than to play for safety. As was emphasised by many speakers not only during this discussion, but throughout the meeting, it is useless to talk about "cheap and abundant" electricity if the engineering policy of our supply undertakings mainly results in increased capital costs. For this and for other reasons it is a thousand pities that the discussion was so curtailed. We hope an early opportunity will be taken to deal further with the subject.

Municipal Finance.

THE Paper read by Mr. EDWARD CALVERT before the Incorporated Municipal Electrical Association last week raises an important question: How far shall the finance of a municipal electricity department be controlled by an official who is not under the orders of the head of that department? This is one of those questions which it is meet that a body like the I.M.E.A. should consider, but it is one to which it is difficult to give a general answer. This was evidently realised by those who discussed the subject, many of whom inclined to consider that both the problem and its solution lay in the clash of the personalities of those most concerned—the electrical engineer and the borough treasurer. In other words that it would be best to arrange for the quality of tact to be present in full measure in the composition of those two officials, and to trust to it rather than to written laws and regulations.

A Financial Responsibility Necessary.

BUT further consideration will show that the matter cannot be left there. It is obvious on the one hand that nothing is to be gained by the electrical engineer insisting on dealing with such matters as the raising of loans or similar pure financial questions. On the other hand everything is to be gained by the electrical engineer having full financial control of his own department; in fact disaster will follow if he does not have that control. Fortunately for the success of municipal electricity supply the large majority of cases fall between these two extremes and can be dealt with by a "give and take" policy such as that outlined by Mr. W. C. P. TAPPER. In cases where the collection of accounts has been allowed to fall into the hands of the borough treasurer it is rather a matter for the conscience stricken engineer to deal with than to bring into play the full weight of the Association. In any event, as Mr. WORDINGHAM said, the engineer must have many tools in his bag, and a knowledge of finance is one that should be kept among the sharpest and most constantly in use.

Expenses—Wholesale or Retail.

BY far the liveliest discussion at the I.M.E.A. Convention was on whether the expenses of members attending Council and Committee meetings should be paid by the Association or by the authorities employing the individuals concerned. The latter is the present procedure and the weight of opinion seems to be in favour of its continuance. But so divergent were the views expressed and so hot some of the threats of what would follow if this or that policy were or were not adopted that the meeting took the wisest, if not the most heroic, course in postponing further consideration until next year. We hope that even after further consideration no change will be made. Individual local authorities gain advantages from having a member on the Council and in the large majority of cases have no objection to paying for these increased facilities. On the other hand it is obvious that if each local authority pays a share, on whatever basis that share is arranged, the way will be open to undesirable bickering.

A Chance for Logical Action.

ANOTHER reason for making no change is that it is just as well, even for associations, to be logical when they can. To pay the Council members' expenses on a communal basis and then to object to paying the Commissioners' expenses on the same basis would hardly do. Yet we note that the Association passed a strongly worded resolution that the Commissioners' expenses should be a national charge, which is going a step or so farther. On its merits there is much to be said for making the change. A large undertaking may cause the Commissioners very little trouble (or expense), and contrariwise a small undertaking may cause them both, yet on the unit basis one will pay a great deal more than the other. Moreover, as the work of the Commissioners is undertaken for the good of the nation as a whole, it might well be argued that it should be paid for by the nation and not only by a section of it. We are glad, therefore, that the resolution was carried in spite of a characteristic outburst from Mr. PURSE, who drew a lurid picture of the results of Government control. This, however, is largely a bogey. The Commissioners work under statutory authority, and wherever their money comes from will continue to perform their duties in an atmosphere as free as possible from Treasury minutes. A more weighty reason for the change is that these expenses are becoming a heavy charge on many undertakings with the unfortunate result that "cheap and abundant" electricity is being relegated to an ever and ever more distant future.

Possibilities of Tramway Development.

THE papers read at the 14th annual congress of the Tramways and Light Railways Association last week revealed an undercurrent of dissatisfaction with progress and a suspicion, most frankly expressed by Mr. SPENCER, that tramway undertakings will have to rouse themselves if they are going to compete successfully with other forms of motor traffic. The record of the Bournemouth tramways narrated by Mr. BULFIN was not a very inspiring one. He explained past difficulties by the fact that the Bournemouth Corporation was not born with tramways, hardly achieved them, but rather had tramways

thrust upon them! It was many years before the differences between the various interests were composed. Even to-day Bournemouth, as a seaside resort, is not an ideal place for a tramway undertaking. The winter months almost inevitably lead to loss, which may or may not be recouped by the influx of visitors during the summer.

Railless Traction.

Mr. Munro, in dealing with railless traction, made out a good case for this system in circumstances where the cost of construction of a permanent track is not warranted; possibly Bournemouth might have benefited from the method, had it been available in the past. The great advantages are doubtless the low capital charges and small cost per passenger mile. The author, however, did not make enough of another advantage over the tramway—the greater elasticity arising from the fact that cars are not tied to a line of rails, and so have more freedom in negotiating traffic and avoiding blocks due to the breakdown of an individual car.

Improvements in Rolling Stock.

The third paper, by Mr. Spencer, dealt with improvements in rolling stock. The contrast between the title and contents of the paper reminds one of the famous chapter on "Snakes in Iceland." There aren't any. It is doubtless broadly true, as the author contends, that rolling stock is substantially similar to that used 20 or 25 years ago. The improvements he suggests, largely with a view to diminishing weight, noise, and vibration, would doubtless be valuable, though hardly revolutionary. There is, however, good ground for thinking that tramcars constitute a peculiarly good example of the British passion for solidity, and that their weight might, with advantage, be materially reduced. Mr. Spencer does no more than justice to the enterprise of designers of motor vehicles. But it must be conceded that in a vehicle that proceeds along iron rails and is essentially electrical, the line of development was, from the first, much more clearly defined.

Electricity Supply in Manchester.

The results of the past year's working of the Manchester Corporation electricity department, the largest and most important municipal undertaking in the United Kingdom, are not quite as good as those for 1920–21. Considering the circumstances, however, they are quite as satisfactory as could be expected. The total revenue was nearly £1 430 000, compared with £1 547 226, a decrease of over £117 231, mainly due to a drop in the sales of current for lighting and power. The working expenditure was £138 137 less, so that the gross profit was £452 893, against £431 987 in the previous year; but as interest, sinking fund and other payments absorbed £408 329, the net surplus was only £44 564, against £69 123. All interest and sinking fund charges for the year on the new Barton power station and the high tension mains therefrom were met out of revenue, and to this fact, coupled with the restrictions on the use of electricity, and the increased cost of coal, must be attributed the temporary setback, for we feel sure it is not more than temporary. The total sales decreased by 21 per cent. (158·5 million units against 199 618 813), a strange experience for a department which has shown progressive increases every year since its inauguration, except in 1919 and 1920. The average price of fuel only fell by 1s. 4d. a ton, and the average weight of fuel rose 0·03d. per unit sold, but we imagine there will be a substantial improvement on these figures during the current year as the quality of the coal has improved and its price has decreased.

Year's Progress and Developments.

We are interested to note that fair progress has been made with the Barton power station, though it is to be feared there will be a delay in the erection of the plant owing to the engineers' strike. No. 1 boiler house at Stuart Street has been modernised, and an additional 8 000 kW turbo-alternator and condensing plant have been installed. This station now contains 100 250 kW of plant, and it is therefore probably the largest single station now operating in the country, at any rate municipally owned. A number of sub-stations, both d.c. and a.c., have been enlarged or erected; a net addition of over 50 miles has been made to the mains, and considerable progress has been made with the 33 000 V transmission cables in connection with the Barton supply. The electric lighting of six streets was carried out, thus completing the scheme of public lighting sanctioned by the Council. There are now 858 public electric lamps, compared with 564 in 1921. A considerable advance has also been made with the lighting of the various housing estates, and work has been completed on the inhabited portions of six estates. It will thus be seen that the past year was one of great activity and progressive achievement in many ways. The total capital outlay is now £5 607 698, but the mortgage debt is only £3 248 936, and there are substantial reserve and renewals accounts, amounting jointly to nearly £230 000. The undertaking is therefore in a prosperous condition, and provided the trade boom materialises, next year's accounts should show a decided improvement.

Railway Accident Statistics.

The "Returns of Railway Accidents during 1921" and the report of the Ministry of Transport Committee, presided over by Colonel Pringle, which was appointed in October 1920 to consider the adoption of automatic train control, have been issued with an opportune simultaneity. With regard to the former, out of 1 217 687 000 passengers carried only 18 were killed in accidents to trains and 71 from other accidents connected with the running of trains or other railway vehicles. In addition 11 railway servants and three other persons were killed in accidents, while suicide accounted for 250, making a grand total of 726 for passengers and railway servants killed for one reason or another. This figure is very small compared with the number of passengers carried, and except for the suicides, with whom it is difficult to know how to deal, it might be argued that perfection has as nearly been reached as it ever will be.

The Advantages of Automatic Control.

But the object of automatic train control is something other than the prevention of accidents, useful as that prevention will be. In the first place it will make possible the acceleration of both signal and train movements, and for these reasons its use is almost compulsory where electrification is undertaken. It will relieve a number of men from an exacting and heavy task, and, while increasing efficiency, will at least reduce a number of unnecessary deaths due to human or mechanical failure. Experience on the London Underground Railways is sufficient guarantee of that. It is interesting to note that after a

period of prejudice the drivers are now favourably inclined to train control, and the real difficulties are to make a selection of the various systems and to take the necessary steps towards the standardisation of both track and locomotive equipment. With this end in view the Committee, who see the weak points rather than the advantages in all the systems now available, recommend the immediate formation of a committee of experts for this purpose. From the merely human point of view it is work that should be undertaken.

The Northumberland Clause in a Gas Bill.

THE principle embodied in what is known as the Northumberland clause, has in the past been applied to a number of electricity undertakings. It is somewhat of a novelty, however, to see it in a gas Bill. As our readers know, it was introduced in 1904 at the instance of the gas interests who dreaded the effect of competition by municipal electricity undertakings. Generally speaking, the clause which imposes upon municipal authorities the obligation of fixing their charges for electricity supply so that their undertakings shall not become a charge upon the rates, is fair, for all municipal services such as electricity or gas should be self-supporting. Therefore we are glad a Select Committee of the House of Commons has now inserted the clause in the Bill of the Stretford Joint Gas Board, which is to take over the business of the old gas company. The Board will not be allowed to impose a rate-in-aid until the maximum permissible price has been reached, and when this event happens it must apply to the Board of Trade for authority. Thus a device invented for the protection of gas interests is now being applied against them! Poetic justice!

The Eastern Companies Jubilee.

WHEN an industry celebrates its jubilees, as the electrical industry is now doing, it is not necessarily a sign that it is growing old. Indeed we are pleased to think that in the case of our own industry it is an indication of an increased virility and of a determination to make progress in the future proportional to what has been made in the past. That, we feel sure, is the view of those responsible for the conduct of the Eastern and Associated Telegraph Companies, a group of undertakings which will celebrate their jubilee on July 24 by a banquet, fete and reception in the gardens of the Royal Botanic Society. The DUKE OF YORK has expressed his intention of being present, and invitations have been issued to men and women, both British and foreign, who are distinguished in science, art, and literature. The opportunity is to be seized by the staffs of the companies to present their chairman, Sir JOHN DENISON-PENDER, with a volume containing the signatures of nearly 8 000 subscribers, and the reproduction in platinum set with brilliants of the stars of the Orders of St. Michael and St. George, and of the British Empire. In addition, a bed will be endowed in St. Bartholomew's Hospital in memory of the late Lady DENISON-PENDER.

Fifty Years of Progress.

IN our Diamond Jubilee issue last November we gave a detailed account of the progress with which the Eastern Telegraph group had been connected. It will be sufficient to say here that when the Eastern Co. was incorporated in 1872, only about 8 000 nautical miles of cables were in existence, while now there are roundly 325 000 miles. The capital invested in submarine cable enterprise fifty years ago was £2 000 000, now it is £50 000 000, nearly half of which is represented by the undertakings comprising the Eastern and Associated Telegraph Companies. Technically, though not so spectacular, progress has been equally sure. And it is interesting to note that the Eastern Co., by establishing their own research department were among the first to realise that for success science, technology and commerce must go ever hand-in-hand. They have built firm and sure. There is little doubt that the next fifty years will add further success to their credit, so that the celebration will not only recall the past, but welcome the future.

A Duty on Illuminating Ware.

THE Report of Sir WILLIAM ASHLEY'S Committee on Domestic, Illuminating and Mounting Glassware, is of some interest to readers of THE ELECTRICIAN as, in consequence of its findings, an Order has been made by the Board of Trade imposing a duty of 33⅓ per cent. on glass imported from Germany. The Committee found that the import of electric bulbs in 1921 from Germany and Czecho-Slovakia was not on a sufficiently large scale to have a serious effect upon unemployment. On the other hand, the Committee find (with one dissentient) that the statutory conditions, required before a duty can be imposed on domestic and illuminating ware, were fulfilled. Consequently, an Order has been made applying the duty for two years. This is good; but we regret the restriction should be confined to German goods alone, for we are afraid that under the circumstances neither the manufacturers nor the workers in the British glass industry will reap much benefit.

The Newcomen Society.

At the second summer meeting of the Newcomen Society, which was held recently in London, the proceedings were mainly devoted to visits to places of either intrinsic historical interest or where equipment of historical interest was to be found. The first of these included Westminster Hall, with its centuries-old roof, and a great deal of time was spent in inspecting the steps that have been taken to repair and protect the roof of this structure from the ravages of the death-watch beetle. In the second class were the Rotunda at Woolwich, where old arms and ordnance were examined, the Naval Museum at Greenwich, and the Deptford pumping station of the Metropolitan Water Board, where two Watt engines were on view. All these visits are instructive in that they show the advances that have been made in our knowledge of engineering design and construction during even a hundred years. But it is to be hoped that at some of its subsequent meetings the Society will deal with apparatus of electrical interest.

Their House in Order.

THE technical proceedings at the twenty-seventh Annual Convention of the Incorporated Municipal Electrical Association, of which we give a full and complete account elsewhere in this week's issue, fall naturally into three parts. Perhaps from the purely technical point of view it might be said that none of these parts was more important than the others. Sub-station design and the control of finance are obviously both questions that have not yet been given a final solution, and still present problems that require treatment. For that reason it is well they should be discussed. But looking at the matter from the broadest possible point of view, these two questions are completely overshadowed

by what may be conveniently called the subject of development. It is therefore fortunate that the PRESIDENT'S Address, with COLONEL VIGNOLES' Paper and the discussion thereon, formed a unit of opinion concentrated into one day of the meeting from which some very useful lessons can be drawn.

The Reiteration of Fundamentals.

THE PRESIDENT'S Address deals in generalities. It states fundamental propositions which have been stated before, stated so often, in fact, that they have become trite. But because a statement is trite it is not necessarily untrue; and it is sometimes well, if not essential, that it should be reiterated, and reiterated, until its lessons have been acted upon and it can be consigned to an honourable position in our mental museum.

The Tribute of Attention.

WHEN, for instance, MR. ALLEN announces that: "The electricity supply industry is indissociably wrapped up in other great industries," and that "Each section of industry, by its action or inaction, affects the destinies of other sections," the ordinary individual automatically brings into play his critical and cynical faculties, shrugging his shoulders in a depreciatory way at this glorification of the obvious. But do the majority of electrical engineers, whether they be connected with supply or manufacturing, or research or teaching, or selling, or with any other branch of the industry, always act as if that interdependence were ever present in their minds? They do not; because they do not realise its truth in practice, however much they may pay it the compliment of a depreciatory shrug. For that reason we are pleased that this obvious fact was stated by MR. ALLEN, by MR. HIRST at the luncheon given by the General Electric Company to the Convention, and by Dr. FERRANTI at the Annual Dinner. Such a body of opinion should be paid the tribute and attention and the still greater tribute of action. For if I.M.E.A. are really, as Dr. FERRANTI said, trustees for the electricity users, they must not run the risk of being treated as false trustees.

An Atomic Fable.

NOW SIR ERNEST RUTHERFORD, as we noted last week, has recently been telling us something about the constitution of the atom. The atom is composed of a large number of smaller, and to some extent antagonistic, bodies. These bodies are constantly in motion. They possess an amount of energy which is large but can with difficulty be released for useful purposes; and their actions and interactions, therefore, go far to neutralise their potential utility.

A National Service.

NOW analogies are not always exact, but our imperfect account of the modern atomic theory, and still more a study of SIR ERNEST RUTHERFORD'S Kelvin lecture, may be recommended as a fable (with a moral) to those who think that all is well with the electrical industry and that progress can be achieved by sitting down and waiting for it, with intervals for the exercise of their skill in tennis and golf. To quote MR. ALLEN again: "Directly we realise that electricity supply is a national service we also realise the opportunity of establishing between contending parties within the industry that confidence the absence of which may have been the cause of troubles and delays in the past."

Meeting a Universal Demand.

WE believe it was COLONEL CROMPTON who, a short time ago, said that what the electrical industry had to sell was electricity—a commodity that everyone would increasingly require. We suppose that this also is trite, but it certainly is not always realised. That is sufficiently evident from the discussion on COLONEL VIGNOLES' Paper, to which we have referred above. COLONEL VIGNOLES laid down, quite rightly, that the domestic load must be developed to supplement and to relieve the fluctuations in the power load, and that to do this means paying much more attention in the future to the small consumer and especially to encouraging him to employ more and more electrical apparatus. He lays down as essentials for this development propaganda, hiring, and a low price per unit.

The Scientific Tariff Bogey.

NOW a discussion on any or all of these points would have been both interesting and profitable. Yet what do we find? Speaker after speaker rising, not to suggest means for selling electricity but methods for discovering a tariff which shall be scientifically accurate and, at the same time, bring into the undertaking a fair economic return from each consumer. It is like the search for the Philosopher's Stone; and about as likely to succeed. What we want is the business, not the scientific, view point.

Waiting for the Future.

Then there is the reminiscent, or self-congratulatory speaker. We say this in no carping spirit. It is satisfactory to find that there are so many enthusiasts for development and so much enterprise is being successfully displayed. But these speakers do not seem to imbue their audiences with their enthusiasm, and to that extent they fail. In any event there is much more to do than has ever been done. Finally there is the type of man who is sure that the domestic load is a thing of the future, but proposes to wait for the future (and the perfect machine) before he does anything to help progress. The WATTS, the STEPHENSONS, the FERRANTIS have always been in a minority amongst us, but nowadays we seem, in addition, to have more than our fair share of Doubting Thomases. Coupled with these is the man who thinks there is nothing in the domestic load. It is wonderful to find how many of him there are among central-station engineers. But it is difficult to say anything about him that will pass the censor. We do not propose to try.

Get Rid of Pessimism.

One thing, however, is evident: the electricity supply industry must rid itself of pessimism, and, though it may seem a bold thing to say, of science, at least in connection with tariffs, electricity supply is a business, not a science, and requires business men to run it. The others must change their methods, as they could easily afford to do, or drop out. Fortunately there is this saving grace about the whole matter. The industry, partly wittingly and partly unwittingly, has, like Frankinstein, raised a monster. The public has already begun to demand cheap and abundant electricity. It will not rest until it is supplied.

What Cheap Electricity Means.

YET that, after all, is a poor thing to permit to happen to us. How much better would it be, in MR. HIRST'S fine phrase, to work and endeavour to inoculate England with electricity! Such an enterprise is abundantly worth while. It will mean the continued healthy growth of the electrical industry, and all the industries dependent upon it, which are the majority of the industries of the country. It will thereby mean the restoration of the world's trade and continued and permanent commercial prosperity.

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The Choice of Steam Conditions in Modern Power Stations.

By L. C. KEMP, B.Sc. (Eng.) A.M.Inst.C.E.

DURING the last few years much thought has been given to thermo-dynamics in relation to the design of steam power stations, and considerable progress has been made in the improvement of overall thermal efficiency. Steam pressures and temperatures have been rapidly increased, and it is of interest that in this respect British has tended to be ahead of American practice. At the same time, it is a fact that the advantages derivable from a proper selection of steam conditions have not received adequate recognition, and it is only in comparatively few cases, among the most modern

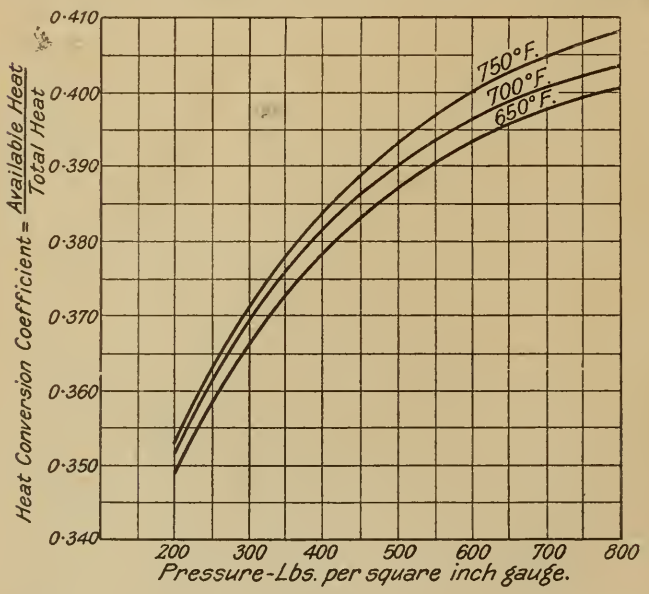


FIG. 1.—VARIATION OF HEAT CONVERSION CO-EFFICIENT WITH PRESSURE.

power stations, that the results of investigation into the subject have been put into practical effect.

Initial Steam Temperature and Efficiency.

The higher the initial temperature of the steam on its admission to a heat engine the better will be the efficiency of generation. This is due both to the greater proportion of heat available for conversion into mechanical energy and to the fact, in the case of the steam turbine, that the thermo-dynamic efficiency is, generally speaking, improved by an increase in the total temperature or superheat. Reciprocating engines are, for mechanical reasons, incapable of dealing with steam at the high temperatures now considered permissible, and this may be mentioned as one of the many well-known reasons for the choice of the steam turbine as the prime mover best suited to the requirements of the modern steam power station.

Thus the tendency in recent times has rightly been towards increasing the total temperature of the steam in the boiler house to the highest satisfactory working limit, compatible with the strength of the materials of construction at present at the disposal of boiler and turbine manufacturers. This safe working limit, which is largely a matter for individual opinion and discretion, is at present taken to be located between 650° F. and 750° F. There are some seven or eight power stations in this country operating with initial steam temperatures between 700° F. and 750° F., and with one exception no considerable trouble has been experienced. There is no doubt that all the difficulties incidental to temperatures near the higher limit have not been fully overcome, but recent experience leads us to expect that when minute care is given to every individual detail in the boiler house, steam pipeline and joints, valves and turbines, the difficulties can be met and advantageous results obtained.

The Selection of Steam Pressure.

Having decided upon the total steam temperature for which a new power station is to be designed, a considerable range of working pressures is open for selection. Under these conditions an increase in pressure is accompanied by an improvement in the proportion of heat available for conversion into mechanical energy, but, unfortunately, at the same time this is offset to some extent by a decrease in the superheat carried by the steam and by a drop in the thermo-dynamic efficiency for which the turbine can be designed.

It is intended in the present article to make an examination of the various effects on the economy of electrical generation in a power station when the steam pressure is increased whilst keeping constant the selected total temperature. In approaching the subject it is well to bear in mind the processes of heat conversion which occur in a power station between the coal entering the boiler furnaces and the electricity leaving the turbo-generator.

The Thermal Efficiency Chain.

The overall thermal efficiency of a power station may be represented by a chain of the thermal efficiencies of the individual units of plant comprising the power equipment.

In general terms,

Overall Thermal Efficiency of a Power Station (based on units sent out) = Average boiler efficiency α.
× Station co-efficient β covering radiation, leakages, steam for auxiliary plant, and boiler blow-down.
× Station co-efficient γ representing the ratio of units sent out to total units generated.
× Heat conversion co-efficient δ (or Rankine efficiency) representing the ratio of the adiabatic heat drop to the total heat in the steam.
× Average turbine thermo-dynamic efficiency μ.
× Average alternator efficiency η.
= $\alpha, \beta, \gamma, \delta, \mu, \eta$.

The efficiencies α, μ, η will be average values dependent on the load curve and the degree of care exercised in the supervision of the plant.

The value of the heat conversion co-efficient is of the order of 30 to 40 per cent., depending on the steam condi-

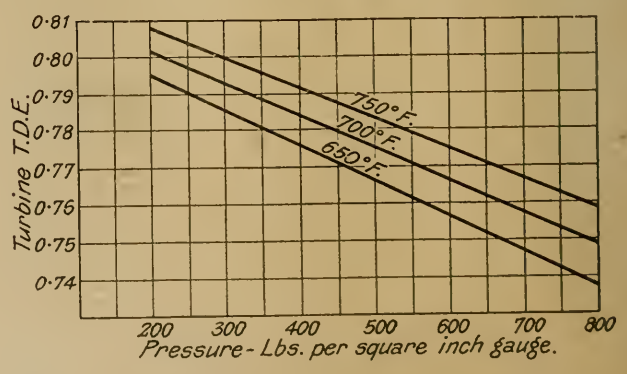


FIG. 2.—COMPARATIVE TURBINE T.D.E. AND PRESSURE

tions, whereas the other efficiencies and co-efficients are of the order of 80 to 95 per cent. For this reason an improvement of the conversion factor by 1 per cent. has a relatively greater effect upon the overall thermal efficiency of the power station than the same per cent. improvement in the efficiencies of the boilers, turbines, or station co-efficients, and, furthermore, a greater range of variation is obtainable with the conversion co-efficient.

Effect of Variation of Steam Conditions.

Variations in the steam conditions will affect the thermal efficiency of the power station mainly in respect of the heat conversion co-efficient and the turbine thermo-dynamic efficiency. The efficiency obtainable from water tube boiler plants of first-class design and manufacture will not be altered by increases in steam pressure, nor will the station co-efficients be appreciably affected. Experience so far obtained in the operation of high-pressure water tube boilers tends to show that maintenance and repair charges are no higher than for standard boilers designed for the more moderate pressures. The cost of the power equipment will, however, be increased for the higher steam pressures, and this fact must be taken into account in deciding the particular steam conditions at which a correct balance between first cost and thermal efficiency is obtained.

Effect on Heat Conversion Co-efficient.

For any given value of total steam temperature increases in pressure will be accompanied by a reduction in the

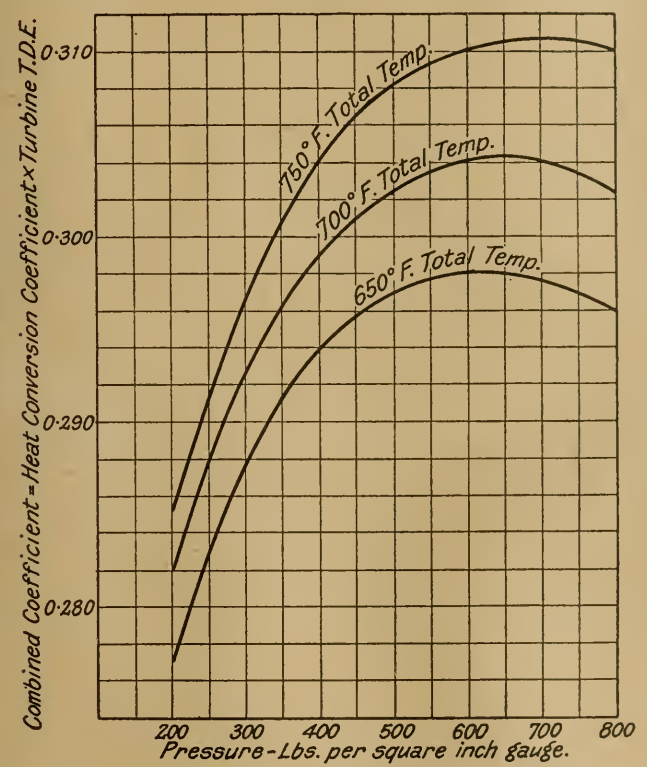


FIG. 3.—COMBINED CO-EFFICIENT AND PRESSURE CURVES.

superheat carried by the steam and an increase in the available heat or the adiabatic heat drop. The total heat shows only small variations, and is in fact slightly reduced at the higher pressures.

This is shown clearly in Table I., in which the values of superheat, available heat, total heat and heat conversion co-efficient have been tabulated for boiler pressures between 200 and 800 lb. per square inch and for constant total temperatures of 650, 700 and 750° F. The available heats have in each case been based on a vacuum of 28·7 in. (Bar. 30 in.).

To show the way in which the heat conversion co-efficient varies with steam pressure, the curves in Fig. 1 have been plotted. From this it will be seen that increases in pressure for constant total temperature improve the conversion co-efficient, but that the rate of improvement diminishes at the higher pressures. For example, taking the total temperature of 700° F., the same improvement in conversion co-efficient is obtained for increases in pressure between 200 and 350 lb. per sq. in. as between 350 and 700 lb. per sq. in.

Effect on Turbine Thermo-dynamic Efficiency.

In examining the thermo-dynamic efficiency for which a turbine may be designed under varying conditions of steam pressure and superheat it is necessary to consider individually the effect upon the principal losses which occur in the turbine, namely :—

(*a*) Hydraulic losses in the fixed and moving blades.
(*b*) Mechanical losses.
(*c*) Gland losses.
(*d*) Disc frictional losses.
(*e*) Wetness correction.

The hydraulic efficiency is inherently dependent upon the ratio U/C_0 of blade speed to steam speed, and thus, if the disc diameters and the number of stages are not considerably altered, a rise in pressure will have the effect of increasing the steam speed between each stage and cause corresponding reduction in the ratio U/C_0 and the hydraulic efficiency. The actual loss from this cause is not very great, and in fact does not exceed 5 per cent. over the whole pressure range considered, even when the disc diameters and number of stages are allowed to remain unaltered.

Mechanical Losses and Higher Pressures.

The mechanical losses, representing bearing friction and the power required to drive the governor and oil pump, are not effected by changes in the steam conditions. Gland losses are certainly increased for an increase in pressure but not to a very considerable extent. For example, the gland

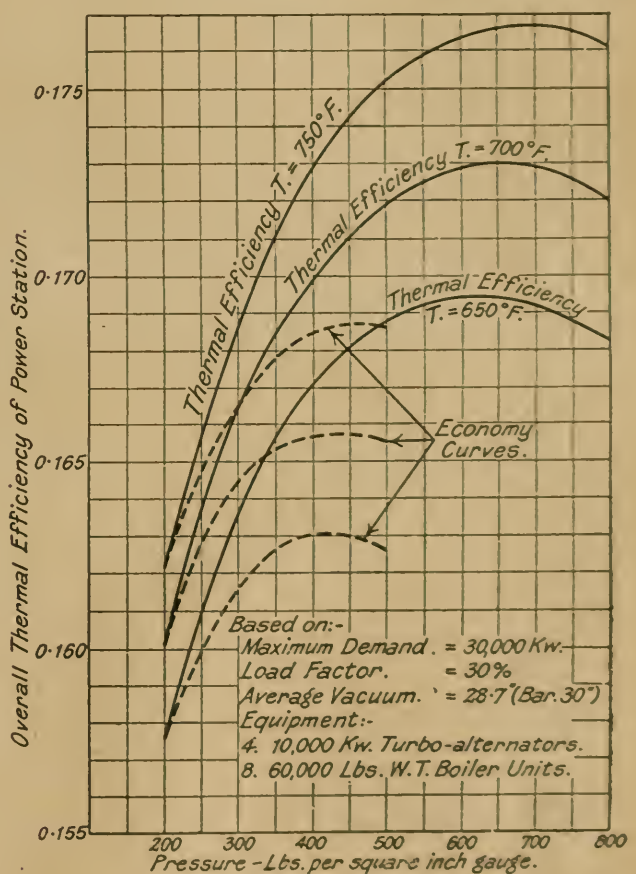


FIG. 4.—CURVES OF THERMAL EFFICIENCY AND THERMAL ECONOMY, APPLIED TO A PARTICULAR POWER STATION.

losses in a 20 000 kW turbine designed for 200 lb. per sq. in. working pressure would be about 0·5 per cent., but even with considerably increased boiler pressure the gland losses would not be more than 0·65 per cent., and this small difference could in practice be reduced by suitably increasing the length of the glands.

Disc frictional losses increase with pressure but not quite in proportion to the increase in the initial pressure of the steam, for the reason that a greater proportion of the increased pressure would in all probability be taken across the first stage of the machine with the object of limiting the high pressures and temperatures to a comparatively small portion

TABLE I.

Steam Pressure. lb. per sq. in. (gauge).	Total Temperature = 650° F.				Total Temperature = 700° F.				Total Temperature = 750° F.			
	Super-heat. °F.	Total Heat (from 150° F.) B.T.U.'s.	Available Heat (Vac. 28·7 in.) B.T.U.'s.	Heat Con-version Co-efficient.	Super-heat. °F.	Total Heat (from 150° F.) B.T.U.'s	Available Heat B.T.U.'s.	Heat Con-version Co-efficient.	Super-heat. °F.	Total Heat (from 150° F.) B.T.U.'s.	Available Heat B.T.U.'s.	Heat Con-version Co-efficient.
200	262	1222	426·0	0·3483	312	1246	438·0	0·3510	362	1272	448·0	0·3525
300	228	1217	446·0	0·3660	278	1241	459·0	0·3692	328	1267	470·0	0·3710
400	201	1213	459·0	0·3773	251	1238	473·0	0·3815	301	1263	485·0	0·3840
500	179	1210	468·0	0·3870	229	1236	482·0	0·3900	279	1261	496·0	0·3932
600	162	1208	475·0	0·3935	212	1235	489·0	0·3965	262	1260	504·0	0·4002
700	146	1208	480·5	0·3980	196	1235	495·0	0·4010	246	1260	510·0	0·4050
800	134	1208	484·5	0·4010	184	1235	499·5	0·4040	234	1260	515·5	0·4086

of the high pressure end of the turbine casing, and so avoiding many mechanical difficulties. Such a practice would also tend to keep down gland leakages as well as disc frictional losses.

The wetness correction has the greatest influence on the overall efficiency. The superheat is reduced at the higher pressures, and a corresponding increase occurs in the percentage of moisture in the steam passing through the later turbine stages. Thus, for a constant total temperature of 650° F. the effect of increasing the pressure from 200 to 700 lb. per sq. in. would be to increase the final percentage of moisture from about 7 to 12 per cent., and a correction of approximately 3½ per cent. on the overall efficiency would become necessary.

Fig. 2 shows the change in turbine thermo-dynamic efficiency which is brought about by variations of pressure at constant total temperature. These curves are based on the above considerations and apply particularly to turbines of 10 000 kW capacity. For the purpose of showing relative, as opposed to actual, turbine efficiencies they may, however, be taken to apply to all standard sizes of turbines between 5 000 kW and 20 000 kW capacity. It is seen that the overall turbine efficiency is reduced some 4½ per cent. for an increase in pressure from 200 lb. per sq. in. to 700 lb. per sq. in.

Pressure Variations and Thermal Efficiency.

In order to show the effect on the overall thermal efficiency of the power station it is necessary to multiply the conversion co-efficients by the corresponding turbine efficiencies. This operation has been carried out in Fig. 3, which shows the combined co-efficients for the various pressures. A point is reached round about 700 lb. per sq. in. where a maximum value is obtained for the combined co-efficient and thus also for the thermal efficiency of the power station.

Effect of Increases in Capital Cost.

The main items of plant to be affected in this respect will be the boilers and steam pipework. The turbines will also be rather more expensive at the higher pressures due to the heavier steel castings at the high pressure end and to possible additions to the number of stages. On the other hand, the capacity and surface of the condensers will be slightly decreased by reason of the reduced steam consumptions at the higher pressures and this will tend to offset the increased cost of the turbines.

Standard types of water tube boilers with integral superheaters and steel economisers are suitable for all pressures up to 450 lb. per sq. in. without serious modification except in respect of the dimensions of the tubes and drums.

TABLE II.

Working pressure — lb. per sq. in.	200	250	300	350	400	450
Approx. cost in £ per 1 000 lb. per hour steaming capacity.						
(*a*) 50 000 lb. capacity units	176·0	180·5	184·5	189·0	193·5	198·0
(*b*) 72 000 lb. capacity units	159·0	163·0	167·0	171·0	175·0	179·0

In Table II. approximate figures are given to show the extent of the increase in the cost of Babcock and Wilcox type C.T.M. steel cased boiler units of 50 000 and 72 000 lb. capacity, designed in each case to deliver steam at a total temperature of 700° F. It is seen that for every 100 lb. per sq. in. increase in pressure the first cost of the boiler installation would be increased some £8 to £9 per 1 000 lb. per hour in steaming capacity. This applies only within the pressure limits stated, since the standard type of construction could not conveniently be used for pressures above 450 to 500 lb. per sq. in. Radical modifications in design then become necessary, with the effect of increasing the first cost by at least 15 per cent. above that for the standard type of construction. Thus between boilers of standard type designed for 450 lb. per sq. in. and boilers of a special type designed for 550 lb. per sq. in. the increase in cost would be in the neighbourhood of £30 per 1 000 lb. steaming capacity. The design of the steam pipework calls for special consideration at the higher pressures, and the amount of increase in cost would of course depend upon the layout and capacity of the power station.

The Cost Factor and Overall Economy.

The incidence of the total increase in capital cost upon the economy of generation will depend upon a number of local factors, of which the coal cost, load curve and thermal efficiency of generation are the most important.

Each addition to first cost attendant on increased pressure will involve the undertaking in yearly capital charges which correspond in purchasing power to a certain number of pounds of coal or units of electricity. Thus in their effect on the economy of generation the additional capital charges will tend to counteract the advantages in thermal efficiency obtained at the higher pressures as indicated by the curves in Fig. 3.

Each new power station will present a new set of working conditions and will call for special consideration in this respect, but in order to indicate the method of applying the correction for increased cost it is purposed to make calculations applying to a particular example.

Consider the case of a power station to be erected in a district calling for a maximum demand of approximately 30 000 kW at 30 per cent. load factor and designed to the following operating conditions :—

Units Installed.
4—10 000 kW turbo alternator units (one spare).
8—60 000 lb. capacity water tube boiler units (two spare).
Coal Cost—16s. per ton delivered.
Calorific Value—11 500 B.T.U.'s per lb.
Vacuum (yearly average) = 28·7 in. Bar. 30 in.

The aggregate steaming capacity would then be 480 000 lb. per hour and the total increase in cost of the boiler plant £4 000 per 100 lb. per sq. in. pressure increase for pressures up to 450/500 lb. per sq. in.

The increase in cost of boiler house headers, steam pipework, feed ranges and other items of auxiliary equipment

affected by pressure may be taken for a power station of this size to be about £3 per 1 000 lb. of steaming capacity for each 100 lb. per sq. in. pressure rise up to a limit of 500 lb. per sq. in.

Pressure—lb. per sq. in.	200	300	400	450	500
Additional capital costs—	£	£	£	£	£
(*a*) Boiler plant	—	4 000	8 000	10 000	12 000*
(*b*) Steam pipework, etc.	—	1 440	2 880	3 600	4 320
(*c*) Total	—	5 440	10 880	13 600	16 320
Additional capital charges (11 per cent.)					
£ per annum	—	599	1 197	1 496	1 797

On the basis of a selection of 700° F. for total steam temperature and using the combined turbine and conversion co-efficients from Fig. 3, cost factors may be obtained to represent the effect of the additional capital charges on the economy of generation by means of a calculation such as is shown in Table III. In this case the cost factor has been taken to be unity for 200 lb. per sq. in. working pressure, and it is seen that by increasing the pressure to 450 lb. per sq. in. the undertaking would be called upon to find additional capital charges to the amount of £1 496 per annum, or approximately 3 per cent. of the annual coal cost. This is economically equivalent to a 3 per cent. increase in coal consumption, and it is apparent therefore that an index to the thermal economy of generation is obtained by multiplying the thermal efficiency by the cost factor.

This operation has been carried out in Fig. 4, in which the curves of combined co-efficient in Fig. 3 have been reproduced to a new scale indicating the thermal efficiencies for the example now under consideration, and corresponding

TABLE III.

1. Pressure—lb. per sq. in.	200	300	400	450	500
2. Thermal efficiency of power station at 30 per cent. load factor per cent.	16·00	16·65	16·99	17·1	17·2
3. Coal cost—pence/unit	0·1592	0·1530	0·1500	0·1490	0·1481
4. Total units generated —millions/annum ..	78·84	78·84	78·84	78·84	78·84
5. Yearly coal cost, £ ..	52 300	50 200	49 200	48 900	48 650
6. Capital charges corresponding to increased cost of plant— £ annum	Nil	599	1 197	1 496	1 797
7. Ratio : $\frac{\text{Additional cap. charges}}{\text{Yearly coal cost}}$	Nil	0·0119	0·0243	0·0306	0·0369
8. Cost factor (based on unity at 200 lb./sq. in.) $= \frac{\text{Item 5} - \text{Item 6}}{\text{Item 5}}$	1·0000	0·9881	0·9757	0·9694	0·9631

economy curves added for total temperatures of 650° F. and 750° F. as well as for 700° F.

The steam conditions at which maximum economy of generation is obtained in this example would appear from the curves to be as follows :—

	A.	B.	C.
Selected total temperature °F. ..	650	700	750
Pressure—lb./sq. in.	400	430	450
Superheat	201	244	289

It is of interest to note that by taking 450 lb. per sq. in. pressure for Case C instead of, say, 250 lb. per sq. in., a saving would be effected equivalent to 1·32 per cent. in coal consumption or nearly £700 per annum after allowance has been made for additional capital charges at the higher pressure.

The Cost Factor and Working Pressures.

The cost factor has a very considerable effect in reducing the working pressures at which the economic maxima occur, and it is important that a correct estimate should be obtained of the additional capital charges and maintenance costs, if any addition to the latter is to be anticipated. The foregoing figures, although applying to a particular example, are helpful in so far as they indicate a method of arriving at a positive result, and show that the choice of steam conditions for any given power station can with advantage be based on calculations which take into account economic as well as thermo-dynamic considerations.

* Assuming water tube boilers and standard type for this pressure.

The Reheating Problem.

Mention must be made in this article of the revolutionising effect on steam conditions and the general design of power stations which will be brought about by a satisfactory solution of the problem of inter-stage reheating in steam turbines. Very large gains in thermal efficiency are promised both by reason of the augmented heat drop and the fact that the turbine efficiency can be maintained at a high level due to the comparatively dry state of the steam throughout its expansion. There is no doubt that such a power station, introducing into its design a successful application of inter-stage reheating, will utilise advantageously very much higher boiler pressures than those indicated by present practice, and a big field for investigation will be opened out in this direction.

In conclusion, the author wishes to express his thanks to the English Electric Company, Babcock and Wilcox, and Stewarts and Lloyds, for the assistance and information they have provided.

Review.

Protective Relays ; Their Theory, Design and Practical Operation. By VICTOR H. TODD. (London : Hill Publishing Co.)

Not many years ago the American electrical engineer was wont to pride himself upon connecting up his system "solid," to the exclusion of all automatic gear. British engineers, on the other hand, have always maintained that to ensure continuity of supply a minimum number of simple and reliable automatic devices were essential, in order that a faulty machine or feeder should be isolated from the system.

It is interesting to note the result of experience by these two schools of thought. The British engineer has succeeded in perfecting his protective gear, in the direction of still greater simplicity and increased reliability, whilst the American engineer has now gone to the other extreme and has devised a relay for almost every purpose under the sun.

The book under review treats of the protective relays manufactured by two firms only, but even so the number of varieties dealt with is so large as to bewilder anyone in search of the relay best suited to his particular requirements. However, to anyone wishing to know what relays can do, this volume will prove of interest.

It is stated in the preface that the book is intended "not only for the operator and tester who has a fair knowledge of electricity" but also for the "designer of the system." Whether the "designer of the system" is not to be credited with a "fair knowledge of electricity" is not clear, but even he should hardly require to be told that "the secondary terminals of a voltage transformer should never be short-circuited" or the windings will be burnt out.

The author rightly emphasizes the importance of a minimum time lag at heavy overloads in the case of inverse time lag relays, but he does not point out that for feeder protection a momentary overload is unlikely to occur and that, for such purposes, a definite time lag can often usefully be employed. The reason for this omission is doubtless that the only definite time lag relay with which he appears to be familiar is the "bellows" pattern, which he rightly disparages.

The most difficult systems to protect—in fact the only systems which present any real difficulty—are those forming a ring main, which the author dismisses in less than two pages. The directional relay with graded time lags, which is the method of protection advocated, is certainly a very excellent one ; but there are others—the Merz-Price for example. This latter system is briefly described in another part of the book, but no mention is made of the difficulties which occur with it owing to capacity currents, or how their effects can be eliminated. The author is evidently averse, and rightly so, from using pilot wires at all, if they can possibly be avoided.

It is easy to criticise a treatise written to meet the conditions ruling in another country—conditions which necessarily differ very widely from our own, but in any case the author is to be congratulated upon producing a volume which, although it may not contain much that is actually new, deals with a subject of great importance and on which the existing literature is excessively meagre.

KENELM EDGCUMBE.

Recent Tendencies in Switchgear Design and Manufacture.

By J. R. COWIE.

Amongst the many developments during the past ten years those relating to power station switchgear are outstanding. Designs may be classed under two headings for comparison :—

(1) Armourclad gear embodying the total enclosure of all conductors in earthed metal cases.

(2) Cell structures of brick or stone housing and supporting bare conductors and apparatus.

The first is a development introduced to give complete safety in handling, compactness, and therefore economy in buildings, ready accessibility of essential parts, robust construction and a minimum of cleaning and maintenance.

Disadvantages of Cell Structures.

The present-day examples of the second may be taken as representing an improved arrangement of the earlier designs without eliminating the disadvantages. Conductors are partially protected by providing phase and busbar barriers, but the size of the structure becomes alarming when dealing with large capacities or when operating with the higher voltages. Many improvements have been made in the switches used for this class of work, principally in the employment of cast steel instead of cast iron on the switch top plates and in the strengthening and ribbing of the oil switch tanks.

Another point to which more attention is being paid in some designs is the screening of all live metal, especially on the oil switch tops. But with this class of gear it is almost impossible to provide efficient interlocks between the many parts and so ensure correct sequence of operation. In the early designs the most frequent cause of accident was the opening of air break isolating switches on a wrong panel—*i.e.*, on isolators carrying load, and such operation mistakes have resulted in serious damage to buildings, switchgear, structure, and in some instances loss of life.

Maintenance, cleaning, etc., is an expensive item, which has usually to be carried out at night or during the week ends, and is a source of worry to the engineer in charge until the last cell doors have been closed.

Dusty Insulators.

Especially with the higher voltages, leakages across dusty insulators may give the engineer in charge quite an uncomfortable time until this defect has been located and rectified. As a result, in many large stations complete enclosure of transformer and alternator terminals is being called for.

Evolution of Armourclad Gear.

These difficulties were appreciated in the early days of switchgear development, and an armourclad switchgear unit was produced primarily for use on the North-East Coast Power Companies' systems. The growth of the use of this equipment has been phenomenal, and enormous savings in cost have been effected : in buildings, in maintenance staff ; by convenience in handling ; by interchangeability of parts, simplification of erection, and immunity from operators' errors in the manipulation of isolating switches owing to effective interlocks. The manufacturers being satisfied that these features were of importance to the industry, apart from their commercial value, larger designs to cover wider applications were made, and various medium-sized power stations were equipped throughout the country, one of the earliest power station equipments being at the Stepney Borough Council's Osborne Street generating station.

In 1912 Mr. S. E. Fedden decided to instal a large armourclad switchboard in his Neepsend Power Station, this being the first installation for a really large station. Twelve panels were first erected, as shown in Fig. 1 (1 and 2). Certain novel features are evident from the photographs. The operating or control board overlooks the turbine room with the switch house immediately behind it, the separating wall fulfilling the double duty of a partition and a substitute for the usual slate panels. The wall is tiled with dark vertical bands between the panels, and all the instruments, relays, operating mechanisms, etc., are mounted directly on the wall. The switchgear is of very massive construction, particularly the oil circuit breakers, as may be seen by reference to Fig. 2. Duplicate bus bars are provided, either of which may readily be connected through the oil circuit breaker to the outgoing or incoming cables *via* the transformer chamber, which houses any required combination of current transformers.

Switchgear Details.

The essential parts of the switchgear may be divided into the " fixed " and " movable " portions, as follows :—

Fixed Portion.—(1) *The Bus bars*—Each set of three bus bars is mounted in a cast metal chamber and is supported from the main frame standards. Each bus bar is connected to a socket supported by a large tubular insulator fixed in a spout-like aperture to the front of the chamber.

(2) *The Transformer Chamber* is mounted immediately below the bus bar chamber, and is provided with similar spouts and sockets to the latter. The size of the chamber depends upon the number of protective gear and instrument transformers required. A potential transformer of the totally-enclosed oil-immersed type is mounted in front of the chamber and is connected through plug type e.h.t. fuses which pass through insulators embedded in the hood of the transformer case and the main chamber.

A cable dividing box with the requisite number of glands is mounted on the lower side of the transformer chamber, or spur connections may be taken through the wall behind or through the floor.

Movable Portion.—(3) *Oil Circuit Breaker.*—Despite the size and weight of the oil circuit, effective means of handling are provided. The breaker is of the " carriage " type and may be moved backwards and forwards on the main frame supporting standards through the agency of rollers and a rack and pinion device which is actuated by a ratchet lever. This movement affords means for completely isolating the circuit breaker or the cables from the bus bars. The plug contacts seen in the illustrations projecting from the front of the switch engage with the sockets in the fixed chambers bus bar and transformer chamber and therefore to the cable. The movement of the oil circuit breaker actuates folding doors, which cover the spout openings of the fixed chambers when the circuit breaker is withdrawn, in order to prevent access to live conductors.

Mechanical Strength of Tank Necessary.

A portable truck with a moving platform is used for lowering the heavy tanks when a circuit breaker is withdrawn, or for moving a switch bodily. These circuit breakers have dealt with some severe faults close to the bus bars with complete satisfaction. Extensive experience under actual operating conditions has conclusively proved that great mechanical strength of the tank and supporting top plate, a large volume of oil and extremely rapid motion of the separating contacts through a moderate distance are necessary.

Too much reliance is apt to be placed on the cushioning effect of the air above the oil, and whilst this is of certain value, mechanical strength must not under any consideration be sacrificed in its favour. Adequate vent pipes suitably baffled to prevent undue discharge of the oil are a further safeguard against the high internal pressures established.

It should be mentioned here that with the heavy steel tanks used a solid web some 3 in. by 2 in. thick is formed round the top of the tank (see Fig. 2) to give a secure fixing to the supporting studs, and further to prevent the emission of oil or flame at this point, which is between two machined surfaces.

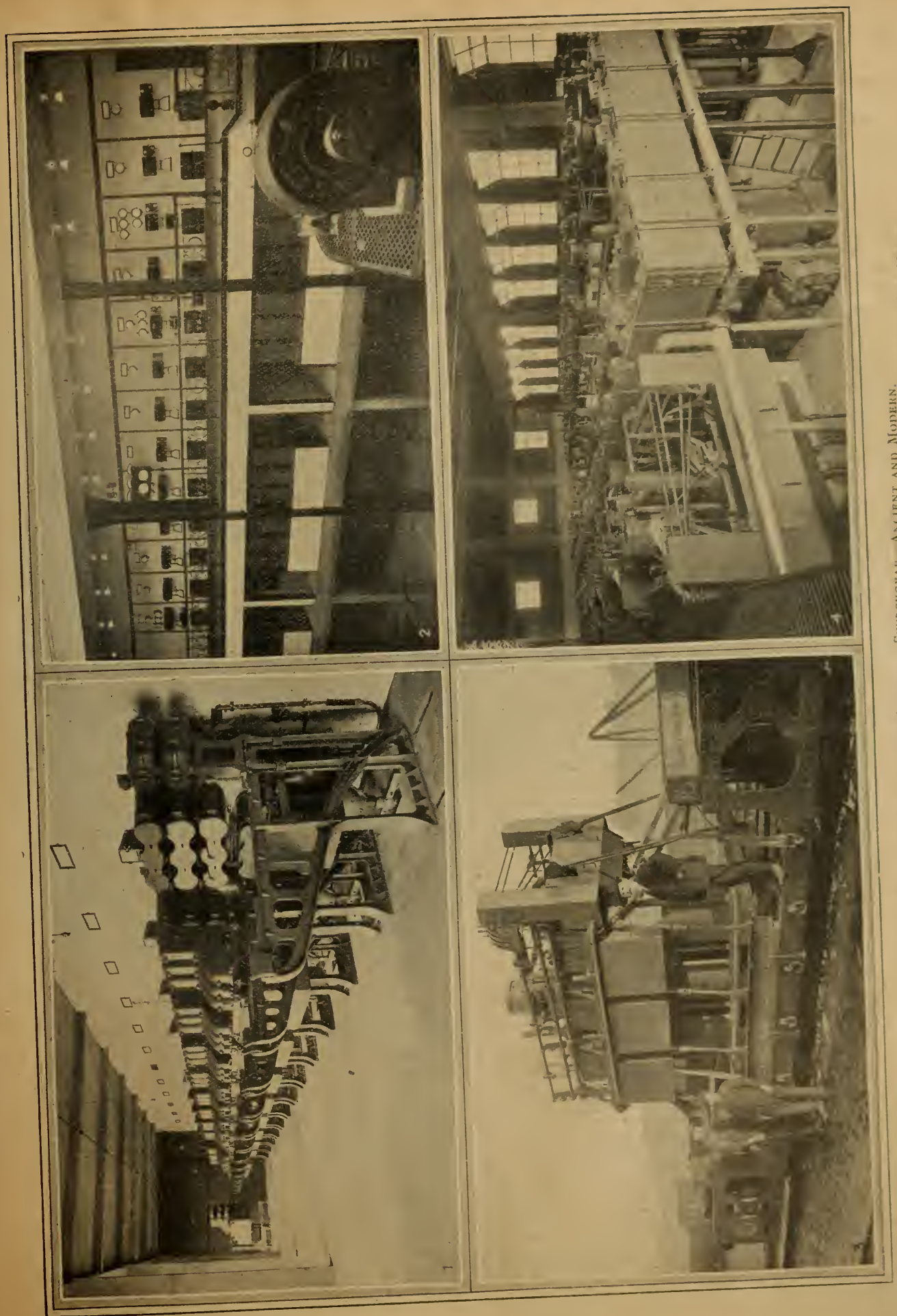


FIG. 1.—SOME VIEWS OF IRONCLAD SWITCHGEAR—ANCIENT AND MODERN.
1. THE SWITCHES AT NEEPSEND STATION, SHEFFIELD.
2. THE SWITCHBOARD AT NEEPSEND.
3. THE LATEST SWITCHGEAR FOR CARVILLE.
4. A MODERN SWITCHROOM.

Speed Rather than Length of Break Important.

Yet another important feature in the actual oil switch itself which has not been previously mentioned is that within limits, provided that the speed of operation of the switch be fast enough and the containing tanks and structures strong enough, length of break is not an important criterion in the rupturing capacity of the oil switch, but speed of break is. This has been proved by experience in this country and has recently been confirmed by experiments on the Continent, thus proving that an armour-clad switch of high velocity is a better switch than a more lightly clad switch of slow breaking velocity and with a long break.

Super Power Station Gear.

About 1915 it was found that a much larger type of switchgear was necessary to meet the requirements of the super power stations then under consideration. The illustration Fig 1 (4) shows a switch room with twenty-eight

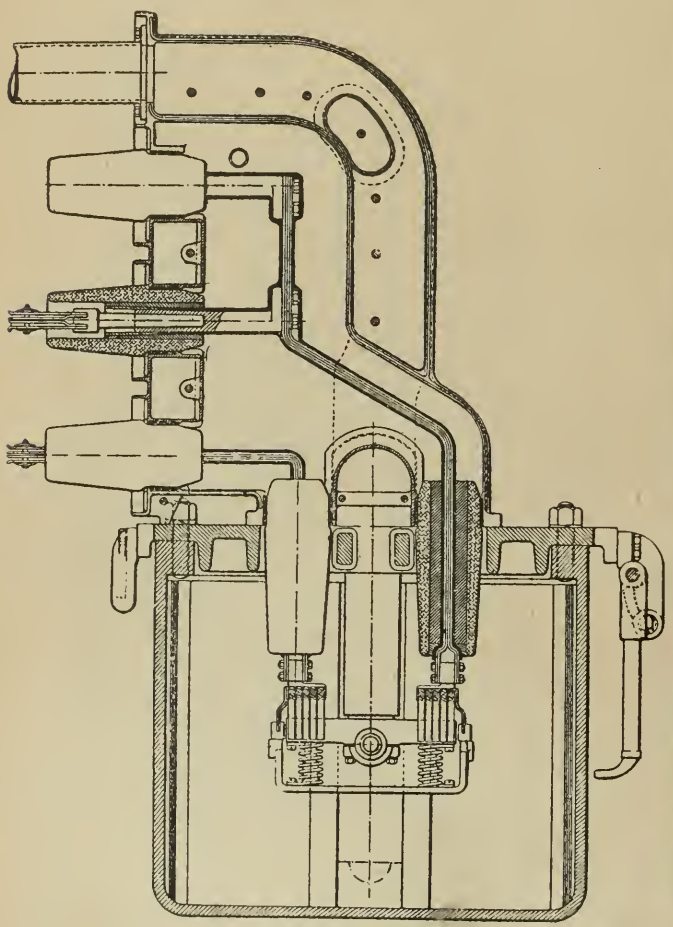


Fig. 2. Details of Oil Switch (1912).

switches, each switch having a rated rupturing capacity of 1 500 000 kVA. These are at the moment the largest switches that have been constructed. Fig. 4 illustrates the control room of these switches with their instruments, telegraphs, and visible indication of the operation of the salient parts of the switch panels. To meet these requirements a special design was prepared and models were made on somewhat different lines to those previously described, but retaining all the salient principles.

An illustration of a typical equipment is shown on Fig. 1 (3) It may be noted that complete assembly of the unit may be made in the shops, so that erection work on site is reduced to an absolute minimum. The photograph 1 (3) was taken as the unit was leaving the works for Carville Power Station, and pending the completion of the switch house it was erected with five other units in a corner of the engine room. It is difficult to imagine how an equivalent equipment in a stone cell structure could be similarly used without incurring enormous expense. It is necessary to make special arrangements with the railway authorities for the transport of complete units owing to their dimensions, but by partially dismantling them ordinary trucks may be used.

General Design and Construction.

Before describing installations of this class of gear, a brief summary of the objects of design and general construction is desirable. The fundamental object in the design has been to attain a high degree of safety from every point of view, and at the same time to render all parts requiring inspection readily accessible. This is obtained by the adoption of the draw-out feature and a complete system of interlocking ; the latter has been applied to the extent of rendering it impossible to obtain access to any live conductor without deliberate mechanical interference. The

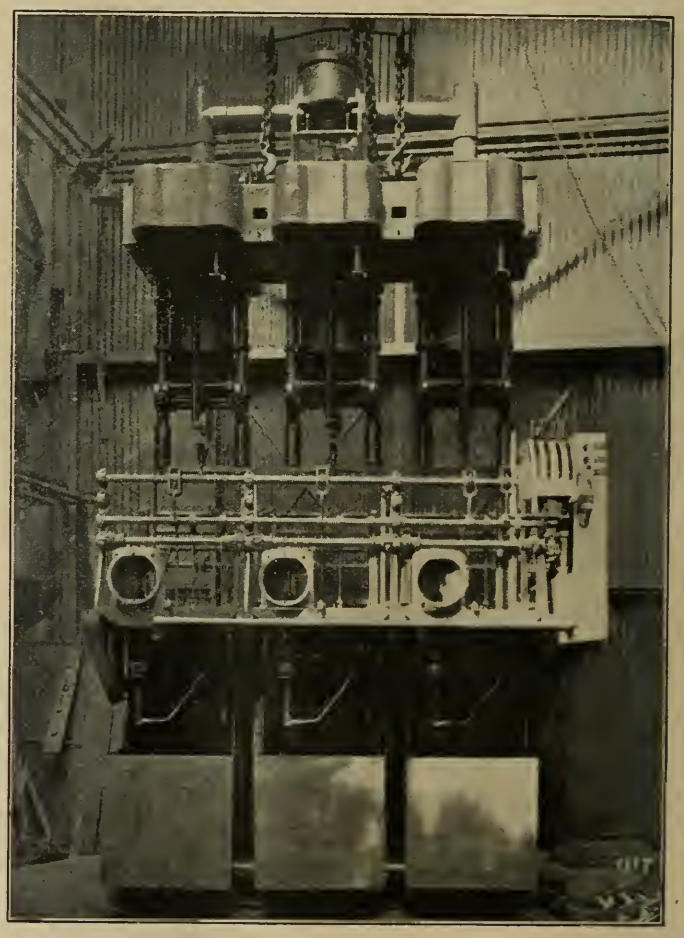


Fig. 3.

interlocks equally assure the correct sequence of operation of the various switches.

The general construction of a panel is shown in Fig. 3, which depicts a compact three-phase unit with separate metallic enclosures for each phase. The central tanks are steel cylinders of great mechanical strength, which contain the main circuit breaking parts. The rectangular tanks on either side contain the incoming isolating switch with instrument transformers and the busbar selector switches respectively.

The bus bars are arranged between two lines of panels, and each bar is insulated with varnished cloth, surrounded by a metallic earthed case, which is then filled with insulating compound.

Arrangements of Sparking Contacts.

A striking characteristic of the oil circuit breaker is the arrangement of the sparking contacts. The arc on breaking circuit is substantially horizontal with a large unobstructed

head of oil above it. A bell-mouthed vent in the top casing immediately above the break leads through large steel pipes fitted with non-return valves on each panel. The sparking contacts are attached to the ends of substantial arms so arranged that a relatively small movement of the main contacts gives a large movement to the sparking contacts in opposite directions, thus the speed of break is extremely high, due to the sum of the velocities of the arms moving in opposite directions. Further, the conductors supporting and forming the sparking contacts are ingeniously arranged to form a complete loop in the path of the current ; the resultant electro-magnetic forces elongate the arc and impel it upwards. (Gregory's Patent No. 111 766 of 1917.)

Means of Inspection.

For convenience in inspection, the removable portion of a panel, comprising the massive top plate carrying the solenoid operating mechanism, one set of isolating switch contacts on either side, and all movable parts of the main

Automatic Earthing Device.

In connection with earthing, a further detail is of interest in that all isolating switch tanks when lowered, automatically operate a lever which earths conductors within. Interlocks prevent the tank being lowered (Coates and Mirrey's Patent No. 122 443 of 1919) unless the enclosed conductors are dead, so that a double safeguard is afforded. The interlocks also provide operation of all parts in correct sequence. Reference to Fig. 3 will give a clear idea of the general construction, though lack of space prohibits a detailed description.

Control Board Construction.

A departure has also been made in the control board construction, as shown in Fig 4. Each panel consists of polished slate slabs mounted on the front of a dust-tight sheet steel cubicle in the form of a complete unit. The upper slates are enamelled white, with a bold diagram of connections in colours, all switches being represented by an

Fig. 4.

circuit breaker, may readily be raised by the crane provided for the purpose.

The separation of the conductors in both the fixed and removable portions (Clothier's Patent No. 110 808 of 1917) is made under oil, and metal screens automatically cover the apertures left in the fixed portion, so that whether the removable portion is in or out, all the live conductors are metal clad. The insulators are always immersed so that in no case is there dependence upon the insulation of the air. The whole framework is of earthed metal, which is securely bolted, so that a short between phases is rendered impossible.

Oil Circuit Breakers.

The oil circuit breakers are remote electrically controlled and the isolating switches are operated by hand from levers mounted on a pedestal accessible from the platform erected along each side of the panels. There is a separate lever for operating an earthing switch on the incoming conductors, to enable either phase of a feeder or generator to be substantially connected to earth. This switch is, of course, interlocked to ensure that the main isolating switches are open before conductors are earthed.

automatic indicator, so that during operation the position of any switch is seen at a glance.

The lay-out of these units is arranged for convenience with the units in four rows with the busbars between the outer rows and with a junction at one end of the building. This makes for compactness and small floor and building space.

The circuit breakers illustrated are the largest which have so far been constructed, and are installed in many of the large power stations in this country, including Dalmarnock (Glasgow), Carville (Wallsend), North Tees (Middlesbrough), Nechells (Birmingham). Their behaviour in these important situations has been very successful, and quite up to the manufacturers' expectations.

All-British Design.

It is gratifying to find that Continental and American practice is entirely superseded by an all-British design, although we gather from the American Press that the lead which has been given will soon be followed across the water. Concurrent with the developments of switchgear has been the steady progress made on discriminating auto-

matic protection devices for alternators, feeders and power transformers, all of which have been very fully discussed in papers read before the Institution of Electrical Engineers, and in the technical press, showing the importance that is attached in this country to the reliability of supply. Such discriminating protective gear has made it possible to link up feeders in parallel, and so utilise the cable capital expenditure to a much greater extent. Modern tendency, however, tends to divide a large city up into separate sections, and the cable lay-out in Glasgow has been designed to allow the city to be divided into four independent sections, so that in the event of any serious trouble on any one section of the plant, from the boiler house onwards, only one-fourth of the supply will be affected.

The Distribution Problem.

Another great problem which calls for switchgear of a very different nature to super station gear is the difficulty engineers are experiencing in adequately handling the large amount of power that is being used in modern buildings in a large city, owing to the very great increase of domestic appliances in the home. This distribution problem varies in various local areas, and it is interesting to note a suggestion by Mr. Woodhouse, in a paper before the Institution of Electrical Engineers, that the distribution voltage for consumers should be 3 300 V. The writer is in agreement with this view, which means that we are in this work returning to the days of the early pioneers, with this essential difference, that switchgear designs, naturally of a much smaller and special class, are in being ready to tackle house to house and building to building demand.

British Engineers Can Meet the Demands.

In conclusion, modern power stations call for the last word in efficiency in the boiler house, in the turbine room and auxiliaries. There is no useful purpose served if the switchgear installed be not of the same high standard as the rest of the plant. Reliability of supply means business from the large power users. British designers have had to face the problem of pouring power into densely populated areas and into cable net works connected, inter-connected and re-connected, so that experience in handling heavy fault currents is unique. The experience in using discriminating protection gear is unique. The switchgear itself, the safety valve of the whole system, is the result of long experience in handling difficult problems. Whether it be for low voltage work or for extra high voltage work British engineers are in a position to meet the demands of the supply industry, either in this country or from our kinsmen beyond the seas.

A Commentary on Power Station Switchgear.

By W. A. COATES.

The cost of buildings has fallen very rapidly during the last few months, so that to-day for a simple building such as is usually required for housing switchgear the price will hardly be more than 20 or 25 per cent. of the maximum figure reached during the war. This being so, the space advantage (with corresponding decreased building costs) enjoyed by ironclad switchgear is largely discounted in the case of new installations, and comparison between conventional cubicle structures and totally-enclosed ironclad equipments must be made more particularly on their technical merits. As a matter of fact, from the space standpoint it is often possible to accommodate gear in conventional cubicles occupying very little more space than an ironclad structure, when the cubicle design is approached with this end specifically in view. Present-day cubicle designs are to a great extent a legacy from days when minimum safe clearances were still indeterminate and plenty of space round all apparatus was considered essential.

Ironclad Switchgear Claims Examined.

Ironclad switchgear claims as its principal advantages: (*a*) Fool-proof features in operation; (*b*) immunity from attacks of vermin; (*c*) reduced maintenance; and (*d*) simplicity in erection. In power station work fully interlocked switchgear is probably not an unmixed blessing, since interlocks necessarily carry with them a certain degree of inflexibility. We have heard, for instance, of a generator having to be shut down to permit a potential transformer fuse to be replaced. In the power station are employed only skilled operators who can operate a conventional cubicle equipment with perfect safety. Where the switchgear is liable to be operated by semi-skilled persons interlocks are undoubtedly very valuable, and it is suggested that this is the principle field for gear of this class. Rugged mechanical interlocks are to be preferred to electrical devices which ultimately generally depend on more or less flimsy auxiliary switches.

Interlocks and Duplicate Bus Bars.

In particular this lack of electrical flexibility is found on those switching systems in which duplicate bus bars are employed. In cubicle arrangements the connection to the two bars is usually made by means of independent single pole selector switches, so that (especially when an oil circuit breaker is used coupling the two sets of bars) it is possible to transfer any circuit from one set of bars to the other without interrupting the supply. Due to the necessity for interlocks it is not possible on any ironclad switch structure to close the selector switches on to both bars simultaneously, and if it is desired to transfer a circuit from one set of bars to the other the current must first of all be interrupted. In a large power system this can sometimes be accomplished without actually interrupting the supply to a sub-station, by sending current round an alternative cable route, but even so the labour and time occupied in making such changes is distinctly greater than would be the case with a cubicle structure. It may be noted that some authorities have deliberately sacrificed this extra flexibility on their cubicle layouts and have used double throw selector switches so as to avoid any chance of the two bars being tied together inadvertently.

Saving Cleaners' Wages.

The next two advantages referred to—*i.e.*, the freedom from attacks of vermin and the smaller amount of cleaning required—are of course self-evident, and are distinct advantages in practically all locations. In some cities the latter point may conceivably enable at least one cleaner's wages to be saved, where much switchgear is installed. Ease of transportation and erection is specially valuable for sub-station applications in rapidly extending areas. As the system increases in capacity the smaller units originally installed can be shifted towards the outlying districts and new units of larger breaking capacity purchased for the close-up sub-stations.

Ironclad Equipments require Higher Insulation.

In designing ironclad equipments a higher factor of safety is desirable on the insulation, not because this class of equipment is more liable to trouble in this direction, but merely because if trouble does occur it is more difficult to get at the conductors to repair the damage. In a conventional cubicle, should an insulator or a protective transformer fail, it is a comparatively simple matter to effect repairs.

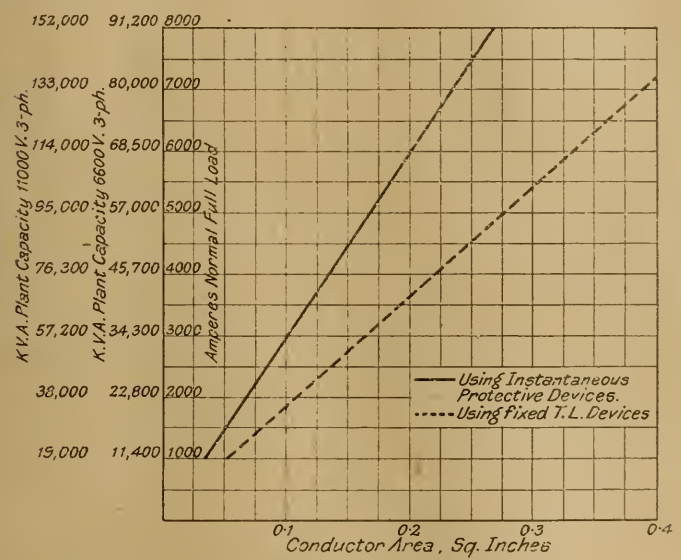
It would seem that at the present moment it is impossible to lay down any definite statement as to which class of gear should be used for a given location. The choice is very largely a matter for decision on the merits of each particular case, bearing in mind the class of operator which will be available.

Limiting Resistances and Potential Transformers.

A point to which considerable attention has been directed recently is the desirability of using limiting resistances in series with potential transformers which are connected off the main bus bars of a large power system. The short circuit current which may flow through the wires connected to a potential transformer should the h.t. terminals of the latter become short-circuited may very easily be sufficient to fuse the connecting wires themselves during the same period as is required to melt the protective fuses. Moreover, the fuses are generally distinctly limited in their breaking capacity. The carbon tetrachloride fuse is probably the best available, and it has shown its ability on very large systems to clear short-circuit currents which were limited only by the resistance of the fuse itself. The limiting resistance should be divided and placed half on each side of the transformer protected, immediately between fuses and bus bars. The actual ohmic value employed depends on the transformer characteristics, but it is usually possible to keep the maximum short circuit current down to 25 or 30 A and still maintain B.E.S.A. limits of accuracy in transformation.

Limitations of Limiting Resistances.

The use of limiting resistances for potential transformers does not safeguard the only point of danger, however, and



Minimum Sizes of Small Conductors on Large Switch Gear.

for very large systems there should be established a minimum cross-section of conductor which should be used to make any direct connection from the main bus bars. In a previous article* the writer showed some curves connecting short-circuit currents with conductor temperature. It is now suggested that on the switchgear of large steam-driven power plants the smallest conductor should not be less than indicated in the curves given herewith. These are based on an assumed alternator reactance of 10 per cent., and the possibility of a circuit breaker being reclosed on a short circuit after it has once tripped. The final conductor temperature would be approximately 500° C. under these conditions.

Series Transformer Design.

The series transformers used on the switchboards in large power stations should invariably be of the bar primary type on account of the risk when heavy short circuits occur of bursting transformers having wound primaries. Further, the copper sections used in small wound primary series transformers will often be much less than the minimum proposed above. Small feeders connected direct off the main switchboard may conceivably have normal full load currents such that a bar primary transformer is by no means correct, but accuracy in such a case should be put second to safety in operation.

* "Small Conductors on Bus Bars of Large Systems"—*Metropolitan-Vickers Gazette*, June, 1920.

Control Room Considerations.

There is a growing tendency towards using separate control rooms in connection with large stations. Although this is done it is still necessary to consider seriously what steps shall be taken to facilitate the work of the switchboard operator. The dummy diagram system which is so popular in America has not been used in this country to any very great extent. It is undoubtedly a great advantage where the switching system is at all complicated or where possible alternative paths of supply exist. It should not be used, however, except in those cases where the isolating switches are of the three-pole type, arranged so that when they are operated a corresponding indication is automatically given on the dummy diagram, either by means of a pilot light or an electro-magnetic indicator. The small hand-operated links sometimes put into dummy diagrams to represent isolating switches are a questionable advantage, since a man may easily forget to move them at the right time.

To bring the size of the control switchboard down to more reasonable proportions it can frequently be arranged that the controlling elements—*i.e.*, the indicating instruments, rheostat handwheels, oil circuit breaker control push-buttons and synchronising devices, are mounted on one board, while on a second board, frequently standing at the rear of the control board, are mounted all relays and integrating instruments. The equipment on this secondary board does not have to be adjusted or read save at infrequent intervals, so that there is no objection to it being located in a somewhat inaccessible position.

The Ideal Control Board.

While we are not within reach of it yet, it is suggested that the ideal will only be attained when we can get a desk control board, which is about the size of an ordinary writing-desk. In this case the indicating instruments would be similar to those which are used on the battery circuit of a motor-car. These could conveniently be located on the vertical part of the desk, leaving the horizontal surface for a series of small push buttons operating the various oil switches, and worked into the run of a miniature bus bar system in which pea lamps serve as pilot lights.

Dash board instruments, about 3 in. diameter, and of either moving iron or d'Arsonval pattern are already on the market. Extreme accuracy is unnecessary at the central control point, although in point of fact these little instruments can be built to the accuracy requirements of the B.E.S.A. First Grade. Development would be required for A.C. wattmeters, and power factor meters. A large synchroscope will probably always be desirable, so that the operator can see his position at a glance.

Hammersmith Mains Extensions.

Hammersmith Electricity Committee propose to spend £15,127 on the extension of mains. In March, 1920, the Council approved of the extension of the main distribution system to meet increased demands in the King Street and Starch Green districts and a cable which is now feeding the northern area of the borough, was laid from the generating station to Wood Lane, at a cost of £21,603. But as there is no stand-by cable, it is necessary to draw in a second main to form a ring, the estimated cost of which is £3,008. The load in the Hammersmith Road district has considerably increased and additional demands have to be met which are created by the supply required of the Post Office Savings Bank in Blythe Road and also additional requirements of the "Olympia" premises, having regard to their extension. The existing h.t. feeders are not capable of dealing with this additional supply, and the Electricity Committee concur in the recommendation of the Engineer that the Council should proceed with the arrangements for an e.h.t. supply to the "Olympia," where a sub-station could be equipped from which the existing h.t. system could be fed. The suggestion is to divert the proposed new feeder to Wood Lane *via* "Olympia," thus forming a ring main from the electricity works to Wood Lane, from there to "Olympia," and from "Olympia" to the works. A scheme for the extension of the l.t. distribution system is also to be carried out at an estimated cost of £1 994 10s.

The Development of Condensing Plant and Auxiliaries.

By J. H. SHAW, M.I.E.E.

To meet the requirements of large turbo-units demanding low absolute pressures and high rates of duty it has not been necessary to develop new types of condensing plant, or make radical changes, neither has it been necessary to depart materially from the design used for reciprocating engines.

There was ready for use the very excellent Edwards air pump. This is highly efficient as an air extractor for vacua up to 28 in. But the limitations of this pump are reached because it is impossible to keep the valves tight at extremely low pressures, while the clearance on the top of the bucket lowers the volumetric efficiency. The large bulk required for the bigger sets is also a disadvantage.

The Vacuum Augmentor.

Then Sir Charles Parsons introduced the vacuum augmentor which consists of a steam jet and an auxiliary condenser between the main condenser and the air pump. This augmentor increased the air-withdrawing capacity of the combination at low absolute pressures, thus decreasing the required displacement capacity of the air pump. The disadvantage of the vacuum augmentor is, that whereas the air pump takes almost the same amount of power to drive as without the augmentor, the augmentor itself takes about 1 per cent. of the steam consumption of the turbine.

Dry Air Pumps.

The advantages of withdrawing the air and water separately from the condenser, the water from the hottest part and the air from the coldest being recognised, different forms of dry air pumps were evolved. Among these whirling jets, plugs of water and water ejectors were developed for the purpose of withdrawing the air and included the Le Blanc pump, the Rees-Roturbo air pump, and the Muller-Jose ejector. All these are, however, being rapidly replaced by the almost universal steam jets.

Steam Jets Now Universal.

The best known of these latter class are the Le Blanc ejector and the Hick-Breguet ejectair. The first named was developed as a tandem ejector, the steam used by the first jet being compressed by the second jet. The result was that the steam consumption was high and the vacua varied, in the case of one with which the writer was acquainted, more or less with the steam pressure.

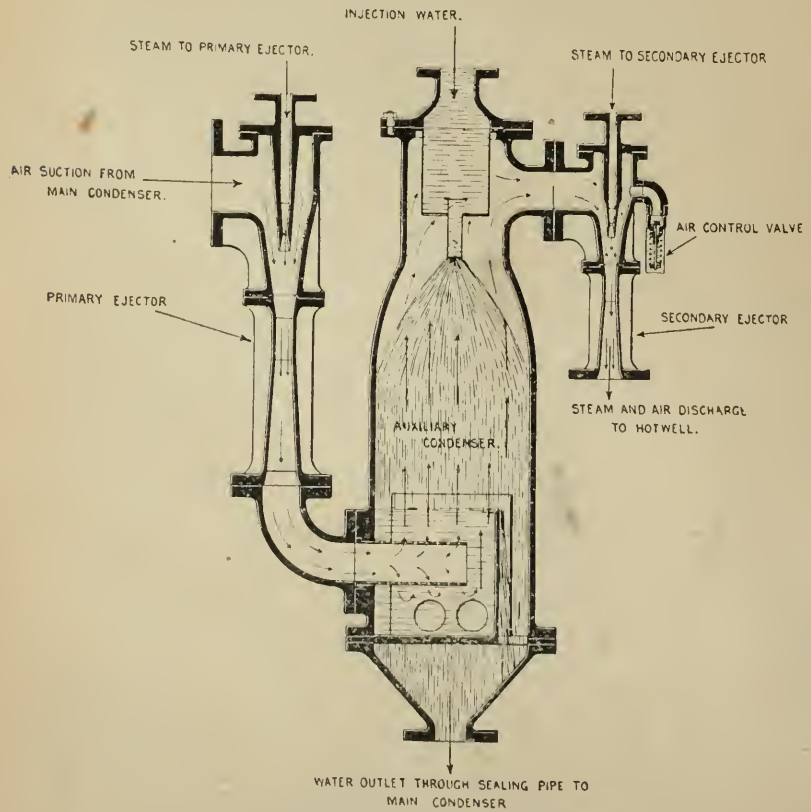


FIG. 1.—DIAGRAM OF THE HICK-BREGUET EJECTAIR.

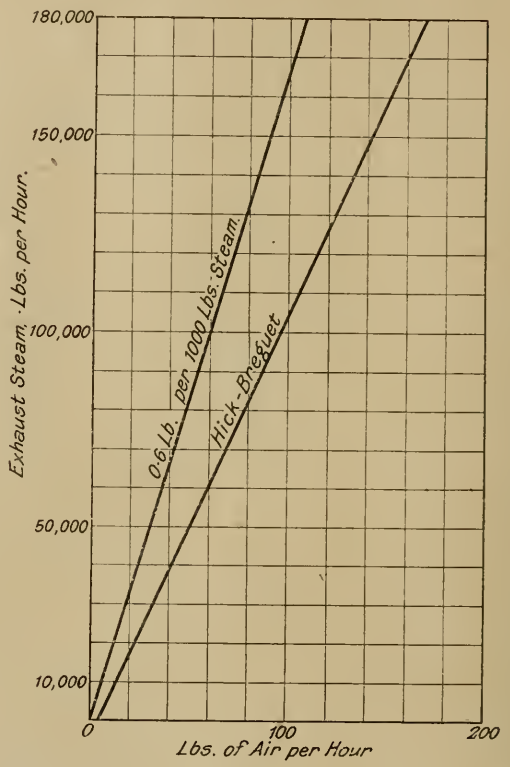


FIG. 2.—AIR CAPACITY OF EJECTORS FOR SURFACE CONDENSERS.

The compound Le Blanc and the Hick-Breguet ejectors are similar in appearance and design. In the first named there are numerous jets in each stage, whereas in the Hick-Breguet one steam jet is used in each stage. A cross section of a Hick-Breguet ejectair is shown in Fig. 1.

In this case an intermediate condenser is used to condense the steam used by the first or primary jet, the water for condensation being obtained from the discharge of the extraction pump, and the water and condensed steam being drained from the intermediate condenser by means of a U leg into the suction of the extraction pump.

The quantity of air to be withdrawn by an air pump attached to a steam turbine condenser depends on the type of low pressure gland used on the turbine and the layout of the condenser. It can be calculated by assuming 0·6 lb. of air at 60° F. per 1 000 lb. of steam. This formula and the Hick-Breguet formula are given graphically in Fig. 2.

Efficiency Comparisons.

There is little difference in the efficiency attained by the modern steam jet extractors, ejector or ejectairs, and for approximate calculations it can be assumed that with vacua between 28 and 29 lb. a steam jet extractor fitted with an intermediate condenser will extract 1 lb. of dry air at 60° F. for every 10 lb. of steam used and that the total consumption of the ejectair will amount to approximately 1 per cent. of the steam consumption of the turbine. One per cent. of the steam may appear to be high, but because all the heat units in the steam except those used for compression can, by the means of a feed heater, be absorbed

by the condensate the consumption of heat units is almost negligible. Roughly, 80 per cent. of the heat originally in the steam is taken up by the condensate, this 80 per cent. representing 1 000 B.T.U.'s per lb. of steam, and the ejectairs requiring approximately 1 per cent. for their operations means that the condensate temperature is increased by 10° F.

The arrangement generally adopted is illustrated in Fig. 3, which shows the U leg draining the intermediate condenser and the provision of a small heater to condense the discharge from the secondary ejector.

A later design of ejector is the De Las.* This requires the combining tubes to be water cooled, and water at a lower temperature than that possessed by the condensate is necessary for this cooling.

Extraction Pumps.

The water extraction pumps usually employed call for little comment. They are generally efficiently designed with large and well-arranged entrances pumping a comparatively small volume against a high head. Care should be taken that such pumps are installed so as to have a good head of water on the suction side. With such a low pressure in the condenser as 0·5 lb. absolute it is obvious that the water must flow to the pump by gravity. Usually 24 in. between the bottom of the condenser and the centre line of the pump is sufficient, but more should be allowed especially if there are any bends in the suction pipe.

Even if a reasonable head is allowed the discharge from all rotating extraction pumps is more or less variable or pulsating, as can easily be seen on any plant employing a Venturi water meter. It is recommended that where these meters are used an extra 12 in. is left between the condenser bottom and the extraction pump.

Little Development in Condenser Design.

The condenser proper has changed very little during the last twenty years. The size has, of course, kept pace with the demand for larger sizes of plant, and the diameter as a function of the length has increased until it is seldom less than half the tube length.

It is surprising that this quality of condenser design is not more universally recognised; even to-day condensers are installed in which the length is 2·5 to 3 times the diameter. A little thought would convince the technical buyer that with a long but small diameter condenser the ends of the tubes are performing very little duty, it being impossible for the steam to travel down the exhaust pipe at a velocity of 27 000 ft. per min. and abruptly turn through 90 degrees to seek out the ends of the tubes.

In order that the steam shall have access to the heart of the condenser and to reduce the pneumatic drop across the bank of tubes it is usual to arrange the centre of gravity of the tube mass eccentric to the centre of gravity of the bore of the condenser. This is clearly shown in Fig. 6

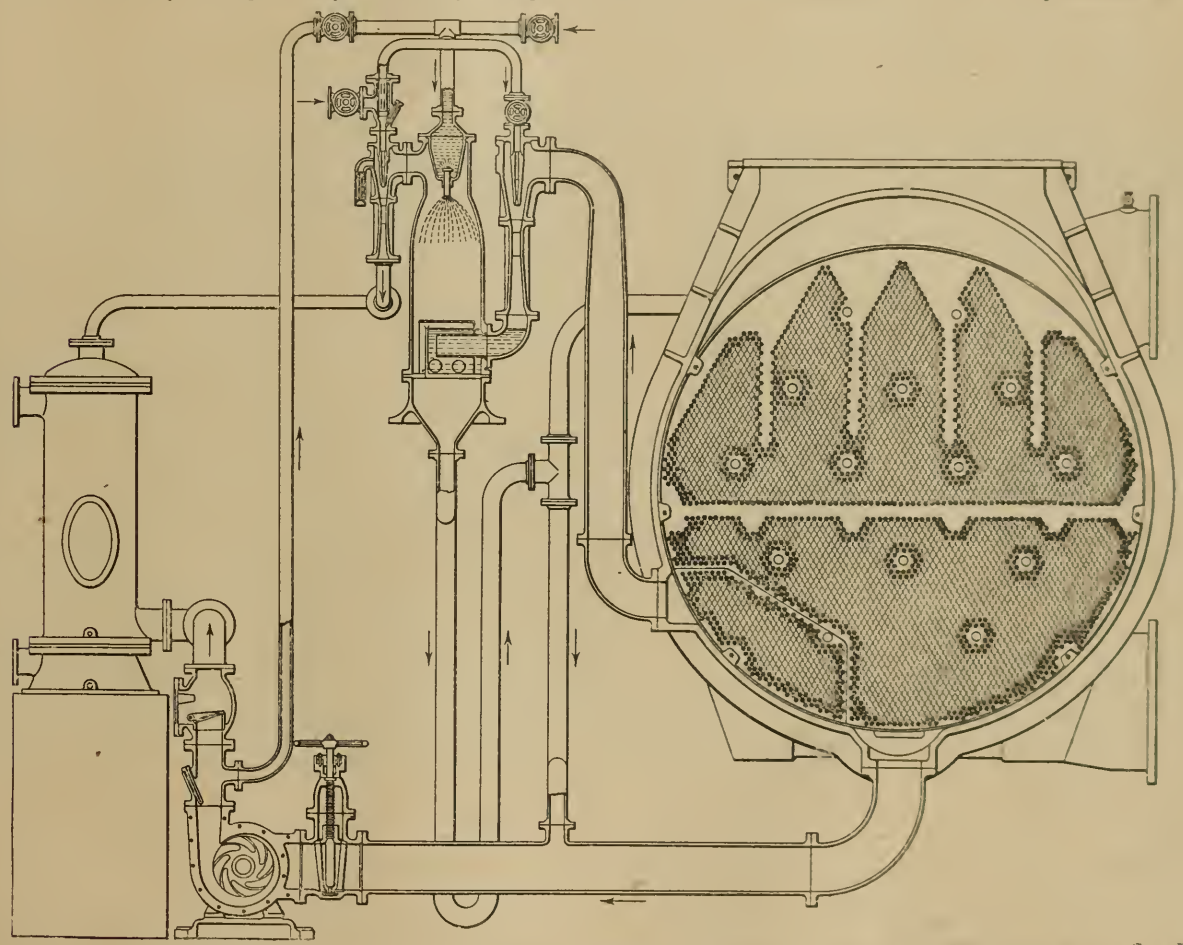


Fig. 3.—Sectional Arrangement of Typical Hick-Breguet Surface Condensing Plant, (Hick Hargreaves and Co Bolton)

This figure also illustrates Hick Hargreaves' latest design of tube plate. In the top half of the tube plate the ordinary pitch of the tubes is turned horizontal and makes a series of narrow lanes direct to the heart of the condenser.

The rating of condensers is, of course, being gradually increased, but perhaps not to the extent that the rating of other plant has advanced.

No Fixed Rules of Design.

In spite of the large amount that has been written upon condenser design, there are no fixed rules regarding the best shape, transmission rates, sizes of tubes, etc., and each manufacturing firm has its own data as to limiting rates of transmission, water velocity, etc. As an approximate guide to the comparative values of transmission rates, Hausbrand gives $K = 453^3\sqrt{v}\,v$ in English units, K = B.T.U.'s transmitted per square ft. per deg. Fah. mean temperature difference, and v = velocity in ft. per second of water in the tubes. This is high for British practice

* See The Electrician, June 16th, 1922, p. 718.

and very few condensers are to be found that are designed for such high rates of transmission. It is common practice to design for K equal to between 600 and 700 with v equal to between 6 and 7 ft. per sec. With some waters, for instance, those containing silt and fine mud, it might be advisable to increase the water velocity up to 10 and 11 ft. per sec., in order to prevent any settlement in the tubes. The transmission rate is again modified by the speed of the water particles and the condensed steam across the tubes, but no data that is readily applicable exists on this subject.

Condenser Costs.

A large condenser with the correct ratio between diameter and length will contain a larger number of tubes, and cost considerably more to build than one of small diameter, but containing the same surface.

A condenser for a 15 000 kW with 27 500 sq. ft. cooling surface and 16 ft. between tube plates will contain 8 770 tubes, whilst a condenser for 20 000 kW with 40 000 sq. ft. will contain 12 000 tubes. It is impossible during a week-end to clean such a condenser, and therefore the continuous service or twin box condenser has been evolved. The water box and return end are divided vertically, two circulating water inlets and outlets being provided. In this case one half the condenser can be shut off on the water side, only the steam space being common, and with the turbine running at about half load full vacuum can be maintained in the steam space whilst the doors can be removed from one half and the tubes cleaned.

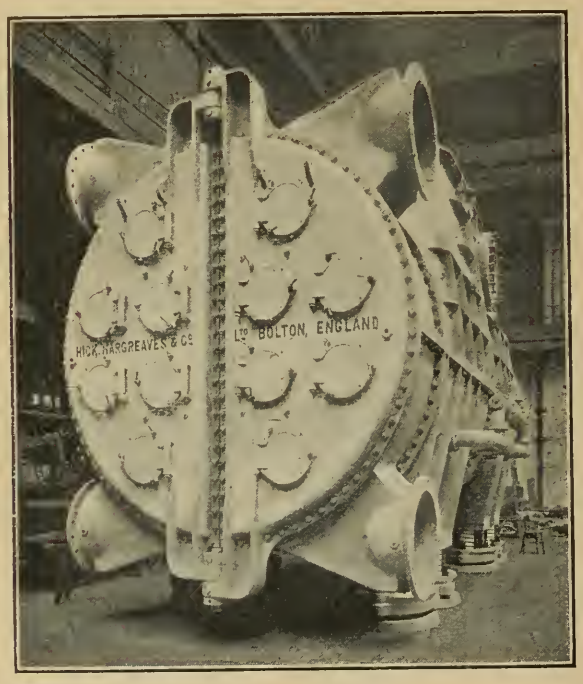


Fig. 4.—Hick Hargreaves Condenser with Patent Hinge.

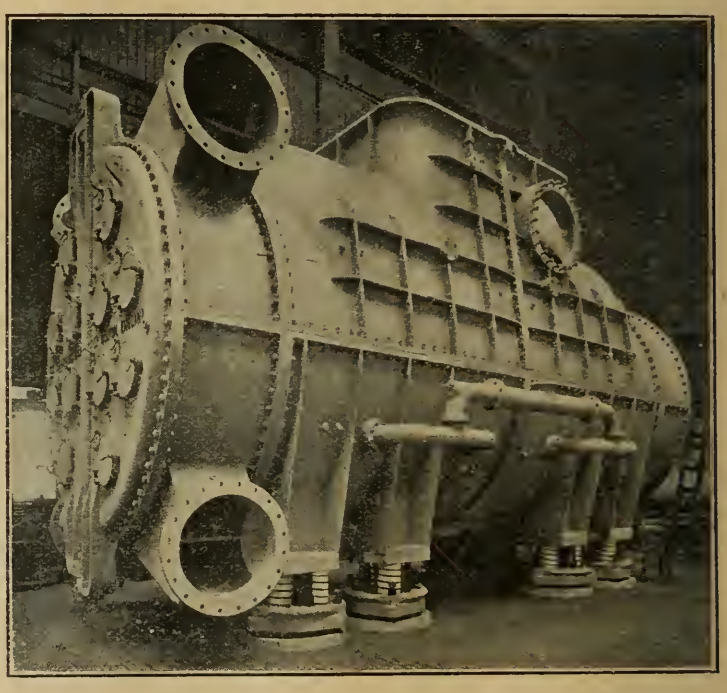


Fig. 5.—Hick Hargreaves Continuous Service Condenser for Shanghai.

Continuous Service Condenser.

A continuous service condenser, built for the Shanghai Municipal Council to condense the steam from a 20 000 kW set is shown in Figs. 4 and 5. The door is formed in two parts, the division being made on the vertical centre line. To enable the joints and the end box to be satisfactorily made it is necessary to provide for relative movement between the door and the end box, because if the doors were hinged on a fixed pin it would be impossible without considerable straining to satisfactorily make this joint.

The condenser shown in Fig. 4 is fitted with Hick Hargreaves and Co.'s patent hinge, which by means of eccentric bushes allows the doors to be moved bodily away from or towards the joint.

A detail of design which is now being appreciated is the sagging of condenser tubes due to insufficient support plates. A $\frac{3}{4}$ in. outside diameter condenser tube, gauge No. 18 thick, and 14 ft. 8 in. long, supported at both ends, will sag $3\frac{17}{32}$ in. when empty. The same tube supported at each end with two intermediate supports will sag $\frac{1}{16}$ in. when full of water, and $\frac{3}{64}$ in. when empty. If the tube, 14 ft. 8 in. long, has only one support plate in addition to the tube plates, the sag is $\frac{5}{32}$ in. when empty, and $\frac{3}{64}$ in. when full of water. It being inadvisable for water to be left standing in the tubes after a condenser is presumably drained, sufficient support plates should be fitted, so that the greatest span does not exceed 5 ft.

The Effect of High Steam Pressures.

The use of high steam pressures has increased interest in the necessity of preventing feed water from being contaminated by air, and the advisability of freeing all make up water of air or other gases. In many stations closed feed systems are being installed, and in others de-gassing plants.

A considerable number of power station designers are intending to or are actually bleeding the main turbine, at one or more stages, into feed heaters. Through these heaters the condensate is pumped and into the hotwells or feed pumps. The condensed steam is drained either into the condenser or the suction of the extraction pump. It is claimed that the reduction in overall heat consumption is a maximum when the feed is heated to 180° F. if only one feed heater per turbine is employed and that the reduction in consumption is approximately 4 per cent. If, however, multi-stage heaters are employed the reduction in heat consumption can be shown to be approximately 7 per cent. if the feed water is heated to approximately 300° F. If it is desirable to heat the feed water before it reaches the economizers, or if economizers are not to be installed the problem should be studied in connection with the driving of the auxiliary machinery.

House Turbine Condensers.

In order to obtain reliability it is necessary that a certain proportion of the auxiliary plant be steam driven. Small auxiliary turbines are, however, most uneconomical and troublesome. It therefore appears desirable that a house turbine be installed to supply power to the essential auxiliaries, such as circulating pumps, stoker drives, forced and induced draught fans, etc.

Such a turbine would have an output of from 3·5 per cent.

to 5 per cent. of the output of the main sets, and if direct current is required a geared set could be employed; if both d.c. and a.c. are necessary the generators can be arranged in tandem. The circulating water for this condenser would be the condensate from the main sets.

As the steam turbine would be of reasonable size and arranged to run at an economical speed the efficiency would only be about 10 per cent. less than the efficiency of the large sets, and providing all the heat rejected from the condenser can be absorbed by the feed water, the proposed arrangement is thermally perfect.

The objection to this system is that whilst the circulating water or condensate from the main sets is proportional to the load on the bus bars, the load on the house machine will be roughly proportional to the number of sets running. From this it will be gathered that during short periods of light load, when the time is too short to shut a large set down, the temperature in the house set condenser will rise, with a corresponding fall in vacuum. To overcome this difficulty

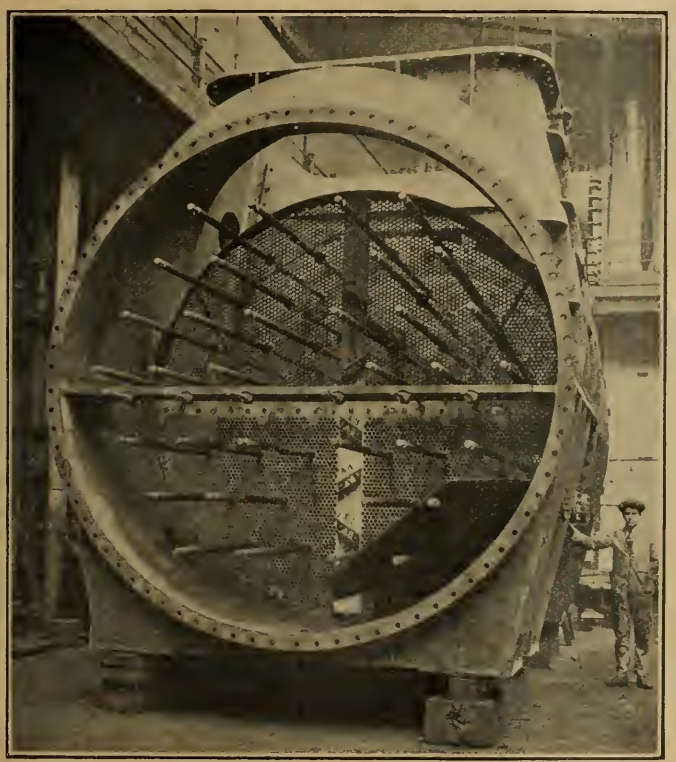


FIG. 6.—HICK HARGREAVES CONDENSER.

Hick Hargreaves and Co., have recently designed and patented a condenser which does away with this drawback.

House Turbine Economies.

In the Hick Hargreaves house turbine condenser, in addition to the connections and tubes for admitting and passing the condensate from the main machines, a small number of additional tubes are provided, and connections arranged on the water boxes for admitting an amount of circulating water at periods of light loads. The quantity of circulating water required to maintain the absolute pressure in the steam space of the house turbine condenser at a reasonable figure is quite small, and as the main machines are on partial loads when this condition prevails the circulating water can be drawn from the system without affecting the efficiency of the main sets. The waste of heat units will be negligible and the valve admitting the circulating water to the house turbine condenser can be controlled by a thermostat or by an electrically operated valve, worked from a control room or switchboard, or any other convenient method.

The steam space in the house turbine condenser would be one chamber, but the water spaces reserved for the condensate from the main machines and the water spaces for the circulating water would be kept quite apart.

The vacuum would be a function of the two water quantities and their temperatures.

In the event of a cessation of supply from the main sets the amount of cold circulating water could be immediately increased, thus enabling the auxiliary power to be maintained and immediate resumption of normal operation.

The present method of operating a house turbine when using condensate as circulating water is to run the auxiliary bus bars in parallel with the main bus bars, and at times of light load to transfer some of the load to the main machines. This is a dangerous method, as in the event of a shut down of the main sets the continuance of the auxiliary supply depends on the correct operation of a reverse power relay.

The Rutenberg Concession.

A discussion took place in the House of Lords on the 21st inst on the form of the PALESTINE MANDATE and the concession granted to Mr. P. Rutenberg for the development of water power.

The subject was introduced by Lord Islington who moved:—"That the mandate for Palestine in its present form is inacceptable to this House, because it directly violates the pledges made by his Majesty's Government to the people of Palestine, and is, as at present framed, opposed to the sentiments and wishes of the great majority of the people of Palestine; that, therefore, its acceptance by the Council of the League of Nations should be postponed until such modifications have therein been effected as will comply with the pledges given by H.M. Government." He complained that the Rutenberg concession, if allowed to materialise, would give to a Jewish community over an Arab community wide powers in respect of economic and industrial conditions for a number of years—powers in respect of water and electric power. It was quite obvious that the grant of that concession was not based on its merits, but on the deliberate policy of economic preference to the Zionists. They were jeopardizing the good feeling which had always existed between this country and the Arab community by adopting a policy, which he described as an unnatural, partial, and altruistic experiment.

In reply, EARL BALFOUR declined to go into the details of the Rutenberg controversy, as it would be debated in the House of Commons. The whole scheme was examined in the most critical spirit by the experts of the Colonial Office and they were quite unanimous that the terms and the character of the undertaking were such that there was no hope of any better contract being made than that which was offered by Mr. Rutenberg. The terms had been examined by persons who were not only disinterested, but also extremely competent. In the Rutenberg scheme there was nothing in the nature of undue favouritism, and if it could be carried into effect it would give economic advantages to Palestine which could be obtained in no other manner.

The terms of the concession were severely criticised by LORDS SYDENHAM and BUCKMASTER. The former said some of the terms of the contract were distinctly improper, and the latter complained that a special privilege had been granted to one person to go, as far as he could see, and exploit America and other countries for raising capital necessary to carry out an important engineering scheme. He did not doubt that that would be of the greatest value, and he had the greatest confidence that under Sir Herbert Samuel the monopoly would be fairly exercised. But that was not the point. Why was the offer not made publicly? It might be a good scheme, but in all these matters he was strongly in favour of public and open competition. He would have liked to see if there were not other people who would have given the necessary guarantees and might also have had the opportunity of interesting their capitalistic friends in embarking on this venture.

A Rival Scheme.

In connection with the criticism of the Rutenberg concession, a "Times" correspondent states that in the early summer of 1920 Suleiman Dabbub and other Bethlehem Arabs applied for a concession for (*inter alia*) electric light and power for Jerusalem and district. The application, which was put forward by the then Deputy Military Governor of Bethlehem, stated that they were already in possession of a capital of £500 000 and that they would have no difficulty in raising two million sterling or more if necessary. In reply to Suleiman Dabbub's application, Headquarters of the Administration replied that no concessions were being granted at the moment, but that the application would be considered later. Nothing further has been heard of it.

It is announced from New York that Mr. Rutenberg has been successful in raising the required capital from members of the Palestine Development Council and others.

According to the latest official survey there are sufficient waterfalls of 1 000 H.P. and over in the Island of Java to develop 303 000 H.P.; but in Sumatra about 1 200 000 H.P. is available, 500 000 in Celebes, and 375 000 H.P. in BORNEO, or a total of about 2 378 000 in the DUTCH EAST INDIES. At present only 49 000 H.P. has been developed, of which 47 000 is in Java, but two large nitrate plants, one of 200 000 H.P. in Sumatra and one of 50 000 H.P. in Java, are projected. The islands are rich in minerals, and with the expansion of the rice, sugar, tea and rubber industries the demand for electrical machinery and apparatus is likely to be a growing one.

INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

A Successful Gathering in the Midlands—Ideas on the Domestic Load—Finance and Substations.

Monday, June 19.

The opening of a MUNICIPAL ELECTRICAL ASSOCIATION CONVENTION is always rather like the first day of school. It is a time when old friendships are renewed and when a certain amount of justifiable curiosity is shown in the personalities and antecedents of the newcomers. These, in the case of the I.M.E.A. Convention, are mainly aldermen and councillors, for once a municipal electrical engineer always a municipal electrical engineer, except in the few cases where he returns, as have Mr. C. H. Wordingham and Mr. J. E. Edgcombe on this occasion, in the honourable position of honorary member, or receives promotion from an assistantship like Mr. R. B. Mitchell or Mr. Nicholls, of York. The councillor "new boys" this time contain a large sprinkling of the Labour element. This is all to the good. If these gentlemen attend the meetings, both formal and informal, as learners, which they seem inclined to do, they will gain a closer knowledge of what electricity supply means and what electricity supply can do to further in a legitimate way the ideals upon which they build much of their policy. It is pleasant to note that their opinions as expressed in convention have been almost universally sane and temperate, and their influence on municipal electrical development should therefore be all to the good.

Wolverhampton, as a town, has many pleasing features, but one of them is not a sufficiently large hotel accommodation to deal with the load that the I.M.E.A. affords. While, therefore, the Council, the Press, and a number of the more distinguished guests are living in the town, of the rest the majority are mainly staying in Birmingham and others are scattered around in Dudley, Stafford, Coventry and Nuneaton. This is a real disadvantage, in spite of the fact that opportunity will be given during the convention for much of that social intermixture and many of those informal meetings which make for the success of these gatherings. The time has, however, come when precedent must be broken and the conventions be held only in towns which can easily accommodate those attending, preferably under one roof.

Tuesday, June 20.

The meeting to-day was held in Wolverhampton. Those staying in that town were therefore able to make a leisurely breakfast before it was time to go to the Grand Theatre. Shortly before 10 o'clock, however, when the Birmingham contingent arrived by chars-a-bancs, there was a large crowd in the foyer, and by the time the MAYOR OF WOLVERHAMPTON (Councillor James Thompson, J.P.) rose to give the convention his official blessing the dress circle was well filled and the front rows of the stalls were occupied, if not crowded. It is becoming customary for the convention meetings to be held in theatres with the council grouped artistically on the stage in front of a drop scene, and it would be interesting to trace the connection, if any, between theatricalism and municipal electricity. The arrangement has the disadvantage, however, that the audience is scattered and that speakers in the discussion, to be heard, must ascend to the stage by devious ways, thus causing some delay and heightening the discomforts of those who incline to nervousness.

A Municipal Welcome.

The MAYOR, in welcoming the Association to Wolverhampton, tuned his remarks to history and archæology rather than to electricity, beginning with the Danes and ending with Prince Albert, via Charles II. and other celebrated and less celebrated persons. Amongst the industries which had in recent years come to the district he mentioned the motor trade and (with natural modesty) boiler making. Wolverhampton, though perhaps not beautiful in itself, was blessed in its surroundings, and it was possible to stay for a fortnight in the town and visit a fresh beauty spot every day. Turning to other matters, he paid a tribute to the foresight and energy of Mr. Allen, and said that if he made as good a president as he did a borough electrical engineer the Association were lucky. (A sentiment which the meeting cordially endorsed.) The electrical industry was the most wonderful and at the moment the most prosperous industry in the country, and without associations like the I.M.E.A. the improvements that must be made in it could not be effected.

The PRESIDENT (Mr. S. T. Allen, Wolverhampton) briefly replied, and then proceeded to deliver his Presidential Address which we give in abstract below.

Mr. S. T. Allen's Presidential Address.

The unfortunate economic position which has arisen as an aftermath of the Great War is by far the most important factor affecting not only the prosperity of the electricity supply industry, but almost all of our national industries. The whole country is struggling against long odds, on the one hand, to adjust itself to the conditions prevailing at the present time, and, on the other hand, to bring about such changes in those conditions as will make for the stabilising of industry, full employment of all classes on productive operations, and a reduction of the financial burdens under which we have been suffering.

Need for an Adjustment of Outlook.

In connection with the supply industry it has been necessary to adjust our outlook, tariffs and operations to the condition of things existing at the moment. It is, however, dangerous and wrong for us to continue to remain satisfied with doing this, hoping that conditions will improve without effort on our part. Each section of industry by its action or inaction affects the destinies of other sections. The electricity supply industry is indissociably wrapped up with other great industries, such as, for example, the manufacturing undertakings dealing with plant and apparatus. They in their turn affect the operations, prosperity or otherwise of innumerable other engineering and allied industries. It is towards the development and progress of the electricity supply industry our special attention must be given at the present time, in order that we do our share in creating that impetus which will hasten the increase of production and sales of commodities manufactured, thus reducing the unemployment and the many doles which must now be made to maintain the country in its unfortunate position.

To bring this about we must first of all fully realise that all those engaged in trade and industry in this country have important common interests, that the success of the electricity supply industry is dependent upon the success of other trades and industries, and without those other industries being kept in a healthy condition the electricity supply industry cannot succeed. To help to promote the common interests, therefore, is to assist our individual interests.

Electricity Supply a Social Organism.

It must be remembered that the electricity supply industry is a part of the social organism. Directly we realise that electricity supply is a national service, we also realise the opportunity of establishing between contending parties within the industry that confidence the absence of which may have been the cause of troubles and delays in the past. The individual interests are only a part of wider interests, the promotion of which should benefit the individual. It is for the I.M.E.A., therefore, to progress with the right driving force behind it, to endeavour to see to it that all industrial concerns are fully educated to the methods, by the adoption of electricity, of cheapening and improving industrial operations in their many phases.

Electrical Co-operation.

The day has gone by when anyone can argue that each municipality in its various operations can quite well act on its own behalf, without regard to or the necessity of co-operating with other local authorities through associations like the I.M.E.A. Just as co-operative associations are necessary and in operation in connection with the supply companies, commercial, technical, employer and employee bodies, so is the I.M.E.A. a necessary body continually to look after and safeguard the interests of local authority undertakings. Joint action does often bring about what individual action fails to, and the results of joint counsels are far more fruitful of success than heterogeneous collections of views made by individuals without regard to the views of others. On account of its very association the I.M.E.A. is asked and expects to be represented on joint committees with other bodies, and in this direction alone is doing very good work which could not otherwise be accomplished.

The Importance of the Personal Element.

It must be remembered that the Association cannot function at all until after efforts have been made by the representatives of which it is composed. Individual authorities, committees and managers of undertakings have, therefore, their peculiar responsibilities at this critical period. One of the most important factors which has special bearing upon successful operation is the personal element. This factor covers the correct attributes of members of committees and responsible officers, a full sense of responsibility, justice, fairness and truth, a keen intention of framing sound policies which will bear sound and fair criticism, an enthusiastic endeavour to bring about the best results even at personal inconvenience, and perhaps at times in the face of small-minded destructive criticism.

No Need for Pessimism.

There is still a tendency for committees to be dissuaded from a sound progressive policy, under the mistaken idea that expenditure for whatever purpose should, at the present time, be curtailed. This is often due to the fact that little distinction is made between the operations of the non-trading and rate-financed sections of a municipality and the electricity department, which as a trading concern, should be conducted on commercial lines. It is also asserted at times that the difficulty of finding the necessary money is a reason for withholding expenditure on such developments which would in normal times be agreed upon. Money can be obtained by municipalities more easily for electricity supply development than by any other bodies. The electricity undertaking of a local authority, when it has been developed on sound business lines, is one of the best assets which that authority possesses.

Having regard to enormous potential loads in towns and in their neighbourhoods, the great advancement which is being made in the application of electricity for industrial, business and private purposes, and the growing demands which are being made for supplies, no municipality having rights to supply electricity should hesitate to develop its undertaking on broad lines. As nowadays, more so than in the past, every town in itself may be considered a large commercial undertaking, competing with other towns, those municipalities who neglect to realise the importance of electricity supply development on the right lines will suffer in the great competition which is ahead of us.

Development Must Precede Demand.

It is of little use for municipalities to say that they will develop their undertakings after demands have arisen. They must create the demands by seeing to it that they have ample electricity supplies ready and available in anticipation of requirements. Successful development does not come by itself, but only follows continued and increasing effort and outlay of money. Expenditure on administration, organisation and publicity must necessarily increase with increased turnover. It is quite useless to expect an undertaking which has reached successfully a certain stage in development to go on increasing its revenues without increasing the amount spent upon administration, publicity, etc. The guide should be mainly the return made per pound of money spent per annum.

Money Necessary for Development.

If close inquiry were made as to why some undertakings have remained almost stationary as far as, for instance, the development of domestic load is concerned, while others have gone ahead so successfully, it would be found due to the hesitation of those particular authorities to expend sufficient to develop the necessary business and the failure to realise that it is as necessary to apply the usual business principles to an electricity supply concern as it is in any other progressive business concern.

During the last twelve months, owing to strikes and industrial troubles, and to the international economic position, many undertakings have suffered considerably from the reduction of output which has naturally resulted in an increase in the cost of production per unit in respect of the capital and other standing charges. These reductions, we hope, will be of a temporary character.

The gaps made in the output curves due to these causes may well be more than made up when normal trade conditions are resumed and after the encouragement of the more extended uses of electricity in the many directions which the public are daily more and more realising make for more efficient operations, the saving of labour and money, and the adding to the comforts and health of the community. Increased output in almost every case means cheaper production costs, and also in itself means more electrical plant and apparatus being sold and thus cheaper apparatus. Cheaper supplies lead to yet greater increased demands and more installations being wired and equipped. Thus the cycle of effects of increased output of electricity is very far-reaching, and tends to increase the prosperity, health and good condition of our towns and improve the industrial condition throughout the country.

What the Use of Electricity Means.

It has been clearly shown also that increased use of electricity proves a great national blessing, in that it means conservation of our coal supplies either for our own future use or for our export trade. The country has, during the last few years, been critically examining the existing methods of generation of electricity, and has found that great improvements can be made in many directions. It has recognised that individual generation of electricity was natural enough, and the only practical procedure, as long as its use was comparatively small, but that as electricity is now a commodity of such everyday use and with such a large and general growing demand, to adhere to the original practice would in many cases bespeak obsolescence.

It has realised the great necessity of generation on a much larger scale, and to provide for greater areas, and, on that account, the necessity of joint action of various supply authorities in the different districts in connection with generation and main transmission, and has shown its decisions in legislation towards those ends. So far the divergent interests of various individual authorities have not permitted the establishment of constructive policies satisfactory to groups acting together, but now that it is realised that joint action for the generation portion of their operations can be made without prejudicing the rights or stability of their individual undertakings, and that by such joint action they can reduce the cost of supplying themselves, approved schemes for joint working will soon come into satisfactory operation in many districts throughout the country.

The Public's Support.

The public, seeing its interests properly safeguarded, can be counted on for sympathetic support towards the schemes, while industrial interests in general, being in the business of manufacturing commodities rather than electrical energy, will find it natural to favour any action that will facilitate a cheaper supply of energy which is an accessory to their operations. The outcome of the establishment of properly co-ordinated and balanced schemes for the establishment of joint generation with common and general main transmission lines will be the tendency to equalise industrial opportunity, and I consider that we can look towards the future in the most optimistic spirit.

In proposing a vote of thanks to the President for his address, Councillor J. G. Beaumont (St. Marylebone) said that the remark that "each section of the industry by its action or inaction affects the destinies of each other section," approached the dignity of an aphorism. Mr. Allen's arguments, put forward in short sentences, fell like hammers on their brains and stimulated them to take in ideas to which they had hitherto remained insensitive.

The President then called on Lieut.-Col. W. A. Vignoles, D.S.O. (Grimsby), to read his Paper on "The Extension of the Uses of Electricity for Domestic Purposes." This we give in abstract below.

The Extension of the Use of Electricity for Domestic Purposes.

By LT.-COL. W. A. VIGNOLES, D.S.O., Borough Electrical Engineer, Grimsby.

The subject of this paper is of great importance at the present time. Though the worst period of high prices has passed, many undertakings are left with the burden of large capital expenditure on buildings, plant and mains, at prices much above those ruling to-day. This expenditure should be written down out of revenue. Meantime the reduction in load factor on shop-lighting, due to early closing and summer-time and the falling off in the power load owing to the slump of trade, make it necessary to look for revenue in other directions. In the domestic field the largest consumers are already connected. The demand comes from the smaller houses, which are apt to prove unremunerative. The paper is accordingly devoted to the questions: (1) Is a substantial increase in domestic load obtainable on a remunerative tariff? and (2) how can such business be obtained?

The Value of the Domestic Load.

The value of any load is approximately represented by the load factor. In the original paper the author presents typical

figures for the 1922 and pre-war hours per annum for various classes of consumers in the Grimsby district. Hours per annum for offices (both lighting and heating) are the same as in pre-war days—viz., 175 to 200 for lighting, and 900 for heating. For shop lighting there has been a diminution from 600 to 800 to 450 to 650. Theatres and cinemas, as in pre-war days, are credited with 1 200. The industrial load is put at 2 360, as compared with 2 710 for power, and 250, as compared with 400 for lighting. Domestic lighting shows a fall, 1 450 to 1 250, but domestic heating and cooking, at 2 500 and 3 250 respectively, are unaltered. The actual hours of maximum demand will, of course, be less. With heating a new form of peak—the "cold-snap" peak—has to be considered. With cooking there is no "cold-snap" peak, and the heaviest load occurs on Sunday mornings, when the power load is a minimum. Moreover, the demand in summer should be higher than in winter, when some coal fires are used. On weekdays the heaviest load will probably be about midday. This is, therefore, a very useful load. The same applies to thermal storage (electricity being used to heat water during "off-peak" hours). Experimental work in this direction has been done on the Continent, and should be closely watched.

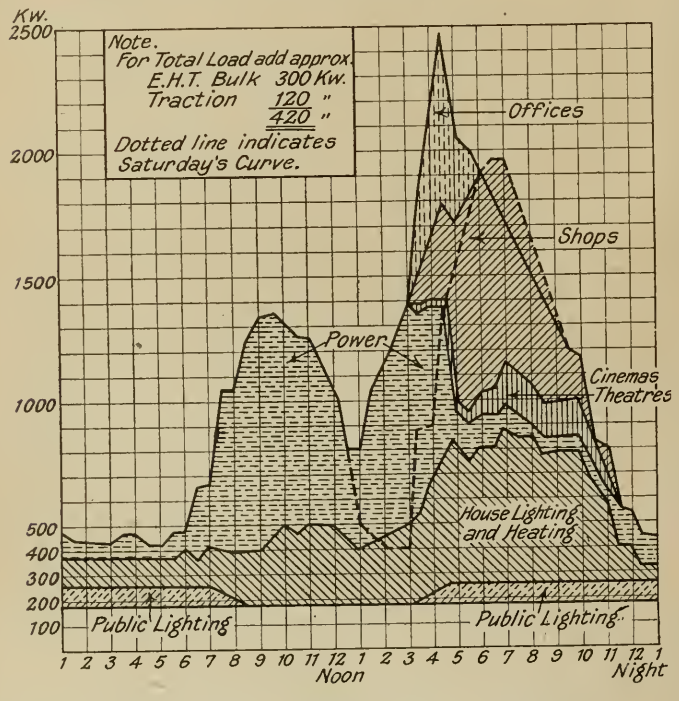


Fig. 1.—Load Curves. Grimsby, Friday, December 16, 1921.

Generally speaking, while a heating demand is desirable, there are certain difficulties that must be watched. The supply for cooking and auxiliaries, such as irons, washers, etc., is still more desirable, and does not have the drawbacks that may occur with a purely heating load.

The Cost of Supply.

Cost can be divided into: (*a*) Consumer cost—i.e., expenses due to dealing with additional consumers; (*b*) standing charges, proportionate to consumer's maximum demand; (*c*) running costs, proportionate to units consumed. In order to illustrate how average cost per unit varies with number of hours of use, curves for Grimsby and Wolverhampton are presented (see Figs. 1 and 2). In Grimsby the present cost of supplying a consumer with a maximum demand of 1 kW (coal 20s. per ton) is based on the formula: £2 per annum per consumer, *plus* £20 per annum per kW of maximum demand, *plus* 0·75d. per unit sold. In Wolverhampton the corresponding formula is £15 1s. per annum per kW of maximum demand, *plus* 0·423d. per unit sold. Thus in Grimsby the average cost of supplying a shop taking 450 units per annum per kW of maximum demand is about 1s. per unit, as compared with a charge of 10d. In Wolverhampton the corresponding cost is 8½d., the charge being 8d. At present many consumers are probably supplied at a loss by undertakings, on a flat rate of 8d. or even 10d.

The Problem of the Small Consumer.

The problem of supplying small consumers is an acute one, as the number tends to continually increase. Large consumers, especially if they purchase plant at very low post-boom prices, may be able to compete with the undertaking.

To show the size of domestic load where a suitable charge is made for heating and cooking the following figures for five different towns are presented, assuming no gas is used and heating and cooking are done electrically:—

1. 2 000 to 2 500 units per annum per house (140 for lighting).
2. 2 000 to 2 800 units per annum per house.
3. Six times the lighting consumption.
4. 1 300 units per annum per house (housing area).
5. Ten times the lighting consumption.

In one town with a tariff of 2½d. per unit, and no special effort made to develop heating load, 35 000 out of 2 900 000 units were sold for heating to 700 consumers. A heating load builds up rapidly under a suitable tariff. Thus in Norwich 1 500 000 units were sold in 1921 at 2d. to 1½d. in Glasgow 6 859 000 units. In Marylebone 2 000 000 units were sold on a flat rate for heating and cooking, and 7 000 000 on a multipart tariff for light, heat and cooking. Norwich had over 5 000 kW of cooking and heating appliances connected at the end of 1921, Glasgow 26 907. Assuming the domestic consumer would use 1 500 to 2 000 units per house per annum, sales would be 15 to 20 million units per annum if only half the houses were supplied on this basis in a town with a resident population of 100 000 in 20 000 houses.

Essentials of Domestic Load.

The essentials in developing a heating and cooking load are: (*a*) the price for electricity must bear comparison with the cost of coal or gas; (*b*) apparatus must not be too expensive, and must give little trouble. It is useless to go in for publicity unless the undertaking can "deliver the goods," and no amount of publicity can replace the skilled canvasser or demonstrator.

Tariffs.

A two-part tariff is the only fair way of charging for electricity for all purposes; but at present an alternative flat-rate must be offered (except in Grimsby, where special powers have been obtained). This flat-rate should be the maximum price authorised. All reductions should be in the form of a two-part tariff. Prices must, naturally, be fixed with due regard to the local cost of gas or coal. For cooking and heating a flat-rate of 2½d. might be fixed. The alternative two-part tariff should involve: (*a*) a fixed first sum per consumer; and (*b*) a charge per kW of maximum demand, or its equivalent. The running charge part of the tariff should not exceed 1½d. per unit, and is less in some towns. In Grimsby the tariff has been fixed at £2 per annum per consumer, £20 per annum per kW of maximum demand, and 1½d. per unit. For private houses the first charge will be £20, *plus* 20 per cent. of the rateable valuable of the premises. For other premises the maximum demand charge is calculated on the estimated maximum demand for lighting, based on an inspection of the premises, with an addition of £1 per kW of the heating or cooking load during "peak" hours.

Under the Grimsby Corporation Act of 1921 it is not compulsory to offer a flat-rate. But at present a flat-rate of 10d. for lighting and 2½d. for heating is being retained until some experience has been gained of the two-part tariff, which it is hoped will be voluntarily adopted by most consumers.

Cost of Extra Heating and Cooking.

The cost of supplying additional heating or cooking load, allowing for "thickening" the mains and feeders, is estimated at £4 10s. per kW of maximum demand, and 0·75d. per unit sold (with coal at 20s. per ton). The average costs for office heating, domestic heating and domestic cooking, work out to 1·9d., 1·3d. and 1·1d. respectively. A flat rate of 1½d. will cover the cost except in the case of offices, where the addition of a charge per kW is specially necessary. The profit on the supply for cooking should be substantial.

The tariff should be framed with an eye to competition. So far as lighting is concerned it is not necessary to cut prices finely. For other purposes we may adopt the ratio: Price of gas per therm to price of electricity per unit for heating and cooking should not be less than 6·5. Thus with gas at 10d. per therm a fair competitive price for electricity would be 1½d. per unit.

The Attitude of the Supply Engineer to the Domestic Problem.

The author recalls two meetings held about 1913 or 1914, one at the Institution, the other at an I.M.E.A. Convention, where domestic electrification was discussed. Evidently but a very small proportion of those present used electricity in

their own houses for heating, and fewer still for cooking. If a supply engineer believes in the domestic load, he should first introduce a suitable tariff. He should then train his staff and interest the electrical contractors in the town. The British Electrical Development Association is prepared to launch a campaign, but they must have the sympathetic support of the supply engineer and the contractor.

Adequate and Reliable Apparatus.

The provision of adequate and reliable apparatus is naturally important. There has been much progress during recent years, and the cost of maintenance is not now excessive, even if apparatus is handled by servants. However, elements do fail at times, and apparatus should be so designed that they can be readily replaced by an unskilled man. The supply undertaking should be prepared to do this work on receipt of a telephone message. If apparatus is hired out, maintenance must be included in the charge for hire and periodical calls made to see that it is working satisfactorily. Lady inspectors could do this work well.

Hire of Apparatus.

So far the cost of apparatus has been high, a complete cooker with oven, grill and hot plates being listed at £18 to £22. Such high prices are apparently due to small output, and undertakings should combine to purchase in bulk. Standard types should be evolved for hiring. With a suitable demand, the price of an electric cooker should not exceed £10 to £12. On the basis of a seven years' life, this might be hired out at £3 or £4 per annum, including maintenance. It is not necessary to hire out radiators which are obtainable at reasonable prices; the same applies to light articles such as toasters or flat-irons. Generally speaking, the rent should cover all expenses, unless there are special inducements to a lower rental in the form of anticipated revenue from the sale of electricity.

The following table, taken from an article by Mr. W. F. T. Pinkney * is interesting as showing both the rentals quoted in Newcastle and the units per annum estimated for each piece of apparatus: —

Apparatus.	Net cost.	Retail price.	Average Maintenance cost per annum	Rental per annum.	Approximate units sold per item per annum.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	
Iron	12 8	1 1 0	1 0	6 0	35
Kettle (2-pt.)..	16 0	1 10 0	2 8	8 0	50
Kettle (3-pt.)..	1 10 0	2 10 0	2 8	10 0	70
Fires	1 10 0	2 12 6	2 7	12 0	500/1 000
Cookers ..	12 10 0	22 0 0	1 0 0	1 10 0	1 600
Cookers ..	16 0 0	25 0 0	1 0 0	2 0 0	1 750

Conclusions.

To sum up the arguments in this paper :—

(*a*) The domestic load may rise to enormous figures if properly encouraged.

(*b*) A price not exceeding 1½d. per unit for heating and cooking is a satisfactory figure from the consumer's point of view, under present conditions.

(*c*) At this price there is some danger of heavy peak loads developing due to office heating, but supply for cooking at this price will show a substantial profit.

(*d*) A hire scheme is essential to the development of a cooking load.

(*e*) Apparatus should be let on hire at rentals calculated to cover all expenses, except perhaps in the case of ovens and complete cookers where, owing to the high cost of the appliances, some help is required from the profits from the sale of electricity.

(*f*) Maintenance of apparatus on hire must be included in the rent.

(*g*) The department must keep in touch with cooking consumers by periodical calls of some member of their staff.

(*h*) Every member of the staff of an electricity department (and everyone connected with the electricity industry) should live in an "All-Electric" house.

The Results of a Vigorous Policy.

A vigorous policy on the above lines by undertakings in the country would have a remarkable effect on the future of domestic supplies. The increased demand for apparatus would have a marked effect on the first cost, while maintenance charges would be reduced with proper organisation; the effect, too, on the consumer would be cumulative, and the "Second Hundred Thousand" electric cookers would be far easier to place than the first.

* The Electrician, March 31, 1922, p. 371.

The Electrical Papers frequently compare electrical progress in the United States with that in Great Britain, to the disadvantage of the latter. The Electrician, in the issue of March 31, 1922, stated that of the houses wired in the United States 36 per cent. use electric washers, 40 per cent. use electric vacuum cleaners, 2 per cent. use electric dish washers, 71 per cent use electric irons, 2 per cent use electric cookers.

Though no figures are available, the writer is of opinion that Great Britain is not behind as regards the last two items, which are the important ones from the point of view of current consumption, and that there is no reason why we should not lead in electric cooking.

The convention of 1913 saw the formation of the Electrical Vehicle Committee, which has been of material assistance in

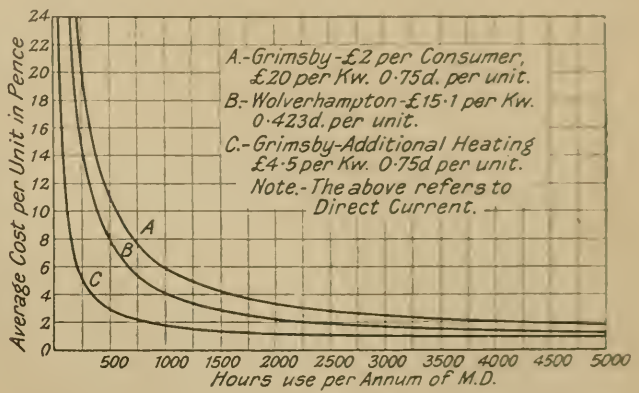


Fig. 2.—Average Cost per unit in Relation to Hours use per Annum of M.V.

developing the electric vehicle, to the great advantage of many undertakings. The Convention of 1914 saw the inauguration of the Development Committee, from which sprang the vigorous British Electrical Development Association, an organisation which is doing valuable work for electrical industry. The wish of the writer is that the Convention of 1922 may see a number of towns combine together to introduce hiring schemes for cookers, and generally to develop the supply of electricity for domestic purposes.

DISCUSSION.

Mr. R. B. Mitchell (Glasgow), who made his first appearance at an I.M.E.A. Convention, agreed that it was desirable to encourage the domestic load. The cooker must first be encouraged, for every cooker connected could be depended upon to consume 1 500 units per annum. But cookers must be hired. They must also be accompanied by an electric kettle to overcome the criticism of the hot plate. It was of no use hiring out small appliances, but it might pay an undertaking to give current consuming devices free. In Glasgow the "snap peak" load had amounted to between 8 000 and 10 000 kW, but the great point about it was that it usually came in the morning, and need not be feared unless the plant was too small for the load. At May 31, 1922, they had 30 489 kW of domestic load connected, the charge being 12½ per cent. of the rental, plus ½d. per unit.

The Curves—Fact or Imagination.

Mr. L. L. Robinson (Hackney) asked how the author arrived at the analysed load curve in the Paper which gave the curves for the individual portions of the supply. It was enormously useful if accurate, but he suspected that many of the curves depended largely on the imagination. They had all experienced the "snap peak," but it was nothing to be afraid of, and could be dealt with by their normal reserve plant, especially if some of the boilers were oil-fired. Flat rates should be kept high, and consumers rewarded in accordance with their deserts by means of multi-part tariffs. In the past they had made too much of the power load. They must now endeavour to develop a well mixed load so that when one sort slumped another would boom. Apparatus must be hired at rates which met interest, capital charges and maintenance, but no more. He was about to experiment with free installations and charging a slightly higher price, through prepayment meters, for the electricity supplied. For developing the domestic load an enthusiastic and a competent sales department was necessary. Even now if electricity were supplied below 1½d. anybody who cooked by gas had money to throw away. His department included a 3-pint kettle with each cooker, but he would not like it to go out that the electric hot plate was inefficient. It was a most efficient piece of apparatus on a cooker for its own work.

Conditions in Marylebone.

Ald. J. A. G. Beaumont (Marylebone) said the rateable value tariff might be ideal on paper, but it would be impossible to apply it in Marylebone, where the rateable value of similar houses varied

according to the uses to which the houses were put. Results in Marylebone seemed to show that their progress with heating and cooking, and to a small extent with power, had been decidedly profitable with the low figure of 1¼d. flat rate. Hot plates and radiator elements should be so designed that they could be replaced by any user in the same way as a lamp. In Marylebone they preferred to let rather than sell heaters, as it kept the undertaking in touch with the users and the apparatus in proper working order. Buying in bulk, which the author had suggested, was worth consideration. His undertaking has been supplying free heaters and cookers for some time and adding ¼d. to the unit charge. He agreed that the staffs should have "all-electric" houses, but they could not be expected to do it unless they got a favourable tariff.

Mr. C. W. Charlesworth (Wolverhampton) said the most important question awaiting solution in every industry was over-capitalisation. To deal with this, rate relief and rate aid were both unsound, and the only way to effect the writing down was from revenue, which meant maintaining prices beyond the immediately necessary level until the required surplus was obtained. Whether this was possible at present, having regard to the grave difficulties in the way of reducing prices to keep pace with the reduction of wages and certain other items seemed problematical. He felt that the most fruitful method was to increase the output.

The Hopkinson System the Only Logical Basis.

Mr. C. H. Wordingham said that in all towns the domestic load was of considerable importance, and particularly in those towns which were mainly residential. Getting the domestic load, however, depended entirely on a suitable tariff. The Hopkinson system was the logical basis to which we would ultimately come for domestic as for power purposes. A large number of different scales of charge were to be deprecated. The greatest want at present in connection with tariffs was a cheap reliable demand indicator, for it was essential to work out the maximum demand, and not to play with rateable values and other absurd things which had nothing to do with the demand, while the ridiculous flat rate should be abolished. If the consumer could be properly educated in demand dodging so that he used most of his appliances off the lighting peak he would obtain electricity practically for a penny per unit, and he ventured to think the scope for domestic appliances was a wide one at that rate.

Councillor A. Sinclair (Swansea) did not agree with the author that the small lighting consumers might easily become a source of loss. His experience showed the contrary.

Fertilising the Field.

Mr. E. E. Hoadley (Maidstone) said what they had heard during that discussion concerned the filling up of the load curves from six in the morning till midnight. They had heard little of what should be done to help the same curves between midnight and six in the morning. At Maidstone they had a load of 3 000 kW, of which 50 per cent. was a night load. But that left a big valley to fill. He hoped the problem of thermal storage and the supply of hot water by electrical means for domestic uses would be well explored within the next year or two. He would like to impress on members the necessity of prompt and efficient service in regard to repair of hired cookers. A flat iron was the most satisfactory electrically heated article that could be put into a household, and after using it a month or so the feminine mind was in a nice condition to receive information about electric cooking.

South African Experiences.

Mr. E. Poole (Durban) said since the introduction of a low tariff in Durban the output had enormously increased. A low tariff, he believed, would bring about such a demand for apparatus that manufacturers would soon turn out something not too expensive or troublesome. The consumption per consumer had been practically doubled, and out of 8 million units sold for lighting and cooking one half was entirely for cooking.

More Ways of Using Electricity.

Mr. J. W. Beauchamp said Col. Vignoles had shown that the conditions were complicated by short hour demands for lighting and power. But there were things which could be done that had not yet been done. The later lighting of shop windows was one. The cheapness of electrical cooking depended on the price of gas; 1½d. per unit against 5s. for gas was a favourable figure. If they did not get hundreds of cookers on that it would be because they were not pushing the business. A fire load unaccompanied by cooking was not altogether a blessing, particularly in a city area. Mr. Allen had on view in Wolverhampton a heat accumulation stove. He (Mr. Beauchamp) had put it there because he wanted the members to think about that problem. Nitrates afforded a means of taking supply when it suited the supplier to give it and when it suited the buyer to receive it. No change of the kind would come about quickly, but it was one of those new things to which they should give attention. It was well known that there were thermal storage water heaters. He had bothered with this stove because they had little apparatus for warming air or rooms. Members might know Harrison and Beard's heat accumulation stove. It warmed the air, using the latent heat of acetate of soda. They should get busy thinking about filling those hollows in the curves by means of heat accumulation. If they took the heat in the night they would get it for 2d. or something of that nature. The small water heater introduced by Mr. Russell of Shoreditch was a useful adjunct for cookery, and took a lot of duty off the hot plate. If they were going to get half the heat in each of the homes in large cities like Wolverhampton a great deal of it would have to be delivered on the storage system.

Mr. A. H. Shaw (Ilford) said, on his multi-part tariff he had different rates for summer and winter, because the power load was only small and he had a heavier load during the winter and a very light one during the summer. This secondary rate was 1½d. in summer and 2d. in winter. The primary rate worked out at 21 per cent. of the rateable value. In Ilford they had 600 small houses connected by services in blocks. Some services supplied 12 houses and others 24. There were small meters in every house, although no meter rent was charged. The results were, on the whole, satisfactory.

Mr. George Wilkinson (Harrogate) deprecated the idea of having a high initial price per unit. Better means could be adopted than introducing a 10d. or 1s. initial rate.

At the conclusion of the meeting those present were conveyed in motor chars-a-bancs to the Royal Artillery Headquarters, where they were entertained to lunch in the Drill Hall by the Wolverhampton Electricity Committee. Our hosts are to be congratulated on having such a fine hall at their disposal, and on the tasteful way in which it was decorated, not only with modern tapestry hangings but with a drop scene reminiscent of the country round Wolverhampton itself. Thanks for the entertainment were suitably presented, in a speech by Councillor Beaumont and musically by the remainder of those present, and were acknowledged by the Mayor.

Then once more chars-a-bancs were requisitioned to take the party to Apley Terrace, on the River Severn. The route taken was *via* Bridgnorth, while on the return Shifnal, the scene of a certain Royal honeymoon, was passed. The grounds and the view were adequately inspected as they deserve to be, and tea was served in the grounds. We heard a certain amount of shop in spite of the sylvan scenery, but, then, engineers are like that.

In the evening a Reception was given by the Mayoress of Wolverhampton at the Art Gallery.

Wednesday, June 21.

This morning members were early astir armed with coats and umbrellas for the journey by road to Stoke-on-Trent. The now familiar chars-a-bancs were under weigh soon after 9 a.m., and a very pleasant run *via* Stafford was the reward of those taking part. On nearing Stoke, the local beauty spot, Trentham Gardens, of which a closer view was given in the afternoon, was passed.

Unfortunately in some ways the organisers of this expedition had been a little too optimistic. The two hours allowed for the journey was barely sufficient for the Wolverhampton party, and nothing like adequate for those coming from Birmingham. The result was the proceedings started nearly an hour late with the briefest of welcomes from the Mayor of Stoke-on-Trent (Ald. S. Sproston) and the President, after an even briefer reply, called on Mr. E. Calvert to read his Paper on "The Administration and Control of Electricity Departments," explaining as he did so that luncheon would be put off for half-an-hour in order that there might be some discussion. We give this Paper in abstract below.

Administration and Control of Electricity Departments.

By EDWARD CALVERT, Chief Electrical Engineer, Finchley.

Municipal accounts have received much consideration in recent years. The Public Health Acts do not contain any detailed method of control of accounts, but deal rather with the form in which district councils' accounts must be kept, provisions for audit and publication, etc. Accounts of receipts and expenditure must, however, be made up "in such a form and to such day in every year as the Local Government Board may appoint." Considerable latitude is allowed to the qualifications of the treasurer, but it is evidently assumed that other officers will handle the money. The Acts did not therefore contemplate a finance department which would deal with the whole finances of a local authority.

The Provision of Independent Checks.

Some doubt exists as to whether the Public Health Acts govern municipal trading undertakings. In 1906 the Local Government Board appointed a Departmental Committee "to inquire and report with regard to the system on which

accounts of local authorities in England and Wales should be kept." Of the witnesses who gave evidence none was directly responsible for the administration of a municipal trading department. The chief feature of the recommendations of the Committee, issued in 1907, is the differentiation of duties of executive officers and departments in such a way that transactions may be checked by independent records of accounts. It is recommended that officers concerned with administration should not control the final accounts thereof; and conversely officers who supervise finance should not take part in the administration or in the receipt and payment of money. The effect of these and other recommendations would be to place in the hands of the Finance Committee powers which might even take away power from the hands of the local authority itself. Much opposition to the recommendations has been raised, and no further action appears to have been taken by the Ministry of Health.

Among the criticisms raised may be mentioned that it would be impracticable for any one committee to deal efficiently with the financial details of all committees; that duplicate books of accounts would be needed; that a single finance officer would not have sufficient technical knowledge to deal with the business of several departments; that a great increase in staff would become necessary; that committees other than the finance committee would become practically sub-committees, leading to inefficiency in view of the absence of a suitably responsible head; that the interpretation of the recommendations would lead to difficulty.

Some Weak Points.

There has been some revival of the movement in favour of these recommendations, and the Council of the I.M.E.A. recently passed a resolution disapproving of the effort to place the general control of electricity departments under any officer other than the chief electrical engineer and general manager. The principle underlying the recommendations is analogous to that in force in the L.C.C. since 1889. From the report of a Special Committee appointed on June 21, 1921, it appears that the L.C.C. is not entirely satisfied with existing procedure. The present highly centralised system is regarded as having drawbacks, including over-elaboration and overlapping, and especially the division of responsibility between heads of executive departments and the head of the accounting or checking department. Accordingly a new scheme is proposed under which the comptroller would act as financial adviser, paymaster-general, and receiver-general and auditor, and would keep the main accounts, but the heads of executive departments would have entire responsibility for all payments for which they are certifying officers, for collection of revenue in their department, and for keeping their departmental accounts. Such a scheme of decentralisation would, it is thought, be quite feasible.

The conclusion confirmed by these considered opinions is that a chief officer cannot efficiently carry out the work of his department unless he is held solely responsible for the financial position.

I.M.E.A. Opinion.

In conclusion, the publication of the following considered opinion of the Council of the Association may be opportune :—

In municipal trading departments which have to be run on business lines, it is imperative that the chief electrical engineer and general manager should bear the full responsibility for the working and development of the undertaking. If the financial control is taken away from him and placed under another officer, a state of dual control is set up and the usual evil results will inevitably follow. The effective check upon the financial details can best be obtained by a properly organised system of audit, and preferably by auditors independent of the permanent staff of the municipality. When the operations of the department in question justify the same, the books should be kept by the staff of the department. A continuous audit is always preferable. In electricity departments questions of commercial management and financial details are so dependent upon technicalities as to render these inseparable; they can only be satisfactorily dealt with by one who has high engineering qualifications for dealing with all branches of the department's business.

DISCUSSION.

Ald. A. Senington (Bristol) said that London could not be taken as typical of the conditions to which the author referred. The demarcation of the duties of officials was important in connection with a trading committee such as an electricity committee, but financial chaos might result if one man, say the electrical engineer, were allowed the sole control.

Mr. F. W. Purse (West Ham) remarked that many insidious attempts were being made by financial officers to obtain the control of electricity undertakings, and the movement was still more dangerous now that the "Geddes" Committees, set up by many of the Councils, were at work. It was true electrical engineers did not want to be troubled with raising money, and the actual keeping of certain accounts was a matter which none of them would differ upon. But when it came to a question of saying whether certain extensions should be made the engineer was the only man who could give information. Therefore, there could not be any question as to what theline of demarcation should be.

Mr. C. H. Wordingham said an engineer who did not have charge of the financial part of his work was a contradiction in terms. He concurred heartily with the Council's resolution. After all, the technics of accountancy were nothing compared with the technics of the scientific side of engineering. It was the man himself who was going to determine whether the undertaking was a success or not. His technical knowledge was merely a box of tools, and the accountancy tool was the simplest and easiest of the lot.

Differences Between Municipal and Company Finance.

Mr. Norman Staniland (Hornsey) said Mr. Calvert had imagined an autocratic finance committee and a very autocratic borough treasurer. It was wrong to compare municipal with company finance, because the way money was spent was quite different. The ordinary council had a united district fund, and the debts were more or less merged in that. At Hornsey all the chairmen of the spending committees were on the Finance Committee, and had their chance to say what they thought about the treatment of their particular committee. He did not see how one could ask for a watertight electricity department when it was dependent on the whole district for any out-balances. The L.C.C. had recently appointed a special control officer to look into the financial standing of all the departments and keep an eye on how they were worked.

Councillor F. Burgess (Bristol) supported co-operation between the two departments.

A Working Arrangement.

Mr. W. C. P. Tapper (Stepney) said with the present methods there was duplication of work. Many records were kept twice over. The engineer must be able to get the information he wanted when he wanted it, and if he had not the books in his department he could not do so. The books should be kept in the department by an officer who was a qualified accountant, under the general manager. The borough treasurer or accountant should carry on a continuous audit of the books of all the departments. The L.C.C. had gone into this question carefully, the committee charged with the work had come to a definite conclusion, and they should follow their lead.

Councillor E. R. Dymond (Hereford) said if two people were responsible for the financial efficiency of the electricity department failure would result. No man trained simply in accountancy and finance could accept the whole responsibility of so technical a work as electricity supply.

Follow the L.C.C.

Ald. C. R. Attlee (Stepney) remarked that the electricity department must not be too widely separated from the others. It was carried on for all the inhabitants and not only for the consumers. If too much power were put into the hands of the technical officer the tendency would be to look after the consumers rather than the ratepayers generally. They should follow the lead of the L.C.C. in the matter.

Mr. J. W. Beauchamp thought they should make the collection of accounts an opportunity for propaganda. This could not be done if they were sent out from the borough treasurer's office.

Mr. L. L. Robinson (Hackney) said in his undertaking there was a liaison officer in the offices of the electricity department who kept it in touch with the finance departments. What was to be done from an engineering or trading point of view was settled by the Electricity Committee and confirmed by the Council with the advice of the engineer. Arrangements were made so that the treasurer could have the greatest possible facilities for a running audit of the electricity department's accounts. The accounts went out from and were paid in their own building, and they obtained the useful result Mr. Beauchamp had referred to.

Bailie W. Crawford (Paisley) said at Paisley the Electricity Committee was a committee of the whole Council, and out of that they formed an advisory committee to co-operate with the manager. They gave the manager freedom with regard to extensions, and also to spend money, with the proviso that his suggestions were put before the advisory committee and afterwards submitted to the Council. The I.M.E.A. should see that all their engineers were well equipped technically, and were also commercial men able to extend their undertakings.

Co-operative Solution.

Councillor A. J. Ward (Sheffield) did not agree with the borough treasurer having control, but in cases where the engineer had more than he could do, a qualified commercial man should be appointed to relieve him of some of the duties.

Mr. CALVERT, in reply, said his view was that in every municipality there should be co-operation between the principal officers of the various departments. Municipalities, in appointing an engineer to manage a large trading department, did not sufficiently carefully assure themselves that his qualifications included other things than ordinary mechanics. The municipality was then at fault, and not the engineer. The engineer, so-called, was nowadays the general commercial manager with a sound knowledge of engineering thrown in, and, as such, he should be presumably in a position to employ engineering brains to carry out the more detailed work.

At the conclusion of the meeting those attending were entertained to luncheon by the Stoke-on-Trent Electricity Committee, and subsequently divided into parties which visited various engineering and pottery works in the district. These parties co-ordinated again at Trentham Gardens, where tea was served, and the return was made by road to Wolverhampton and Birmingham. In the evening, somewhat mercifully, we were left to our own devices, and a Wild West drama at the local picture house tintillated the intellects of some.

Thursday, June 22.

This morning the Convention journeyed to the Witton works of the General Electric Co. where the meeting was held in the Main Hall of the Magnet Club. The Wolverhampton party this time had a taste of Black Country scenery in cold weather and were quite ready to enjoy the warm welcome which this unofficial hostelry knows so well how to provide. Unfortunately all this sort of thing made the meeting very late starting and a strangulated discussion fought for existence between club amenities and the attractions of Witton works.

The subject was "Sub-station Equipment, including Automatic Control," a Paper on this subject, of which we give an abstract below, being read by Mr. R. A. Chattock.

Sub-Station Equipment, including Automatic Control.

By R. A. CHATTOCK, City Electrical Engineer, Birmingham.

The equipment of modern sub-stations involves the consideration of several types of transforming apparatus and switchgear. In this paper it is proposed to deal with :— (1) the various types of sub-station plant available ; (2) the application of these types to various classes of supply ; (3) the conditions under which automatic operation is beneficial, and the methods of obtaining it ; (4) typical sub-station lay-outs, buildings, plant and switchgear, and results obtained under working conditions.

Types of Sub-Station Plant.

The various types of sub-station plant available are dealt with briefly, assuming an incoming supply of 11 000 V three phase alternating current : an outgoing supply of 500 V d.c., for power and lighting purposes, with a regulation of ± 5 per cent. or 1 500 V d.c. for railway traction purposes : a speed of 500 revs. per min.

Supply engineers are familiar with the details of such machines. It is only necessary to tabulate their characteristics for reference as follows :—

The Rotary Converter.

The efficiency of a 1 000 kW rotary converter equipment supplying d.c. at 500 V at 25 cycles varies from 92 per cent. at half load to 94 per cent. at full load, and from 91·4 per cent. at half load to 94 per cent. at full load at 50 cycles. When a d.c. voltage of 1 500 is required—*e.g.*, for railway traction—the efficiency varies from 92·8 per cent. at half-load to 94·5 per cent. at full load. In this case it is necessary to run two 500 kW sets in series in order to obtain 1 000 kW. The efficiencies of such a combination vary between 91·1 per cent. at half-load and 93·5 per cent. at full load.

Another advantage of the rotary converter is high power factor which can be kept either at unity or with a leading characteristic—a great advantage on systems carrying a large inductive load.

The present-day costs of rotary converter equipments of 1 000 kW capacity vary from £6·10 to £7·37 per kW.

The La Cour Motor Converter.

This machine is not quite so efficient as the rotary converter, and is only advocated for 40 cycles or over.

Rotary converters now run satisfactorily even at 50 cycles, so that the need of the La Cour converter is disappearing. For the higher d.c. voltages required for railway traction work, it will, however, enter the field, as it is possible to construct 1 000 kW machines supplying d.c. at 1 500V, thus avoiding the necessity for running two in series as is the case with 50 cycle rotary converters. The efficiency of a La Cour converter varies from 90 per cent. at half-load to 92 per cent. at full load. The power factor can be adjusted to unity. The cost per kW at present-day prices amounts to £4·87.

The Synchronous Motor Generator.

The efficiency of a synchronous motor generator varies from 85·8 per cent. at half-load to 89·5 per cent. at full load. There is no distinction in machines built for 25 and 50 cycles. Special starting motors are required for starting and running up to synchronism. The power factor can be kept at unity, or given a leading characteristic if desired, by varying the excitation, without affecting the stability.

The cost at present-day prices is £6·89 per kW for 25 cycles and £6·5 per kW for 50 cycles.

The Induction Motor Generator.

The efficiency of the induction motor generator is slightly higher when run on 25 cycles than when run on 50 cycles, and varies from 85·5 per cent. at half-load to 88·8 per cent. at full load.

The power factor cannot be adjusted, and varies from 84 per cent. lagging at half-load to 90·5 per cent. lagging at full load when running on 25 cycles, and 74·5 per cent. lagging at half-load to 85·5 per cent. lagging at full load when running on 50 cycles.

The cost at present-day prices is £5·84 per kW for 25 cycles and £5·56 per kW for 50 cycles.

The Synchronous Induction Motor Generator.

The efficiency of the synchronous induction motor generator is lower than that of the ordinary induction motor generator, but the power factor can be adjusted to unity at full load, and with constant excitation it has a leading characteristic at lower loads. This may be a valuable consideration. If the excitation is varied to keep the power factor at unity the machine tends to become unstable at low loads.

The cost at present-day prices is £6·40 per kW for 25 cycle plant, £6·18 per kW for 50 cycle plant.

The Mercury Arc Rectifier.

The mercury arc rectifier has only recently been made commercially in large sizes. The efficiency depends upon a constant loss in maintaining the arc in the rectifier cylinder. Accordingly, as the d.c. voltage is increased, so the efficiency improves, and may attain 92·5 per cent. at full load (on 500 V d.c. 50 cycles), 91·2 per cent. at full load when run on 25 cycles. 95·8 per cent. efficiency is attainable for 1 500 V d.c. at full load on 50 cycles with a 825 kW rectifier.

For a 1 500 V d.c. supply this apparatus is therefore more efficient than any type of rotary apparatus on the market ; on 3 000 V the difference is still more marked. The power factor of this apparatus remains practically constant at all loads. The cost at present-day prices is :—

Two Cylinder—1 000 kW, 500 V, 25 Cycle	..	£8·76 per kW
1 000 kW, 500 V, 50 Cycle	..	£7·48 per kW
Single Cylinder—825 kW, 1 500 V, 25 Cycle	..	£6·38 per kW
825 kW, 1 500 V, 50 Cycle	..	£5·04 per kW

The Storage Battery.

The storage battery is a valuable adjunct to the d.c. sub-station. Its efficiency regarded as a unit with its charging boosters and its necessity for drawing transformed energy from the a.c. system is about 63 per cent. When the cost of the current passed through the battery is taken into account, a higher economic efficiency results. The battery, being charged at night, can be supplied at the cost of coal only ; at times of emergency the supply returned to the line is practically priceless, and at times of peak load the value is a maximum. Taking the two hour rate of discharge as a measure of capacity, and including the cost of regulating switch and charging booster, the cost per kW at present-day prices is £35.

The Static Transformer.

The efficiency of this apparatus is very high, varying between 96 per cent. at half-load and 98 per cent. at full load. The cost at present-day prices is £2 per kVA for small sizes up to 100 kVA, and down to £1 per kVA for larger sizes.

The Frequency Changer.

A frequency changer is only applied to small sections of the supply and not for linking together large systems having different periodicities. The efficiency varies from 89·5 per cent. at half load to 92·5 per cent. at full load. The power factor can be adjusted to unity, and the cost at present-day prices is £5·16 per kW.

Lighting and Power Applications.

Most thickly populated centres of supply are dealt with by a d.c. three-wire network, divided into reasonably sized sections, each one fed by a distinct sub-station through low tension d.c. feeders. Sub-stations are commonly equipped with rotary converters or La Cour motor converters, drawing their supply from extra high tension polyphase a.c. mains. Recently the mercury arc rectifier has found favour. When the price of this is reduced from its present high level, it should prove a formidable rival to the rotary converter. The advantage of using d.c. in a thickly populated district is largely due to the possibility of installing storage batteries.

The overall efficiency of a rotary converter sub-station equipped with a storage battery, over a period of twelve months, and converting an output of about nine million units, amounts to 87 per cent.

The present-day cost of such a sub-station, including land, buildings, plant, battery and switchgear, amounts to £19·9 per kW for a two storey sub-station and £17·4 per kW for a single storey sub-station.

A limitation to the capacity of the d.c. sub-station is imposed by the loading up of the low tension feeders. A point is reached when it becomes practically impossible, without a very heavy expenditure on additional copper, to maintain the proper pressure in the outlying parts of each district. The best way of handling such a condition is to instal automatic rotary transforming plant or mercury arc rectifiers in the outlying districts, feeding back into the distributing network at times of heavy demand.

Apparatus can be made entirely automatic, or semi-automatic by connecting to the main sub-station through pilot wires.

The present-day cost of such plant installed in single units of 250 kW capacity amounts to :—for the automatic rotary converter equipment, £23·7 per kW, and £17·1 per kW for the mercury arc rectifier.

In a thinly populated residential district the use of d.c. is hardly justified, and low tension a.c. supply has to be adopted.

The comparison of the cost of three schemes for dealing with a suburban area of about 13 sq. miles at present-day prices works out as follows :—

Three automatic mercury arc rectifier sub-stations, each comprising one 230 kW rectifier, one 100 Ah battery for balancing purposes, switchboard and sub-station buildings, with direct current feeder and distributor mains	£65 per kW
Three automatic rotary converter sub-stations, each comprising one 250 kW rotary converter, switchboard, station buildings and direct current feeder and distributor mains	£58·5 per kW
Six static transformer sub-stations, each equipped with one 100 kW transformer, with switchgear, sub-station buildings and alternating current distributing mains	£26 per kW

The efficiency of operation of these three systems of supply, reckoned from the high tension input to the sub-stations to the supply delivered at the consumers' premises, and assuming a load factor of 15 per cent. per annum, works out as follows :—

For the automatic mercury arc rectifier equipment	89 per cent.
For the automatic rotary converter equipment ..	84·5 per cent.
For the static transformer equipment	95 per cent.

Tramway Traction.

For tramway traction purposes rotary converters, synchronous and induction motor generators are chiefly used. In thickly populated districts tramway traction plant can be worked in conjunction with the lighting and power plant, but in country districts such equipment is costly to operate, and automatic rotary converting plant and mercury arc rectifiers will probably be used. Control can be conveniently obtained over great distances from a single centre by means of pilot wires operating relays.

Railway Traction.

Requirements for railway traction are not so well defined in this country as are those of the two preceding sections.

The standard pressure of 1 500 V (d.c.) recommended by the Advisory Committee of the Ministry of Transport is not being accepted without question. Advocates of the Brighton and South Coast Railway System (single phase a.c. at 11 000 V) consider this a cheaper proposition. On the other hand d.c pressures above 1 500 V can be obtained and used with safety.

The mercury arc rectifier can supply d.c. at 3 000 V, or the rotary converter utilised by coupling the d.c. ends in series. In order to utilise 3 000 V train motors would be run two in series with 1 500 V on each.

It is doubtful whether rotary converters will be suitable for these higher d.c. pressures. On a 25 cycle system they are more satisfactory than with 50 cycles.

Sub-stations for railway traction should be automatic in operation, and La Cour converters, induction motor generators and mercury arc rectifiers can be conveniently adapted.

The use of single phase alternating current for ordinary traction purposes requires only static transformers installed at intervals along the line to reduce the pressure from 66 000 or 110 000 V to the line pressure of 11 000 V.

Continental experience indicates that frequencies not exceeding 25 cycles are desirable for single phase operation. Frequencies as low as 16⅔ are generally adopted.

Automatic Operation of Sub-Stations.

Sub-station apparatus should be designed to automatically control the starting and stopping of the plant. For a single unit, feeding into a network control is effected by relays actuated by the pressure of the line supply. For a number of units feeding into a network control would be better determined by the current supplied from the group. It is advisable to allow a time lag of about five minutes before the control actually operates, especially in automatic sub-station plant for traction purposes.

Typical Sub-Station Lay-outs.

The single-storey sub-station is cheaper to build and equip than the two-storey sub-station, but the space occupied by this type is greater, hence in a thickly populated district a two-storey sub-station may be adopted. The battery room is then arranged over the machine room, and this necessitates a stronger and more costly building.

The incoming high tension cables are housed in a trench on one side of the building, the outgoing low tension cables in a trench on the other side. The h.t. switchboard is disposed over the h.t. cable trench ; thence the supply is passed into the transformers, into the rotary converting plant, and to the l.t. switchboard situated over the l.t. cable trench. Space is provided also for feeder boosters and balancers.

The heavier plant should be under an overhead travelling crane to afford facilities for installing and overhauling.

In the one-storey sub-station all apparatus is on one floor, and the battery room is built alongside the station on the l.t. side. In the two-storey sub-station transformers, rotary converting plant and balancers are installed on the ground floor ; h.t. and l.t. switchboards on galleries carried between the overhead crane stanchions and the outer walls. The battery room is overhead. Space must be provided for an attendant's office, with simple cooking facilities, and a heating chamber to maintain a temperature of 55° F. in the winter ; ample ventilation is necessary in summer.

Battery Room Design.

As regards the battery room in the early days trouble was experienced in providing and maintaining an acid-proof floor. Asphalt becomes soft and is not impervious to acid. Ultimately a floor was developed constructed of ½ in. of asphalt laid on the concrete and a 2½-in. hard pressed blue brick tile laid on this, place ¼ in. apart and run in with hot pitch. This is impervious to any acid.

A roof of ordinary steel construction over the batteries is not recommended, as acid spray damages the steel work. A paint of the best red lead and boiled oil put on in five coats and finished in ordinary colour paint lasts as long as any special material, but this is not absolutely impervious. The best construction is to put a flat concrete roof and to case in all the joist work in concrete, so that there is no exposed metal of any kind to be attacked.

Ample ventilation should be provided in the battery room by means of fans. With batteries of 2 000 Ah. capacity and over, it is necessary to provide acid neutralisers, screens of finely perforated lead plates, over which water is allowed to trickle, and through which the air is drawn.

The operating efficiency of a sub-station is about 87 per cent. per annum. The actual working cost at present-day prices for

a sub-station containing 4 000 kW of rotary converting plant with a maximum load of 3 560 kW, and an annual converted output of 9 200 000 units, supplying a l.t. 3-wire power and lighting network and an overhead tramway traction system, is as follows :—

	£	Pence per unit sent out.
Interest at 6 per cent. and Sinking Fund according to the life of the buildings and plant on a capital expenditure of £79 732	8,368	0·218
Rates and taxes	810	0·021
Wages of attendants on shift (eight men)	2,063	0·054
Wages of maintenance men	1,130	0·029
Costs of materials used for repairs and maintenance	380	0·009
Proportionate amount for supervision ..	456	0·0011
Costs of units used on the works reckoned at ¾d. per unit	527	0·014
Total	£13 734	0·356

Static Transformer Sub-Stations, A.C. to A.C.

This is a simple and cheap arrangement, comprising a small building equipped with switches for controlling the incoming and outgoing h.t. cables, a static transformer generally of 50-100 kW capacity, equipped with a h.t. switch, fitted either with automatic overload control or combined with h.t. fuses, and a l.t. switch combined with fuses, for connecting to the l.t. distributing network. The cost of such a sub-station is now about £6 per kW.

With overhead lines transformers are frequently fixed to poles, l.t. connections being made either to overhead lines or underground distributing cables, probably the cheapest form of distribution. In America this method has led to "open air sub-stations." Transformers and switchgear are in weathertight cases, installed in the open, and fed from e.h.t. overhead mains, at pressures of 150 000 V. This may be suitable in the dry American climate, but would not prove to be satisfactory in this country.

Large Consumers' Sub-Stations.

For consumers taking large power supplies of 150 H.P. and upwards, it is usual to provide an e.h.t. supply, which the consumer transforms and distributes in his own premises. The costs of the Supply Department's panels at present-day prices are roughly £148 per cable panel and £173 per consumer's panel. A minimum of three panels is required, but in a large works actually six or nine panels are installed to provide sufficient alternative sources of supply. The maximum capacity of each of the incoming cables is 2 000 kW.

Power Factor.

The power factor can be corrected in sub-stations equipped with rotary converters and other synchronous converting plant, but in the case of long h.t. feeders supplying large consumers it is important to correct at the consumer's premises and to give inducements to consumers to adopt such an arrangement.

A simple apparatus is an ordinary condenser attached to the l.t. side of the transformer. Another device is the Kapp vibrator, which can be attached to individual induction motors and arranged to correct the power factor to unity.

The cost of such apparatus suitable for use on 25 cycle circuits at present prices is as follows :—for condensers £9 9s. per kVA, for vibrators £3 12s. per kVA.

DISCUSSION.

Mr. S. J. WATSON (Bury) said Mr. Chattock dealt with the speed of 500 revs. per min. only, but during the last few years speeds had been pushed higher, and at present 1 000 kW rotaries were being made to run at 1 000 revs. per min., and he believed makers were prepared to go to higher speeds. In consequence the prices were relatively lower, the machine was as good and the efficiency slightly higher. It was reasonable to say one could get a rotary with transformer and switchgear at less than £4 per kW. Those who had purchased self-synchronising rotaries during the last year or two would realise their advantages. They could be run up quickly and put on the bars in less than half a minute in the smaller sizes. The old battle on the use of rotaries or synchronous or asynchronous motor generators had been revived in this paper. Rotaries had been much improved during the last few years, but they still had certain defects. No rotaries would hold in when a bad short on the e.h.t. side set up surges, whereas a synchronous motor-generator was far less sensitive. The author referred to "the relatively less reliable system of low tension a.c. in comparison with d.c." But from the generation right through to the detailed distribution the a.c. system was equal to and in many cases far better than d.c. Almost the sole advantage of d.c. was the possibility of using storage batteries when the loads were small, and it was possible to shut the plant down. But as a system grew and the plant had to be run over 24 hours, a.c., and especially single phase, was simpler and better than d.c. The only other advantage of d.c. was in speed regulation.

Cheap and Abundant Supply Impossible.

Mr. S. E. FEDDEN (Sheffield) thought it would be impossible to give a cheap and abundant supply of electricity on any large scale by using the system the author advocated. To lay minds the complications must appear enormous, and to skilled minds the capital expenditure was enormous. At Sheffield they had been endeavouring to cheapen substations, and had been assisted very much by the ironclad switchgear. In the substation they had evolved the door frames and doors cost £50, at present-day prices, and materials and labour for the concrete erection, £100. The whole station cost £150 exclusive of timber for the concrete sheeting, the cost of which was spread over a number of substations. The door frames were put up and concreted in, and when the floor was down the concrete was built up. The ironclad switchgear was put in through the door on one side and the transformers through the other side. Instead of putting up kiosks the same thing was done on a smaller scale, and 11 000 V could then be handled in any outlying district. Those little concrete buildings only cost £30. The cost of a 2 000 kW substation was : building, £294 ; e.h.t. gear, £600 ; l.t. gear, £75 ; e.h.t. transformers, £1 258, and l.t. transformers, £286. The cost was only £2 or £3 a kW instead of £5 or £6. In the case of mercury arc rectifiers the figure was about £32. We could not sell cheaply on that capital expenditure. Batteries were all right for small country houses, but one could not distribute cheap electricity with an efficiency of 60 per cent., and there was very large capital expenditure. Automatic rotary substations would no doubt be useful for railway and other big work, but the big capital expenditure barred them out for other purposes. Mr. Chattock made a point of the great advantage of keeping up the power factor by having all these rotary substations, but it was a most expensive way of doing it. Low power factor was a bogey on most distribution systems.

Colonial Experiences.

Mr. W. H. ALABASTER (Melbourne) said he had recently had to go into the design of rotary substations and numerous static substations. He agreed as to the desirability of limiting as far as possible the area to be supplied by d.c. He had recently put forward a proposal to cut off an outlying district which was poorly developed, and arranged for it to be transferred to the a.c. system. Half the d.c. area was run without a battery with satisfactory results. In the most important area, however, there was a 4 000 Ah battery. He was rather appalled by the author's figure of 0·36d. per unit being added to the working cost by a fairly large substation. He thought that was due to the inclusion of a battery and to the fact that Mr. Chattock was providing for smaller substations than the one to which he had referred. For the last few months he had been running a 5 000 kW frequency changer for connecting a 50-cycle power house with a 25-cycle railway power house, and the result had been so good that he did not see why they should not be satisfactory elsewhere.

Batteries not Justified.

Mr. R. B. MITCHELL (Glasgow) agreed with the first two speakers with regard to system of supply. He did not think batteries in substations were justified, on account of the cost. In Glasgow there was one substation of 6 000 kW capacity, and there was room for another 3 000 kW. If he put in a battery of 6 000 kW, according to Mr. Chattock's figures the cost would be £210 000. In Glasgow they had also installed a rectifier, but their experience had not been so fortunate as Mr. Chattock's. It was of 1 500 kW capacity in three cylinders. That introduced complications. One of the cylinders gave trouble, apart from the relationship of one cylinder to another, and the coils and switchgear caused complications. At the same time he felt sure the makers would get over the difficulties and would be able to run three cylinders in parallel in one substation with success. At Glasgow they had decided to risk 25 cycle supply to outlying areas.

Witton Works Revisited.

At the conclusion of the meeting the party were taken round the various departments of the Witton works, special attention being given to the electric kitchens in the Club premises and to the exhibition of domestic and other electrical labour-saving appliances. A short description of the former will be found elsewhere. As for the latter it enabled visitors to see in peptonised form the activities of the firm on the less impressive, if ultimately more useful side, of electrical engineering. It is hardly necessary here to dilate on the details of "Magnet" domestic equipment, but the display should have had the effect of hastening the conversion of those who believe that the perfect, or even the fairly perfect, apparatus is still to seek. In other fields we noticed the Haydn Harrison lantern and a warning apparatus for platelayers which makes use of a sensitive relay and bell operated by the vibration of an approaching train.

At the conclusion of the works inspection the company were entertained to luncheon in the Magnet Club by the General Electric Co.

Mr. Hirst on Cheap Electricity.

In reply to the toast of "The General Electric Company," proposed by Mr. S. T. Allen, Mr. Hugo Hirst, who presided, recalled the days of 1914, the last time that the I.M.E.A. visited Witton, when the whole world was suffering from a sickness from which it had not yet recovered. It would only recover when Britain recovered and it was therefore our duty for the sake of universal good to concentrate on our own recovery. In his opinion the only way in which we could recover was by the increasing employment of electricity. To that extent the aims of the Association and the G.E.C. were identical. To produce cheap electricity wherewith to inoculate England would strengthen the electrical industry and every other industry that depended on cheap power, so giving employment and increase of strength. It must be realised that there could be no more living for ourselves. It was the aim of the G.E.C. to build up a concern as large as any and the I.M.E.A. could help them by placing at their disposal the cheap unit which was the most essential raw material for fighting the competition from abroad.

Annual Dinner.

In the evening the annual dinner of the Association was held at the Royal Field Artillery Headquarters, Mr. S. T. Allen being in the chair. A large number of members and guests were present, including Mr. J. S. Highfield, the Mayor of Wolverhampton and Dr. S. Z. de Ferranti.

Replying to the toast of "Our Guests" proposed by Mr. R. A. Chattock, Dr. Ferranti said the convention gave an excellent opportunity for renewing old friendships and making new ones. He referred to a visit he had paid forty-one years ago to Wolverhampton in connection with the lighting of the Ironmasters Exchange The effort of keeping the lights going on that occasion had been so worrying that he had decided he must give up electrical engineering if he could not worry less, and in any event he had had no opportunity of seeing the beauties of the town. He was only too pleased to endorse the remark that Mr. Hirst had made that afternoon that we required far more electricity. The country was in a difficult position and there was no surer way to success than by increasing the use of electricity for every possible purpose. The I.M.E.A. had the great responsibility of being the trustees for electricity users and that great responsibility could only be met by endeavouring greatly to increase the use of electricity. It was true there were difficulties in the way but there must be no waiting for perfection. Electricity could, and should, be used for every purpose for which combustible was now employed, for in every case electricity did the work much better than anything else. It was really a question of salesmanship for there could be no better thing to sell than electricity and we must therefore increase its sales by pushing it for all it was worth and by getting together and devising means for bringing about this result.

In proposing the toast of the "Incorporated Municipal Electrical Association," Mr. J. S. Highfield said that municipalities were at present engaged in a great electrical work. Such stations as Nechells, Dalmarnock and Barton made it certain that municipal electricity supply was going to endure. On the Tyneside they could see the work of private enterprise and that was also going to endure. To bring about the position that Dr. Ferranti had outlined the first matter of importance was to realise that companies and municipalities must assist each other, and if they would only work together Dr. Ferranti's dreams might well have a chance of coming true.

The toast was responded to by Mr. S. T. Allen who said he would like to reply to the complimentary things that had been said about the municipalities by referring to the position of the Institution of Electrical Engineers which was known and respected throughout the world. As he had already pointed out, the I.M.E.A. was the oldest municipal association, and it was therefore a pleasure to have with them to-night representatives of similar associations in Australia and South Africa.

Friday, June 23.

This morning the annual general meeting was held in the Grand Theatre, Wolverhampton. The proceedings opened by the President reading a telegram from the Prince of Wales, expressing his thanks for the Association's message of congratulation upon his return from the East.

The New President.

The President next announced that there was only one nomination for the office of President, and he therefore declared Lieut.-Col. W. A. Vignoles (of Grimsby) duly elected.

Lieut.-Col. W. A. Vignoles, in thanking the members for his election, asked them to support him by reading the monthly report that was sent to them and answering the conundrums which appeared therein.

The President said there was also a single nomination for the Vice-Presidency, and he declared Mr. S. E. Britton, of Chester, duly elected.

The Hon. Solicitor (Mr. P. M. Heath), the Hon. Treasurer (Mr. H. Faraday Proctor), and the Hon. Secretary (Mr. A. C. Cramb) were re-elected unopposed.

The President read a resolution electing Mr. F. Ayton, Past President, an Honorary Member.

The Expenses Problem.

Mr. Faraday Proctor, at the request of the President, dealt with the question of the payment of the expenses of members attending Council meetings. The expenses of the Association were at present about £1 500 per annum, and the expenses of individual members of the Council in travelling to London and the provinces were another £1 500, so that if the Association were to pay the whole of those expenses, the total would be about £3 000, but if it paid the travelling expenses only, the amount required would be £550 less. The Council put forward a scale for drawing from the individual undertakings 1d. for every £20 of gross revenue, which would bring in £3,000 per annum. An alternative was to obtain income by the same means, with a maximum of £30 instead of £50. That would mean that about 16 of the largest undertakings would pay £30, whereas under the first alternative they would pay £50. The contribution of the other undertakings would be 1d. per £20 of revenue, subject to a minimum of £5. The balance of the letters received by the Secretary expressed disapproval of any alteration.

Mr. A. C. Cramb said the Municipal Tramways Association considered this question last year and turned it down. Their subscriptions, however, were two to three times those paid by members of the I.M.E.A.

Mr. S. J. Watson (Bury) said the expenses of the Council of the Borough Treasurers' Association were met out of the borough funds.

Coun. V. Blessley (Hampstead) agreed that the expenses of the Council should be borne by the authorities generally, but it seemed an unfair way to meet the expenses by charging so much on every £20 of gross revenue. He proposed that the contributions paid by local councils should be increased by 100 per cent. with a limit of £50.

Ald. A. Senington (Bristol) seconded Mr. Blessley's amendment.

Coun. E. H. King (Islington) moved that the question be deferred until next year. Some Councils would leave the Association if the matter were pushed now.

Ald. R. Dalton (Carlisle) said he seconded this amendment. To put a limit of £50 on the large undertaking was not fair to places like Carlisle.

Mr. W. C. P. Tapper (Stepney) said the figures put forward by the Council would not involve a very large increase for a small undertaking, but the proposal of Mr. Blessley would have that effect.

Mr. Hinnell (Willesden) thought the Association should fall into line with other associations that paid the expenses of their executives. The Council should divide into three or four panels, each panel meeting for three or four months of the year, and that the whole Council should only meet about once a quarter. A committee of two or three always did better work than one of 20 or 30. His proposal would cut the expenses by about 40 per cent.

After further discussion, the amendment (that nothing be done for 12 months) was carried.

The Annual Report.

Mr. A. S. Blackman (Sunderland) moved the adoption of the Council's report and the accounts, of which we give an abstract below:

The Council, in submitting their 27th annual report, state that the work of the Association has progressed satisfactorily during the last twelve months, and that the results attained show that it is being relied upon more and more to look after the interests of municipal electricity supply authorities in many directions.

Membership.

The total number of municipal electricity supply undertakings belonging to the Association is now 206, representing a population of 19 665 270. This represents 81 per cent.

of all the undertakings eligible. Of the 47 municipal authorities which have not yet joined the Association, 43 are in the provinces, and represent a total population of only 788 746. Four London municipalities are not yet members, but the difficulty which precluded them from belonging in the past has now been removed under Section 30 of the Electricity (Supply) Act, 1919. The Council would be glad if members would use any influence they may have with the undertakings referred to above in order that this small minority may be induced to join the I.M.E.A., and thus pay their share, in the form of the annual subscription, towards the expenses which are incurred for the benefit of all municipalities.

During the year applications for membership were received and accepted from Long Eaton, Stafford, Cheadle and Gatley, Swinton and Pendlebury and Cambuslang, and the Council have extended to them a very hearty welcome. It is to be regretted that Great Yarmouth and Morley have resigned membership.

Under the Articles of Association the Bootle Corporation is no longer eligible for membership owing to its electricity undertaking having been transferred to Liverpool Corporation.

Committee Work.

A section of the report amounting to three-fifths of the whole is devoted to drawing attention in great detail to the nature and number of the various Committees upon which members of the I.M.E.A. have been actively engaged during the past year. These include the five standing Committees of the Association, and special Committees on agreements, and with the B.E.A.M.A., the E.L.M.A. and the E.C.A. The Association is also represented by one or more members on the B.E.D.A., the various Sub-Committees of the British Engineering Standards Association, the Electric Vehicle Committee, the Revising Committee of the I.E.E. Model General Conditions of Contract, the I.E.E. Committee on Overhead and Underground Conductors, the I.E.E. Wiring Rules Committee, the National Proving House Committee and the Railway Rates Joint Conference.

Charges for Tramway Supply.

The Council were asked to investigate the charges for tramway supply laid down in the I.M.E.A.-M.T.A. Joint Report of 1911, but after a *questionnaire* had been circulated, it was decided to take no further action for the present.

The Subscription Question.

At the last Annual General Meeting, the Council were requested to make arrangements for the expenses of members of the executive attending meetings to be borne by the whole of the undertakings who benefitted from the work of the Council. An investigation of the matter shows, however, that this would cost £1 500 per annum, if all expenses were covered, and that it would not be possible to do this without increasing the subscription, a policy which is not wise at the present time. The matter was discussed at the Annual General Meeting as reported above.

Marking Underground Cables.

The difference of opinion between the Association and the G.P.O. on the question of marking underground cables is mentioned as are also the important provisions contained in the Grimsby Corporation (Omnibus Act), 1921.

As regards the maximum repayment periods at present allowed for apparatus to be let on hire, the Electricity Commissioners were informed that as much apparatus now on the market was not standardised, the Association did not press at the moment for any extension of the seven years period.

The Minimum Charges Clause.

In connection with the interpretation of the wording of the Minimum Charges Clause in Provisional Orders, the Commissioners stated that they would recommend the Minister of Transport to circulate an explanatory memorandum pointing out that the clause was intended to cover any case where no units were registered on the consumer's meter. The Honorary Solicitor also recommends that it would be advisable to regard 92 days as being the shortest period for which a minimum charge could be made. Manufacturers are going into the matter with a view to meeting the demand for a meter that will read below 2·5 A.

Stand-by Supplies of Electricity.

Members have frequently drawn attention to the unfairness of Section 15 of the 1909 Electric Supply Act, which, from the legal aspect, does not cover those premises which have a private or independent source of electric supply, and require a stand-by supply of electricity from the public mains. In many areas the difficulty has been overcome by the insertion of a clause in a private Act to cover all cases of stand-by supplies. The Council took up the matter with the Electricity Commissioners in January last, and obtained a promise that steps would be taken to insert a clause in the Electricity (Supply) Bill, 1922, so as to make it perfectly clear that a sufficient income should be obtainable to cover capital charges, etc. This point is dealt with in the Electricity (Supply) Bill, 1922, now under consideration by Parliament.

Financial Position.

The annual accounts show that the Association is financially in a satisfactory position. The total receipts for the year were £2 090, and the total amount expended £1 808.

In a discussion on the report, Mr. F. W. PURSE (West Ham) said he was a whole-hearted supporter of compulsory wiring regulations. The power companies as a rule were opposed to compulsory rules, and quite a number of municipal authorities were equally opposed.

The Monthly Report.

Referring to the monthly reports, which were sent out to members, Mr. S. J. WATSON said he commended their usefulness. He appealed to engineers and chairmen to obtain the necessary quantities of these reports and circulate it at least among the members and the Committee. It would be of assistance in enabling them to understand and appreciate many of the difficulties they were up against.

Mr. A. C. CRAMB, as responsible editor of the monthly reports, invited chairmen and engineers to criticise them, adversely or otherwise, and let him have any information of interest to other readers.

The New Council.

The PRESIDENT then announced the result of the ballot for the election of new members of Council. The members elected were: *Committee Representatives*—Ald. A. Wilkinson (Luton) and Ald. H. Leese (Stoke-on-Trent). *Engineers (Large Towns)*—Mr. R. B. Mitchell (Glasgow), Mr. W. H. J. Wood (Bolton), and Mr. H. R. Burnett (Barrow-in-Furness). *Engineers (Small Towns)*—Mr. T. Hall (Burton-on-Trent).

Mr. N. STANILAND proposed that the Electricity Commissioners be informed that the Association is desirous that the Institution Rules, when adopted by any supply authority, should be enforceable on contractors.

Mr. A. DE RENZI (Newcastle-under-Lyme) seconded the motion, and it was carried.

Mr. L. L. ROBINSON suggested that the Council should arrange in the autumn of this year an excursion to the capital station at Gennevilliers, which was to supply Paris.

The PRESIDENT said the matter would be considered by the Council.

The Commissioners' Expenses.

Mr. F. NEWINGTON (Edinburgh) moved a resolution that "in the opinion of this Association the expenses of administration of the Electricity Commissioners should be a national charge."

Mr. F. L. R. STEWART (Rawtenstall) seconded the motion, and said there were amendments down in the House of Commons for modifying the 1919 Act by making the Electricity Commissioners' expenses a national charge. A resolution by that Association supporting such amendments would help a great deal.

Mr. F. W. PURSE said that Treasury control would mean more red tape than ever.

It was ultimately agreed to refer the matter to the Council for consideration and report.

Votes of Thanks.

Votes of thanks were accorded the President and Council, and to the Lord Mayor and Corporation of Birmingham and the Mayors and Corporations of Wolverhampton and Stoke-on-Trent for the assistance they had given in making the Convention a success, and the Mayoress of Wolverhampton received a special tribute for her assistance.

On the motion of Coun. THICKETT (Gt.-Grimsby) the members passed a vote of sympathy with Lady Wilson in her bereavement by the murder of her husband, Field Marshal Sir Henry Wilson.

This concluded the business in the Convention. In the afternoon parties visited the Wolverhampton Corporation Generating Station, and thus brought to an end a successful, if somewhat tiring, meeting.

Correspondence.

THE INTERNATIONAL RAILWAY CONGRESS.

To the Editor of THE ELECTRICIAN.

SIR,—In his article in your issue of June 2, 1922, Mr Roger Smith seems to indicate that the choice of system for railway electrification depends appreciably on the mode of generation, and instances hydro-electric stations as being suitable for supplying low-frequency, single-phase current, whereas steam turbine, 50 cycle stations would lead to the adoption of the direct current system. The suggestion is interesting, but does a broad view of the situation really support the contention? Thus the $16\frac{2}{3}$ cycle railways in Germany, namely the Dessau-Bitterfeld and the Silesian lines, are supplied from steam stations; likewise the 25 cycle, Hamburg-Altona line. In U.S.A., the Norfolk and Western, the New York, New Haven and Hartford, and the Pennsylvania Railroads are worked with single-phase current at 25 cycles supplied from steam stations. Similarly the Brighton line in Great Britain.

In another place, we read: "Those countries like Belgium, Holland and Great Britain . . . have adopted 1 500 V direct current"; but later, "The Advisory Committee to the Ministry of Transport very properly left an open door in the matter of choice of system"—let us hope the latter is the correct statement.

I can agree with Mr. Roger Smith, however, when he says: "People have talked system so long that they have forgotten that the differences in the cost of working one system, as compared with any other system at present in use, do not exceed one or two per cent. on the total cost of running the railway." In this country the coal pits will probably have to be much deeper before main-line electrification becomes a domestic problem. Instead of worrying so much about "system" therefore, it would be better to encourage our manufacturers to lay themselves out to get whatever work there is to be had. In this respect it seems to me that the policy of the Swiss electrical firms who supply any type of equipment is a much better example to follow than that of the American General Electric Co., which advocates so persistently the direct current system. Ought we not to encourage the North-Eastern Railway to proceed with their direct current project and the Brighton Railway with their single-phase project in order to try out things for ourselves and to give our manufacturers the necessary experience?

STANLEY PARKER SMITH.

City and Guilds (Engineering) College,
Exhibition Road, S.W.7,
June 27, 1922.

Electricity Supply in Victoria.

The Electricity Commission of the State of VICTORIA is developing its policy in a systematic way, and a survey of all fuel resources is to be made, though for the moment attention is being concentrated on the Morwell brown coal scheme. In a recent lecture, the chairman of the Commission (Sir John Monash) pointed out that there was no effort in which co-operation was so beneficial as in the generation and distribution of electricity, because the needs of the community were always less than the sum of the needs of the individual consumer. That was why the generation and distribution of electricity had been declared a public utility in Victoria. When the Commission was first appointed its first duty was to survey the electrical resources of the State. The sources of generation were threefold, namely, black coal, brown coal and water power. Victoria's black coal resources were at present very meagre, so the choice lay between brown coal and water power. There was no doubt that the state was very rich in water power resources, but the territory was almost inaccessible, and little was known of the behaviour of its streams throughout the year. Before electrical schemes could be carried out, accurate information would have to be obtained. Want of knowledge, coupled with the possession of rich brown coal deposits, made them decide upon a scheme for using brown coal. Deposits of the latter pervaded practically the whole of Gippsland. There were three open-cut areas (at Morwell, Traralgon and Welshpool), about 30 square miles in area in each. The coal was from 160 to 600 ft. thick. In one corner of the Morwell area, where minute exploration had been made, one square mile contained more coal than Victoria could use in 150 years.

He did not altogether exclude black coal from the power schemes of the future, because there were no doubt fields to be discovered, and water power would take its place in the scheme in the not distant future; but whatever happened there would only be one State electricity scheme. He condemned the suggestion put forward for a flat rate to be charged for all power sold by the State electricity scheme. The cost of electricity was governed by the length of transmission.

N.A.S.E. Smoking Concert.

There was a large gathering of members of the NATIONAL ASSOCIATION OF SUPERVISING ENGINEERS at the smoking concert held on June 15 at the St. Bride's Institute, London, on which occasion the President, Major T. Vincent Smith, who has been obliged to resign on account of ill health, formally introduced the new President, Mr. W. E. Highfield.

Major Smith accompanied several members in their songs, and the rest of the entertainment was provided by Mr. Alfred Stone's Concert Party. Just before the interval the President addressed the gathering.

He had just completed his year of office as President, and during that time had enjoyed the most loyal co-operation of the members in carrying out the necessary work connected with the position. Unfortunately, he found he was unable to devote the time and energy necessary to maintain the duties of an active President, and as he did not want to be a sleeping partner, he was reluctantly obliged to resign from the position. However, his retirement enabled him to introduce the President-elect, Mr. W. E. Highfield, who was the most suitable man the Association could possibly have found. In conclusion he wished the Association every prosperity in the future, and if there was any way in which he could further help them, he would be only too pleased to do so. Mr. Highfield was then welcomed as the new President of the Association and took the chair.

In his opening speech the incoming President said he highly appreciated the privilege of becoming the President of such an Institution and would do his very best to help to justify their choice. The Association was really one of the most important in the country, as it represented the best brains and work of an industry that it was now impossible to do without. He only hoped his own experiences would be of some use.

Australian Wireless Services.

The shareholders of the AMALGAMATED WIRELESS (AUSTRALASIA), LTD., have sanctioned an amendment of the company's articles of association in order to comply with the terms of the agreement entered into with the Commonwealth Government. The chairman (Sir Thomas Hughes) explained that the agreement with the Commonwealth was the outcome of at least three years' effort on the part of the Government and the company to establish an effective commercial wireless service between Australia and Great Britain. An exhaustive series of experiments had been carried out by the company in Australia, and they had an experimental station able to receive messages direct from Europe and the Atlantic Coast of America at all hours of the day at speeds up to 30 words a minute. The Commonwealth Government had operated a number of short-range stations for communication with merchant ships round the coast of Australia, but the service had involved the Commonwealth in a heavy annual loss, because in its present condition it could not possibly become profitable. It was possible to eliminate the loss by installing more modern apparatus and merging that service with a properly organised commercial service for communication with countries overseas. The co-operation of the Government and the company was therefore necessary. The company's capital would be increased to one million pounds, and the Commonwealth would subscribe for 500,001 shares. The Commonwealth would appoint three directors and the private shareholders would also have the right to elect three directors. The six directors would mutually select a seventh.

The company will proceed at once with a comprehensive plan of development, including a direct commercial service between Australia and England; direct commercial service between Australia and North America; and feeder stations in each capital city. The existing coastal service of the Commonwealth will be taken over by the company. During the period of reconstruction the company is guaranteed against any loss on conducting existing services, but when the new stations are ready the combined services will be carried on as one undertaking and the revenue from the coastal service will be a valuable contribution to the total revenue.

The chairman stated that when their first programme was completed they would have one of the most efficient high-power wireless stations in the world, capable of sending and receiving messages simultaneously between Australia and England at high speed. The main trunk station would be situated near Sydney or Melbourne, but the operating staff would be in the city. The capitals of all the States will be able to send and receive their messages by wireless direct to and from the main operating centre. A rapid press service will also be organised. The company will carry all classes of Anglo-Australian messages at $33\frac{1}{3}$ per cent. reduction on existing charges, so that full-rate and code messages will be 2s. per word, deferred messages 1s., and week-end messages 6d. per word.

The United Fruit Co., of Boston, have placed an order with CAMMELL, LAIRD AND CO. for three insulated motor ships. The vessels are to be of about 4 000 tons gross, and will be propelled by electric motors, the current being generated by Camellaird-Fullagar Diesel engines. It is claimed that by the adoption of this combination of machinery there is an enormous reduction in fuel consumption, and greatly increased cubic space and dead-weight capacity, while the machinery lends itself to the greatest flexibility of control.

The "Magnet" Club and Electric Cooking.

The Witton factory of the General Electric Co. is distinguished not only for its engineering productions, but for the social work which is undertaken for the good of those there in employment. A standing monument to the interest which the firm take in their employees' welfare is the magnificent club house which was erected by the company in memory of many who went from Witton to the front and did not return. Some details of these premises have already been given in

FIG. 1.—GENERAL VIEW OF KITCHEN.

THE ELECTRICIAN, and those attending the I.M.E.A. Convention last week were given an opportunity of inspecting them for themselves.

A Satisfactory Answer.

The first question that we hope most readers of THE ELECTRICIAN ask when they are shown a kitchen in an electrical factory is: "Is electric cooking used?" We are glad therefore to record that the Magnet Club possesses an up-to-date electric kitchen, the whole of the equipment for which was manufactured at the company's Heating and Cooking Works, at Birmingham. The kitchen was planned for the supply of meals to a staff and employees approximating 2 000, and has now been in operation for over eighteen months with complete success. The main equipment comprises four ranges, each fitted with three ovens, grillers, steaming ovens, vegetable boilers, fish fryers, stock-pots, hot cupboards, saucepans and boilers, together with the necessary control gear.

In considering the planning of the kitchen, it had to be borne in mind that whilst large numbers had to be catered for, there was no need to make provision for great variety in the type of meal. Any portion of the plant for cooking in any particular way had to be capable of providing for the full number of diners at any one time. In the design of the whole of the appliances, the guiding principle adopted was simplicity of construction, so that access could be easily obtained to any particular part. In the ovens the whole of the electrical portion can be readily removed, leaving an entirely free space for cleaning. There are no crevices for fat or dirt to accumulate, and all seams are welded.

With the exception of the stock pots, all appliances have self-contained elements, the problem of vegetable boiling has been successfully solved by providing such loading that an ample reserve of heat is available to raise the temperature quickly to the boiling point.

The following details of the equipment are of interest:—

Ovens. Four ranges are provided, each fitted with three ovens of 2 cub. ft. capacity, wired for 5 kW maximum consumption, with low heats of 2⅜ kW and 1¼ kW. They are operated by series parallel switches, the elements being of the Firenza type. On two of the ranges plug receptacles are provided for separately heated utensils.

The grillers are arranged with hot-cupboards above and below, the upper ones receiving the heat from the actual grilling elements. Each half of the griller is wired to consume 8 kW, and is sub-divided again so that only a quarter of the total grilling area need be in use if so desired.

The steaming ovens are double cased and lagged, and the doors are arranged with steam-tight joints. Constant water level attachment is fitted, to avoid the possibility of boiling dry. The current consumption 5 kW maximum, with low heats of 2½ and 1¼ kW.

The vegetable boilers are each of 30 gallons capacity, and are made in heavy copper, double cased. The loads are 6 kW, 3 kW,

FIG. 2.—ANOTHER VIEW IN THE KITCHEN.

and 1½ kW, and they are fitted internally with the usual wire baskets and strainers, etc.

The fish-fryers are made with welded steel pans 36 in. by 18 in. by 8 in., the current consumption to each section 6 kW, with low heats of 3 kW and 1½ kW.

The stock-pots are made of heavy copper, and the heating elements are not self-contained, but the stand is provided with hot-plate 20 in. square loaded to 5 kW maximum, with low heats of 2½ kW and 1¼ kW.

The hot-cupboards and carving tables are each provided with three carving wells, heated separately, the consumption for each being 500 W. The hot-cupboards have a maximum consumption of 3 kW.

The saucepans and boilers are all fitted with self-contained heating elements, with series parallel control. Pilot lamps are fitted near the plug receptacles to which they are connected.

The series parallel principle of control has been adopted throughout the whole of the cooking apparatus in the canteen, and pilot lamps fitted to every circuit. The internal connections in the apparatus are almost entirely of stiff strip metal, and the use of beads is almost eliminated. Mica insulation is adopted throughout, except where red-hot coils are used.

FIG. 3.—VIEW OF THE OVENS IN THE "MAGNET" CLUB KITCHEN.

Usco Ash Conveyor at Wolverhampton.

One of the more important economic and engineering problems connected with modern central stations is that of ash disposal. There are those who would take the heroic course in this matter by using oil and doing away with coal altogether but for many reasons the system employed at the Wolverhampton Corporation Electricity Works has more to recommend it.

THE "USCO" ASH COFVEYOR.

The ash conveyor here installed is of the continuous action water-trough type, supplied by the UNDERFEED STOKER CO., and in principle consists, as shown in the illustration, of a horizontal water-filled trough containing a conveyor chain of special construction. The trough is situated below the boiler furnaces and receives the ash direct from the grates through chutes terminating below the water level in the trough. The cool damp ash is removed from the trough by the conveyor to any desired point. It should be pointed out that the action of the conveyor being continuous the load is handled in most economical manner, while other features of this system are its automatic action and the way in which it eliminates manual labour. The power absorbed in running the conveyor is said to be extremely small, while a perfect air seal preventing the admission of air to the combustion chambers is maintained. There is an absence of dust, heat and fumes in the ash tunnel and the storage of hot ashes in hoppers under boilers is avoided.

These Usco conveyors may be installed in any arrangement of boiler house whether with or without basement and are in fact now installed and in continuous use working under a wide range of conditions.

At Wolverhampton the conveyor is set in a basement under a line of six boilers. The trough is built in concrete with cast iron bottom plates and the chain returns inside the trough, the ash dropping through it on to the operative portion of the chain. The continuation of the trough is formed by an elevator inclined at 35 deg. to the horizontal, up which the chain carries the ashes and delivers them into a 50-ton capacity concrete storage hopper from which carts are loaded. The overall length of the conveyor is 225 ft., the trough being 153 ft. long. The conveyor is driven by an electric motor through worm and spur reduction gear and final chain drive. The power absorbed being approximately 2½ H.P. The load handled is about 4 tons of ash per hour.

A Safeguarding of Industries Order.

The draft of the new Order under the SAFEGUARDING OF INDUSTRIES ACT schedules a number of articles on which a duty of 33⅓ per cent. is payable on importation if manufactured in Germany. The articles include illuminating glassware for use with artificial light, not including electric incandescent lamp bulbs, miners' lamp glasses, or oil lamp chimneys.

The list does not, however, include any article of glassware (whether domestic or illuminating) which is only pressed, or any article composed of fused silica, vitreosil, or similar material.

The Order will remain in force until August 19, 1924.

Confirmation of Electricity Schemes.

The Ministry of Transport has made Provisional Rules relating to the procedure in connection with the confirmation of Orders approving schemes of electricity supply under sec. 7 of the Electricity (Supply) Act of 1919.

Under the rules, before the Minister of Transport confirms an Order he will publish, in such a manner as he may think best adapted for informing persons affected, notice of the proposal to confirm the Order, and of the place where copies of the Order may be obtained.

Any person desirous of objecting to the confirmation of an Order must do so by a memorial, addressed to the Minister of Transport, written on one side only of foolscap paper.

Any memorial objecting to the confirmation of an Order must be sent by registered post, addressed to The Secretary, Ministry of Transport, and posted not later than the date mentioned in the notice and a copy of the memorial must be sent in like manner to The Secretary, Electricity Commissioners, Gwydyr House, Whitehall, London, S.W.1.

Every such memorial must be sealed or signed by the person objecting or by some responsible and duly authorised person on his behalf, and must state:—(*a*) The Order or portions of Order objected to, (*b*) the specific grounds of objection, and (*c*) the omissions additions, or modifications asked for.

Not less than 10 clear days' previous notice in writing, addressed to the persons objecting to the confirmation of the Order or their Agents, and to any other persons (or their Agents) whom the Minister of Transport considers to be affected, will be given of the time and place of any inquiry which the Minister of Transport may direct to be held.

The costs of any such inquiry shall, unless otherwise directed by the Minister of Transport, be paid by the parties appearing at the inquiry, or by such of them and in such proportions, at such time and in such manner as the person holding the inquiry may direct.

L.C.C. Tramway Accounts.

The total receipts of the LONDON COUNTY COUNCIL TRAMWAYS DEPARTMENT for the year ended March were £5 160 320, compared with £4 904 427 in 1920-21, and the working expenses were £4 386 891, against £4 623 654, leaving a surplus of £773 429 (against £280 773), or £570 581, after charging proportion of renewals (£202 848).

These figures include revenue from and cost of operating the Leyton Tramways from July 1, 1921, and the amount payable to Leyton Council is £3 599, after deducting income tax, thus reducing the surplus to £566 982. After deducting interest (£293 964), redemption of debt (£353 636), income tax, &c., there is a deficit of £88,757. In the past year the cost of track renewals has been charged equally to capital and maintenance account, but it is anticipated that in the current year the tramways revenue will be sufficient to defray the whole cost of all renewals. The total gross debt was £15 616 069, but £6 713 048 has been paid off, leaving £8 772 227 as the outstanding debt.

A Mercury Turbo-Generator Plant.

The HARTFORD (CONN.) Electric Light Co. has ordered a COMMERCIAL MERCURY BOILER AND TURBINE PLANT for its Dutch Point generating station. The unit, which will be of 2 000 kVA capacity, is claimed to be the first of its kind in the world. Fuel oil will be used, and it is expected to cut down the fuel consumption for the generation of current by 50 per cent. The *Electrical World* states that it is intended to instal a mercury turbo-generator on the top of an oil-fired mercury boiler containing a charge of about 30 000 lb. of mercury. The turbine will be operated by the mercury vapour at rather low pressure, and the exhaust from the mercury turbine generates steam in a modified water tube boiler.

I.E.E. War Memorial.

On Wednesday the memorial, erected in the entrance hall of the Institution of Electrical Engineers' building, to the memory of the members of the Institution who fell in the Great War, was unveiled by Air Chief Marshal Sir H. M. Trenchard, Bart., K.C.B., D.S.O., and dedicated by the Right Rev. Bishop Ryle, K.C.V.O., D.D., Dean of Westminster. The choristers of H.M. Chapel Royal, Savoy, under the direction of Dr. Bromley Derry, and a section of the band of the Royal Engineers, Chatham, attended, and led the singing of "Oh, God, our help in Ages Past" and the National Anthem.

A fuller report of the ceremony will appear in our next issue.

The hand of the assassin has been busy during the last week. Great Britain loses, through the dastardly act of two wretched miscreants, a distinguished soldier and statesman in FIELD-MARSHAL SIR HENRY WILSON; while Germany is deprived by a somewhat similar crime of DR. WALTER RATHENAU, an able engineer and industrial magnate as well as a statesman of some standing and character. As our readers know, Dr. Rathenau was chairman and head of the well-known Allgemeine Elecktricitäts Gesellschaft, of Berlin. In the past we have sometimes criticised the policy of the company, but we regret it has lost its guiding hand, especially under such tragic circumstances.

Parliamentary Intelligence.

S.E. and C.R. Electrification.

Mr. HANNON asked the Chancellor of the Exchequer (House of Commons, June 20) whether the Trade Facilities Committee had undertaken to guarantee capital expenditure and interest of six and a half millions by the South Eastern Railway Company, such expenditure including an amount of about one and a half millions for the erection of a power station for the sole use of the South Eastern Railway Company; and, seeing that such outlay upon a power station by the South Eastern Railway Company would defeat the objects of the Electricity Supply Act, 1919, and of the Electricity Supply Bill now before the House, that the South Eastern Railway Company had undertaken to keep the capital cost of its power station apart from other capital expenditure under its scheme, and also keep separate accounts of costs of generation, so that the travelling public might not suffer from undue capital expenditure and abnormally high costs of generation, and that in the public interest one superstation, as contemplated in the 1919 Act, would more adequately meet the transport and power and lighting needs of the areas affected, whether he would inquire further into this matter?

Sir J. BAIRD, in reply, said: The Treasury have expressed their willingness on the recommendation of the Advisory Committee under the Trade Facilities Act, to guarantee the principal and interest of a loan of £6 500 000 to be raised for the purpose of electrifying the suburban service of the South Eastern and Chatham Railway Company, and for the erection of a power station. As regards the erection of the power station, the recommendation of the Advisory Committee has been given subject to the approval of the Electricity Commissioners, who are holding an inquiry into the applications which have been made by the South Eastern and Chatham Railway Company and other parties for permission to erect a station in the area concerned.

Mr. WISE asked the Chancellor of the Exchequer what is the security the Government would hold against the advance to the South Eastern Railway Company under the Trade Facilities Act?

Sir J. BAIRD: The hon. Member is under a misapprehension. No advances are made by H.M. Government under the Trade Facilities Act which is limited to guarantees of loans raised by the parties concerned. The South Eastern and Chatham Company have undertaken to make annual payments sufficient to cover the service of the guaranteed loan.

Electricity Commission.

Sir JAMES REMNANT asked the Parliamentary Secretary to the Ministry of Transport (House of Commons, June 26) whether, under the Electricity (Supply) Act, 1919, the salaries of the Electricity Commissioners, their staff, office, and other expenses, had to be paid by the authorised undertakers supplying electricity throughout the country; what these salaries and expenses for the year 1921 amounted to; and whether he was aware that a compulsory levy was now being made on the undertakers to recover them?

Mr. NEAL: The answers to the first and third parts of the question are in the affirmative. The net cost of the Electricity Commissioners in the financial year 1921-22 is, approximately, £40,000.

Sir J. REMNANT: Is the hon gentleman aware that since the introduction of this Bill something like £250,000 has been spent by the Electricity Commissioners, which is charged to the authorised electricity authorities throughout the country; and, if that is so, how can he expect, with these expenses being piled on them, that they can reduce the price of electricity?

Mr. NEAL: I cannot accept those figures.

Sir J. REMNANT: They are absolutely correct.

In reply to a further question by Sir J. REMNANT, Mr. NEAL said he understood that the Electricity Commissioners had no information as to the cost incurred by the authorised undertakers supplying electricity in the proposed London and Home Counties Electricity District of the public inquiry held in June and July last. As the result of the inquiry the Commissioners issued in December last a statement of their decision, which was circulated to all interested parties, and were now engaged upon the preparation of a draft special Order.

Sir J. REMNANT: Is it not a fact that the cost of the London inquiry has been definitely fixed and levies have been made on the authorised undertakers for repayment?

Mr. NEAL: No, sir, certainly not.

Electric Power Charges.

In the House of Commons last Thursday, replying to Lieut.-Col. ARCHER SHEE, who asked the Parliamentary Secretary to the Ministry of Transport if he would state why the charge for electric power supplied by the County of London Electric Supply Co. still remained at 1½d., plus 90 per cent., in view of the reduction in the cost of material and labour, and whether he was aware that there was a general feeling of dissatisfaction among the consumers of this company's electricity owing to the fact that the high cost was detrimental to the revival of trade, Mr. ARTHUR NEAL said the Electric Lighting Orders under which the company was authorised to supply electricity fixed the maximum price which might be charged to consumers. The price mentioned in the question was within such maximum. He had no knowledge as to any general feeling of dissatisfaction.

Empire Wireless Scheme.

Mr. PIKE PEASE (Assistant Postmaster-General), in reply to Mr. Hurd (House of Commons, June 20), said the British Post Office had no share in the arrangement made between the Australian Government and the Marconi Australian Wireless Co., except to the extent that the contract contemplated communication with a station in this country, and that for the erection of such a station the co-operation of the British Post Office in some form or other was necessary. The bearing of the contract upon the Empire wireless scheme was under the consideration of the Government. The Canadian Government would shortly send two technical representatives to discuss the scheme with representatives of his Majesty's Government, and after these discussions had taken place it would be possible to describe the relationship of Canada towards the Empire wireless scheme.

Water Power Undertakings.

Mr. MILLS asked the Parliamentary Secretary to the Ministry of Transport (House of Commons, June 20) whether, in view of the continued problem of unemployment and consequent unproductive expenditure on unemployment pay and local relief, he would reconsider his decision not to proceed with the recommendations of the Water Power Resources Committee appointed to consider the utilisation of water power for electrical generation?

Sir W. MITCHELL-THOMSON, who replied, referred the questioner to the answer given to the hon. Member for the New Forest Division (Mr. Perkins) on March 13, but added that legislative authority had recently been obtained in one case, and in two other cases was being sought in the present Session by the promoters of water power undertakings.

Monte Video Trams.

In the House of Commons last week COLONEL NEWMAN asked the Under-Secretary for Foreign Affairs whether he had been successful in his efforts to obtain for the British-owned tramway undertaking at Monte Video the return of its property and funds sequestrated some time back by the national or local authority.

MR. HARMSWORTH (in reply) said that since the date of the hon. member's last question on this subject the Bill for the increase in tariff on the tramway had passed the Chamber of Deputies and gone up to the Senate. The appeal of the company against the action of the municipality was now before the Uruguayan Courts. Pending a decision of the Senate in the one case and the Courts in the other, representations by H.M. Government would be out of place.

Electricity Orders Confirmed.

On the motion of Mr. NEAL (Parliamentary Secretary, Ministry of Transport), the Special Order made by the Electricity Commissioners under the Electricity (Supply) Acts, 1882 to 1919, in respect of the parishes of Anlaby, North Ferriby, Melton, Welton, Waudby, Swarland, Willerby, Halternprice, Kirkella, and Westella, in the rural district of Sculcoates, in the East Riding of the County of York, and for the amendment of the Kingston-upon-Hull Electric Lighting Act and Orders, 1890 to 1915, was approved on Friday.

Private Bills.

The Court of Referees of the House of Commons have allowed a *locus standi* to the Aberdare and Aberaman Consumers Gas Co. and other gas companies to oppose the Bill of the SOUTH WALES ELECTRICAL POWER DISTRIBUTION CO., which confers further capital and other powers upon the company.

Electrical Vehicles for Municipal Work.

An interesting discussion took place at the annual conference at the INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS at Cardiff on Friday on a paper by Mr. R. B. MITCHELL, electrical engineer to the Glasgow Corporation, entitled, "Electric Vehicles for Municipal Work."

Mr. E. J. ELFORD, Cardiff, the newly-elected president of the Institution, was in the chair, and Mr. W. J. STEELE, Newcastle, opened the discussion. Mr. Steele contended that whilst electrical vehicles proved the best in certain districts, over long distances they were not so useful as steam. In an experiment over six months they found that steam was slightly cheaper than petrol.

Mr. H. G. WHYATT, Grimsby, said he noticed that Mr. Mitchell did not think that for Glasgow electric vehicles were an advantage over horse vehicles. His experience in Grimsby was that they saved 2s. 7d. per ton by using electric vehicles. These vehicles were bought about 18 months ago, and the total cost of collecting by them was 8s. 11¾d. per ton, whilst by their own horses the cost was 11s. 6¾d., and by other horses which they hired, 6½d. per ton more.

Mr. J. A. DAWES, Inspector of Cleansing, Ministry of Health, mentioned that his data showed that up to a distance of a mile the horse vehicle was quite satisfactory, but after a mile, especially where they had what was called kerb collections, the electric vehicles were cheaper. For longer distances the heavier vehicle answered best, and for distances of three miles or more steam was to be preferred.

The PRESIDENT was of the opinion that they could not get a proper basis of comparison if they put one vehicle on a short distance and another on a longish haul with different kinds of refuse. He thought the loading line was a very important question, and that many of the standard vehicles of the manufacturers were a good deal higher than they need be.

Mr. Mitchell was not present to reply to the discussion, but wrote stating that he would be pleased to supply any member with whatever information he had in his possession.

During the conference demonstrations of a number of electrically-driven appliances were given.

Legal Intelligence.

Welding Patent Litigation.

Last week Mr. Justice Eve heard a somewhat unusual action brought by Weldrics, Ltd., against the Quasi Arc Co., Ltd., for an injunction to restrain defendants from threatening them by means of circulars, advertisements or otherwise with legal proceedings or liability in respect of falsely alleging infringements of patent rights, of which defendants claimed to be the owners or were interested in. Defendants denied there was any threat to plaintiffs.

Sir Duncan Kerly, K.C., and Mr. C. Terrell appeared for plaintiffs, and Mr. J. Hunter Gray, K.C., and Mr. J. Whitehead for defendants.

In opening plaintiff's case, Sir Duncan Kerly said defendants had not suggested that plaintiffs had infringed their patents. Their case, in reply to the plaintiffs' charge of threats, was that there was no threat, but only a warning. Both plaintiffs and defendants made welding electrodes. In that case the electrode weld was covered with asbestos. Defendants were possessed of certain patents, but so far as the present case was concerned only one of them was of importance. That was a patent which was an improvement on an earlier patent. The original patent was that the electrode should be laid out for the purpose of welding along a groove. By way of improving it the patentee said he had discovered that the better way was, instead of putting it in a groove, to put it on an incline and that the covering should be of blue asbestos fibre. The first patent to be referred to was 1 274 of 1912, and the later one was 11 079 of 1912, which amended the previous one with a view to reducing the oxidising of the metal. Some time after this defendants commenced an action against a Mr. Scott Anderson and as the result of negotiations he elected not to defend the action, which came on undefended. Defendants obtained a judgment against Mr. Anderson which counsel contended was too wide in its terms. They got an injunction against Anderson restraining him from infringing the patent or from selling "any metal electrode covered wholly or partly with blue asbestos." These last words, counsel said, were quite unnecessary. Having got the injunction defendants proceeded to issue circulars to the trade in which they stated that all electrodes covered with blue asbestos were infringing patents held by them. This, later on, came to the knowledge of plaintiffs, and it was seriously interfering with their business. There were only a few firms engaged in making asbestos covered electrodes, and at least one firm was "bluffed" by defendants' circular and they ceased manufacturing them. In July, 1921, plaintiffs, having heard of the circular, wrote to defendants asking whether their electrode infringed the defendants' rights, and the latter having seen samples replied that plaintiffs' covering material appeared to be applied as a paste and in their view did not interfere with their patent rights. In November, 1921, however, defendants wrote to the Rose Street Foundry and Engineering Co., of Inverness, enclosing a copy of the circular and pointing out they were using blue asbestos. The Rose Street Co. were plaintiffs' manufacturers and their case was that this amounted to a threat against them of legal proceedings in connection with defendants' patents.

Mr. Samuel H. Gordon, of the Rose Street Foundry, gave evidence of the receipt of the letter enclosing the circular of which plaintiffs complained.

Mr. Andrew Stewart, a director of the Pneumatic Consolidated Tool Co., said the company proposed to take up an agency for plaintiff's goods, but learning of the circular about the blue asbestos he was unable to do business with them.

At the close of plaintiff's evidence, Mr. C. Terrell suggested that the sending of the letter and circular to the Rose Street Co. was intended to frighten plaintiffs, as defendants must have known the company were making plaintiffs' electrodes, and that amounted to a threat, as alleged in the action.

Mr. J. Hunter Gray, K.C., who opened the case for defendants, said he was of opinion the warning issued by defendants had overstated what was the judgment against Anderson, and he had advised his clients to modify it. They did not propose to send out any similar statements in that form. Those remarks, however, did not prejudice defendants in the present action, and he submitted that plaintiffs had no cause of action, and, further, that the circular was in no sense a threat, but a general warning to the trade.

Mr. Charles Henry Champneys, chairman and joint managing director of defendant company, stated that the Rose Street Company were customers of defendants, but he was not aware till the correspondence in connection with the action that there was any working connection between them and plaintiffs. In cross-examination (by Sir Duncan Kerly), witness said he thought he had the sole right to use blue asbestos. He was inclined to say he had a monopoly in the use of blue asbestos.

After further evidence was given, his Lordship, in giving judgment, said the case presented a great deal of difficulty. The facts were not really in dispute. In 1921 plaintiffs discovered it was possible to utilise blue asbestos after pulverisation and making it into a paste for the purpose of covering electrodes. Defendants got to know that these were being put on the market, and in July of that year plaintiffs took a strong but perfectly straightforward course by writing asking if they were infringing defendants' patent. Eventually defendants wrote that the paste did not come within the scope of their patent rights, not knowing that the paste was made of blue asbestos. Later in the year they found that the Rose Street Co. were dealing in blue asbestos, but did not know that company were intimately associated with plaintiffs. The result was the defendants wrote that the paste was not an infringement, but if blue asbestos was used they would stand upon their rights and take proceedings. Under those circumstances, his Lordship said he did not see how it was possible to hold that plaintiff company were aggrieved. The circular was a general warning that they intended to assert their rights if there was any infringement of their patents. The action failed, and would be dismissed with costs.

Postmaster General v. Liverpool Corporation.

The Court of Appeal (Lords Justices Bankes, Scrutton, and Atkin) delivered their reserved judgment on Monday upon the appeal of the Liverpool Corporation from a judgment of a Divisional Court reversing a decision of the Liverpool County Court judge who had found against the Postmaster-General upon his claim against the Corporation for the agreed cost (£40 8s. 7d.) of repairing damage done to the Post Office telephone plant by an electric light main belonging to appellants.

The electric light cable had been laid in 1889, enclosed in an iron cable. The telephone wire, laid in 1903, was in an iron pipe, and was adjoining and underneath the electric cable On August 6, 1918, there was an escape of electric current causing an explosion, which damaged both the electric light cable and the telephone wire. Contrary to the views expressed by the County Court judge, the Divisional Court held that both on the ground of nuisance and on the ground of debt the Postmaster-General was entitled to succeed, and from this result the Corporation appealed.

Lord Justice Bankes, in giving judgment allowing the appeal, after setting out the facts and referring to the material statutory provisions cited during the arguments, said that upon the facts the Postmaster-General could not, in his opinion, occupy any other position in regard to the telephone wire than that of a mere licensee. He thought, therefore, that he could not succeed in his claim. Having regard to the finding of the County Court judge the Postmaster-General must be regarded as a licensee with knowledge of the facts and of possible damage from the electric main. The damage arose from deliberately putting the telephone cable in immediate contact with the electric main. For these reasons he thought the appeal must be allowed, with costs there and below, and the judgment of the County Court judge in favour of the Corporation restored. (Lord Justices Scrutton and Atkin concurred.)

Electric Lamp Patents.

Last week Mr. Justice Astbury heard a motion on behalf of the British Thomson-Houston Co. for judgment in four actions in respect of patents. The defendants were H. Bake and Co., Childs Thomann, and the Empire Electric Lamp Co.

Counsel said the judgment was drawn in the usual form, and his Lordship gave judgment for plaintiffs, as asked.

Personal and Appointments.

Alderman Hamilton has retired from the chairmanship of the Preston Electricity Committee.

The Council of the University of Leeds has appointed Dr. W. T. David, M.A. Cambridge, D.Sc., Wales, to be Professor of Civil and Mechanical Engineering, and to take up his duties next October on Prof. Goodman's retirement from the chair.

Mr. E. B. Pausey has resigned his appointment as power station superintendent at the Loughborough Corporation Electricity Works, having accepted a similar appointment at the Poulton power station of the Wallasey Corporation.

Readers of The Electrician will be interested to learn that The Metropolitan Electric Supply Company have appointed Major H. Richardson, O.B.E., M.C., Manager of the Electricity Undertaking of the Dundee Corporation, as General Manager of the Company in succession to Mr. W. R. Rendell, who has resigned on account of ill health. Major Richardson will take up his duties on 1st October next.

Sub-Station Fire on Metropolitan Railway.

A fire broke out at about 6.30 on Sunday evening at the Metropolitan Railway Company's Moor Lane sub-station, and did damage estimated at about £100 000. Traffic on the Metropolitan line from Aldgate to Baker Street, and on the Great Northern and City Railway from Moorgate to Finsbury Park was stopped during Sunday night, but was resumed on Monday.

We are informed that the fire was due to an internal short circuit in one of the transformers. The oil became ignited, burnt through the tanks and set fire to the building. There is no foundation for the statements in some of the daily papers as to overloading being the cause.

On the West Ham Borough electricity account there is a surplus for the year of £23,472.

Electricity Supply.

The Ministry of Transport has revoked the DEAL AND WALMER Electricity Order held by the Gas Co.

As from July 1 the charges for electricity at MANSFIELD are to be reduced from 150 per cent. to 100 per cent. above pre-war prices.

PRESTON Electricity Committee has decided to charge half lighting rates to private users of electricity for the decorations during Guild week.

EXETER City Council has reduced the charges for electricity by $\frac{1}{8}$d. per unit and the charge for power to the tramways from $2\frac{5}{8}$d. to $2\frac{1}{4}$d. per unit.

HEMEL HEMPSTEAD Rural Council has consented to an application by Watford Urban Council for an Order to enable them to supply electricity to Kings Langley and Bovingdon.

BARNSTAPLE Town Council have received a letter inquiring whether they are prepared to consider negotiations for the sale of the Corporation Electricity Works. A special meeting is to be held to consider the proposal.

DOUGLAS (ISLE OF MAN) Town Council has accepted the offer of the Manx Electric Railway Co. for electricity for the decorative lighting on the front up to September 30 at $6\frac{1}{4}$d. per unit up to 11 p.m., and 9d. per unit after that hour.

NORWICH Electricity Committee announce a reduction in the charges for electricity as from July 1. This will leave the advance in the charge for power at 50 per cent. above pre-war instead of 100 per cent., and bring the charge for lighting in combination with the assessment charge to 1d. per unit. The committee also propose to reduce the charge for public lighting from £3 per lamp per annum to £2 15s. The number of public lamps is 2 627.

At a meeting of the FAVERSHAM Town Council, on June 20, Councillor Clark proposed that the municipal electricity undertaking should be disposed of, on the grounds of the cost to the ratepayers, the deficiencies aggregating upwards of £17 000 in 17 years, and that a large capital expenditure was necessary to put cables in order. It was stated that £14,133 had been repaid off loans, and that the largest loan of £18 000 would be repaid in six years. The motion was defeated by 6 votes to 4.

HAMMERSMITH Borough Council have received the formal sanction of the Electricity Commissioners to the borrowing of (*a*) £17 735 (on account of £27 000), in connection with the supply of electricity to the Wormholt Housing Estate, repayable as to £15 155 (mains and services) within 25 years, £420 (switchgear) within 20 years, and £2 160 (meters) within 10 years; (*b*) £16 894, for general main extensions, etc., repayable as to £8,494 (mains and services) within 25 years, £5 423 (transformers, etc.), within 20 years, and £2 977 (meters) within 10 years.

For some time past the Light Railways and Electric Lighting Committee of SOUTHEND Town Council have been considering alternative schemes to meet the future demands for electricity in the town. At their meeting last week they decided to recommend the Council to adopt the scheme submitted by the consulting engineer, Mr. C. H. Wordingham, who advocates the generation of electricity by means of turbo-alternators, the scrapping of the existing works in London Road, and the sub-stations, and the establishment of a generating station on a site outside the borough. The estimated cost of the scheme is £409 000. The alternative scheme recommended by the borough electrical engineer (Mr. R. Birkett) recommends the continuance of the present works, and the installation of additional Diesel plant, at an estimated cost of £240 000. A special meeting of the Town Council is being held this week, when the report and recommendations of the Committee will be considered.

Business Items, etc.

ELECTRIC LAMP FACTORS, LTD., have removed to larger premises at 44, Berners Street, London, W. 1. Telephone: Museum 6886.

Mr. ROBERT LEACH has been appointed sales engineer to FERGUSON, PAILIN LTD., for Lancashire, Yorkshire and North Wales areas.

It is announced that HEAD WRIGHTSON AND CO. have taken over the interest of the amalgamated industries in Whitwell and Co., Ironworks, Thornaby.

F. W. PARKES AND CO. announce that they have removed from 65, Dame Street, Dublin, to larger premises at Faraday House, Temple Lane, Dame Street.

RADIO INSTRUMENTS, LTD., announce that the address of their company is 12A, Hyde Street, New Oxford Street, W.C.1, not 18A, Hyde Street, as stated in our issue last week.

The Birmingham sales office of CALLENDER'S CABLE AND CONSTRUCTION CO. is now at Daimler House, Paradise Street, Birmingham. The company's representative at this office is Mr. J. M. Dunkeley.

The business offices and manufactory of the BRITISH CLIP CO., makers and patentees of the "Whippet" Clip, have been transferred to more central premises at 146, Blackfriars Road, S.E.1, to which address all communications should be sent.

Electric Traction.

By 52 votes to 28 GLASGOW Town Council last week decided to offer £250,000 for the purchase of PAISLEY District Tramways Co.

HAMMERSMITH Borough Council recommend that the original penny fare stages on the London United Tramways system be reintroduced.

DEWSBURY Town Council has applied to the Ministry of Transport for an extension of two years for carrying out the work authorised by the Tramways Order, 1911.

The WESTON-SUPER-MARE and District Electric Supply Co., have applied to the Ministry of Transport for an extension of time until August, 1924, for the completion of the tramways authorised by the order of 1900.

After fully considering the position with regard to the tramways, trolley 'bus, and motor-'bus undertakings of the Corporation Keighley Town Council have decided that for the present at any rate, a £40 000 scheme for the reconstruction of the tramway track must be shelved. An electric arc welding plant is to be purchased at an estimated cost of £316 for welding up tram rails where the foundations are good, also a rail grinder, at an estimated cost of £150. These steps are only palliative, and the bigger problem of dealing with those portions of the track which are in a very unsatisfactory state will have to be dealt with later.

With regard to the motor-'bus and trolley-'bus services the Council is faced with a serious position, due to the heavy losses of the trolley 'busses, caused largely by constant failures of the mechanism. The tramways department have, it is stated, at least half a dozen vehicles which are not fit to run at the present time, and the repairs have not been worth the money spent upon them. The greatest difficulty has been with regard to the motors, which are an integral portion of the rear wheels, but now the committee has obtained the sanction of the Council to carry out a conversion from the present wheel drive to a back axle drive, the cost being estimated at £525.

The HULL members of the Tramwaymen's Union are greatly disturbed at the proposals of the Corporation Economy Committee. These have not yet been publicly disclosed, but it is understood that a sum of £30,000 is to be saved. At a meeting held on Friday a resolution was passed by which the men pledged themselves to resist to the uttermost any attempt to economise at the expense of the men employed in the undertaking, which would obviously curtail the efficiency of the service, and in turn cause the public further inconvenience. The meeting also discussed the competition of motor 'buses with tram cars, and it was suggested that privately-motor-owned 'buses should not be licensed by the Corporation, unless the persons employed on such vehicles are working under trade union conditions as to pay and hours. The tramwaymen were advised that they had no power to enforce this; but they passed a resolution, pointing out that with proper tramway organisation private 'buses could not carry passengers within the city boundaries.

Wireless and Telegraph Notes.

At the request of the German Chamber of Commerce at COLOGNE, the postal authorities have agreed to the appointment of officials at the main Cologne telegraph office who have a thorough knowledge of French and English.

A Reuter's message from New York states that Signor Marconi has announced the invention of a WIRELESS SEARCHLIGHT, by which wireless waves, reflected like light waves, may be sent in any direction in a beam instead of being scattered in all directions.

Considerable acceleration of the commercial wireless service between ENGLAND AND SPAIN has been secured by the recent transfer of this service from the Poldhu station to a new Marconi station at Ongar. Under the new conditions messages to Spain, marked "via Marconi," instead of being relayed by long land line circuits to Cornwall are transmitted direct by distant control from Rio House, London, to the receiving station in Spain.

American data is now added to the COLLECTIVE EUROPEAN WIRELESS WEATHER REPORT which is transmitted daily at 11.30 a.m. (Greenwich Mean Time) from the Eiffel Tower. The observations circulated consist of the reading of the barometer and the direction and force of the wind at 1 a.m. (G.M.T.) on the day of issue at about thirty places scattered over the Continent, including Bermuda, Chicago, Cleveland, Denver, Cape Hatteras, Salt Lake City, San Francisco, Washington, and Winnipeg. Approximate positions of the centres of cyclones and anticyclones are also indicated.

On July 24 the EASTERN ASSOCIATED TELEGRAPH COMPANIES will celebrate the FIFTIETH ANNIVERSARY of their incorporation at a banquet and fete, to be held in the gardens of the Royal Botanical Society, at which the Duke of York has promised to be present. The staffs of the companies are marking the occasion by a presentation to the chairman, Sir John Denison-Pender, of a bound volume containing the signatures of nearly 8 000 subscribers, and the reproduction in platinum, set with brilliants, of the Stars of the Insignia of the Orders of K.C.M.G. and G.B.E. In addition they are permanently endowing a bed in St. Bartholomew's Hospital to the memory of Lady Beatrice Katherine Denison-Pender (the chairman's late wife).

Miscellaneous.

The J. S. Fry and Sons, Ltd. Colston Research Fellowship, which provides for payment of fees and a maintenance allowance of £150 a year, at Bristol University, has been awarded to Mr. Francis Baliol Wrightson, a student in the Faculty of Engineering.

The District Industrial Council for Electricity Supply Industry (West Midlands area) notifies a further reduction of a halfpenny per hour in the wages of employees as from July 1 next. The revision is based upon the average of the cost of living figures for the three preceding months, the agreement providing that there shall be an increase or decrease of one half-penny per hour for every completed six points variation. The average of the figures for April, May and June shows a decrease of nine points.

We are asked by the Institute of Physics to mention that a great many persons who have received a copy of the preliminary number of the proposed Journal of Scientific Instruments, and who may wish to support it have not yet filled in the form inserted in the Journal. It is hoped that all who intend to subscribe will inform the Institute without delay so that an estimate may be formed of the support which may be relied upon. Sufficient support must be forthcoming before it is possible to issue the Journal.

A new scheme for the development of British chemistry and science has been put forward by Sir William Jackson Pope, Prof. of Chemistry at Cambridge University. He proposes the immediate establishment of an Advisory Science Committee to the Board of Trade. Extravagance and muddling could be saved once and for all, he maintains, by the establishment of an advisory body of about twelve scientific and chemical experts, which would meet at stated intervals and give expert guidance to the Government in all matters concerning the nation's scientific welfare. As it would not be a part of the Government machine, the cost of maintenance would be negligible, and the saving it could effect in national expenditure would be incalculable.

Companies' Meetings, Reports, etc.

Shropshire, Worcestershire and Staffordshire Electric Power Co.

The ordinary general meeting of the Shropshire, Worcestershire and Staffordshire Electric Power Co. was held on June 22, at Electrical Federation Offices, 88, Kingsway, W.C., Mr. Wm. L. Madgen (chairman and managing director) presiding.

The chairman, in moving the adoption of the report and accounts, said that a great change had recently taken place in connection with electric supply undertakings. When most of the undertakings were established, a few years before the beginning of the present century, there was a marked difference between distribution companies and power companies. Whereas distribution companies were liable to be purchased by the local authorities after a term of years, usually about 22 years—20 of which had already elapsed—power companies had a perpetual tenure and were not subject to expropriation. It was now to be observed that the progress of electric supply although very slow to commence, had during the past few years undergone a remarkable change, both in the use for power and for domestic purposes.

Past Year's Working.

With regard to their own company, the volume of business done and the net profits obtained during the year 1921 had not been so large as in the previous year. The obvious explanation was that the coal strike had suspended industrial operations and inaugurated a severe depression in trade generally. The figures for the past year were better than those for 1919, but they expressed only a small part of the improvement that had taken place. The sale of electricity for power purposes was in their area an accurate barometer of the general state of trade; therefore they were probably dependent to a larger extent for their profits on general industrial conditions than many other electricity supply undertakings. This was brought out very clearly by the number of potential consumers on their mains. During the last few years they had connected up a large number of new consumers, and old consumers had increased their equipments for the employment of electricity; there was a larger potential demand on their generating plant than at any previous period. But notwithstanding all this, the output of electricity from the company's generating station at the present time was only about 50 per cent. of the generating plant installed, showing clearly that the prosperity of the company was very largely dependent upon the state of trade in the district.

Improved Financial Position.

A comparison of the balance sheet now presented with the preceding balance sheet showed a marked improvement in the financial standing of the company. They had paid off many of their liabilities; had improved their reserves and increased their available cash resources. They had been enabled to do this by the issue made during the past year of £300 000 7½ per cent. ten-year guaranteed convertible debenture stock. The issue was oversubscribed, and had enabled the company to put its finances on a satisfactory basis. The loan from the Ministry of Munitions had been reduced by the agreed annual instalment of £13 066, which made with previous instalments a total amount repaid of £62 867, leaving a balance outstanding and repayable by annual instalments during the period of twenty years from 1921 of £257 133. The reserve fund now stands at £86 310, after applying the amount appropriated from the sinking fund under the first debenture trust deed.

A sum of £48 617 was expended during the past year upon buildings, plant, machinery and mains. They had, however, about reached the practical limit of extensions on the site of their power station at Smethwick, and contemplated that their further requirements would have to be met by means of an additional power house of considerable magnitude at Stourport on the River Severn.

The S.W. Midlands District.

During the past year an inquiry had been held in the district by the Electricity Commissioners for the delimitation of the company's area with a view to the constitution of a joint electricity authority for the district.

The company, in association with the city of Birmingham, had made an alternative proposal to the effect that an advisory committee should be constituted to administer the supply in the South-west Midland area, including a portion of their own statutory area and of the Parliamentary area of the city of Birmingham. The Commissioners had acceded to that suggestion. If the scheme was confirmed at a second inquiry, to be held on the 29th inst., it would probably be put into effect immediately after the passage of the Electricity (Supply) Bill now before Parliament. Application had been made to the Treasury to guarantee the expenditure involved for the erection of the above-mentioned power station on the Severn, and a decision might shortly be expected, in which case a meeting of the shareholders would be called to authorise the constitution of the undertaking of the power-house as a separate undertaking.

The report and accounts were adopted.

The General Electric Co. (of New York) announce a dividend of 2 per cent. on capital stock, payable on July 15.

At a general meeting of the Allgemeine Elektricitats Gesellschaft last week, it was decided to increase the capital by an amount up to 250 000 000 marks.

The directors of the India Rubber Gutta Percha and Telegraph Works announce that they are unable to recommend an interim dividend on the ordinary shares.

After providing for interest on and redemption of debentures the accounts for 1921 of the Lisbon Electric Tramway Co. show a loss of £29 184, which increase the debit carry forward to £48 455.

The directors of the Eastern Extension Australasia and China Telegraph Co. have declared an interim dividend for the three months ended March 31 last of 5s. per share, payable free of income tax, on the 15th prox.

Edgar Allen and Co. report a net profit for the year of £25 238. The directors propose a final dividend on the ordinary shares of 6d. per share, making 5 per cent. for the year, tax free, carrying forward £20 067, compared with £30 240 brought in.

The directors of the Metropolitan-Vickers Electrical Co. announce their intention to increase the sinking fund for the redemption of the six per cent. prior lien debentures by setting aside this year the additional sum of £131 233, and that the whole of the above-mentioned debentures will be paid off at par on January 1st, 1923.

The Eastern Telegraph Co. announce the payment on July 15, of dividend at the rate of 3½ per cent. per annum less income tax on the preference stock of the company for the quarter ending June 30, 1922, and a first quarterly interim dividend of 2½ per cent. on the ordinary stock, free of income tax, in respect of profits for the year ending December 31, 1922.

Subscriptions are now invited for the expected issue of £2 500 000 in 4½ per cent. second debenture stock by the Underground Electric Railways. The loan, £1 000 000 of which is on behalf of the London Electric Railway and £1 500 000 for the City and South London Railway, is issued at £94, and is guaranteed as to principal and interest by the Government under the provisions of the Trade Facilities Act. The proceeds of the issue will be applied towards the construction and equipment of the Edgware and Hampstead Railway, forming an extension from the terminus of the section of the London Electric Railway at Golders Green to Hendon and Edgware, the construction of connecting railways at Camden Town to enable a through service of trains to be worked between the City and South London Railway and the London Electric Railway, the enlargement of tunnels and improvement of stations on the City and South London Railway, and the provision of new rolling stock and equipment.

The profit of J. G. White and Co. for the year ended February 28 last was £11 154, plus £13 193 brought in, making available £24 347 which has been used in pursuance of the scheme for reduction of capital. The nominal capital was reduced from £500 000 to £350 000 by writing off from each of 200 000 issued ordinary shares of £1 each the sum of 15s. per share. The sum of £150 000 was written off from the debt due by J. G. White Commercial Co. and £100 000 has been received from that company in cash, reducing the balance of its debt to £84 000. Investments now stand in the books at £304 887, after deduction of reserve of £50 000, balance on profit and loss account above-mentioned, and £5 149 available on revaluation of office furniture, plant and instruments, making total deduction of £79 497. As a further part of the scheme for the reduction and reorganisation of capital, 50 000 of unissued ordinary shares of £1 each were sub-divided into 200 000 ordinary shares of 5s. each, and these shares, since the date of the balance sheet, have been allotted at par. Preference shareholders have accepted the arrangement waiving their cumulative rights for a period of three years ending August 31, 1923.

H

Tenders Invited and Accepted.

UNITED KINGDOM.

Gellygaer Urban Council, July 4.—Transformer plant, e.h.t. and l.t. switchgear, steel poles, h.d. copper wire, cable and boxes, etc. Specifications from the Electrical Engineer and Manager, Bargoed.

Wimbledon Corporation, July 10.—Four 1 000 kVA, 10 000/2 000 V transformers. Specification from the Borough Electrical Engineer.

Torquay Corporation, July 12.—One 3 000 kW turbo-alternator and condensing plant. Specification, etc., from the Borough Electrical Engineer.

Navan Urban Council, July 12.—D. c. main switchboard, d.c. generators, mains, oil engine set, house service meters and fuses, public lighting fittings and brackets, lamps, cables, insulators, etc. Specifications from Mr. J. J. Woods, Clones, co. Monaghan.

Connahs Quay Urban Council, July 14.—Sub-station equipment, overhead and underground mains, public lighting, etc. Specifications from Mr. A. J. Leigh, 122, The Albany, Old Hall Street, Liverpool.

Gravesend Corporation, July 17.—Five thousand kW turbo-generator, condensing plant, switchgear, mains, artesian well and automatic stokers. Specifications from the Borough Electrical Engineer.

London County Council. July 24.—H. T. Switchgear at the Central Repair Depot, Charlton. Particulars from the Clerk of the Council, County Hall, Westminster Bridge, S.E.1.

London County Council, July 31.—Four electric lifts for the Council's tramways central repair depot, Charlton. Particulars from the Clerk of the Council, County Hall, London, S.E.1.

Dublin Corporation, August 1.—Two sets of electrically-driven sewage pumps, each capable of dealing with 18 million gallons per day. Specifications from the City Engineer or Mr. J. S. Alford, 11, Victoria Street, Westminster, S.W.1.

AUSTRALIA.

Postmaster-General's Department, Brisbane, August 9 *—Protective apparatus (Stores Schedule No. 563)

Postmaster-General's Department, Perth, August 9* :—Telephone and telegraph apparatus, testing instruments, and protective apparatus (Schedule No. W.A. 734).

Commonwealth of Australia, August 22.—Silk and cotton-covered switchboard cable (Schedule 35). July 25.—Paper-insulated and lead-covered submarine cable (Schedule 42). October 17.—Automatic c.b. telephone equipment (Schedules 39 and 40). August 9.—Protective apparatus (Schedule 563). Specifications, etc., from the Supply Officer, Room 101, Australia House, Strand, London, W.C.

INDIA.

High Commissioner of India, July 21.—(1) Automatic telephone sets, desk and wall; (2) cards for telephone switchboards, etc.; (3) cells of various descriptions for accumulators. Particulars from the Director-General, India Store Department, Belvedere Road, Lambeth, S.E.1.

Hammersmith Borough Council have accepted the tender of the Clay Cross Co., for a "Green" economiser at £1 550.

Barnes Urban Council have accepted the tender of the Pirelli General Cable Co. for 1 750 yd. of cable, £520.

Hebburn-on-Tyne Electricity Committee recommend the Council to accept the tender of A. Reyrolle and Co. for nine e.h.t. panels, £3 100.

Ayr Corporation have accepted the tender of Callender's Cable and Construction Co. (lowest tender of two received), for cable to Allaway, at £4,791 0s.

Doncaster Town Council has accepted the tender of Babcock and Wilcox, Ltd., for two water tube boilers, with economisers, induced draught plant, and steel chimney, at £21 663.

Rugby Urban Council has accepted the tender of W. T. Henleys Telegraph Works Co. for 1 050 yards of l.t. three-core cable; and that of the British Thomson-Houston Co., for three transformers.

Dover Corporation have accepted the tenders of Callender's Cable and Construction Co. for service cables for Carr House, Arksey, at £685 19s. 8d.; and Johnson and Phillips for e.h.t. switchgear, £96.

Douglas, I.O.M. Electricity Committee has decided to accept the tender of Siemens Bros. and Co. for lighting equipment at £8 237, subject to the consent of Tynwald being obtained to borrow the money.

London County Council have accepted the tender of E. Bennis and Co. (lowest complete tender received) for an ash conveyor for Greenwich power station at £2 874 18s. (10 complete tenders received; highest £6 164); and the same firm's tender for an ash hopper at £2 409 (13 complete tenders received, varying from £1 989 to £3 277).

* Particulars from the Department of Overseas Trade.

Glasgow Corporation are recommended to accept the following tenders for plant required at the Provan Chemical Works:—Bruce Peebles and Co., 60 h.p. totally-enclosed motor; McFarlane Engineering Co., 10 h.p. ditto; J. Bennis, Ltd., 15 cwt. electric-driven lime and ash hoist; Paterson Hughes Engineering Co., electric crane; W. Weir, electric lighting work of Blackfriars Church (£252).

Sunderland Corporation have accepted the following tenders:—Steel, Peech and Tozer, tramway rails; Ferranti, Ltd., 108 d.c. meters; Pirelli General Cable Works, l.t. cable; Consolidated Pneumatic Tool Co., electric blower; W. G. Allen and Sons, two ½-ton soot waggons; Callender's Cable and Construction Co., 7 a.c. disconnecting boxes, 9 d.c. disconnecting boxes; Henley's Telegraph Works Co., 1 feeder pillar.

Bradford Corporation have accepted the following tenders:—Cole, Marchent and Moreley, 20 tons brake shoes, £245; Reyrolle and Co., e.h.p. switchgear for two 1 500 kW motor converters at Bolton Road sub-station; Bertram Thomas, d.c. switchgear for two 1 500 kW motor converters; English Electric Co., 150 kVA special testing transformer; Metropolitan-Vickers Electrical Co., control gear for a.c. motors for No. 4 boiler-house, at Valley Road station; Landis and Gyr, Ltd., 600 single-phase a.c. house service meters; British Insulated and Helsby Cables, Ltd., overhead line from transformer chamber in Thornton Road to York Street.

Arrangements for the Week.

MONDAY, JULY 3rd.

Royal Institution of Great Britain.

5 *p.m.* At Albemarle Street, Piccadilly, London, W.1. General meeting.

TUESDAY, JULY 4th.

The Institute of Physics.

5.30 *p.m.* At the Institution of Electrical Engineers, Victoria Embankment, London, W.C.1. Lecture on "The Physicist in Engineering Practice." By Sir J. Alfred Ewing K.C.B., F.R.S.

SATURDAY, JULY 8th.

Electrical Power Engineers' Association (Derby and District Section).

5 *p.m.* At the Queen's Hotel, Bridge Street, Burton-on-Trent. Address on "Economy in Mains Laying," by Mr. T. A. G. Margary.

Prices of Metals, Chemicals, etc.

		Price.	Tuesday, June 27. Inc.	Dec.
Copper—				
Best Selected	per ton	£66 10 0	—	—
Electro Wirebars	,,	£71 10 0	10s. 0d.	—
H.C. Wire, basis	per lb.	0s. 10 7/16d.	—	—
Sheet	,,	0s. 10⅛d.	—	—
Phosphor Bronze Wire (Telephone)—				
Phosphor Bronze Wire, basis	per lb.	1s. 2 7/16d.	—	—
Brass 60/40—				
Rod, basis	,,	7d.	—	—
Sheet, basis	,,	9¼d.	—	—
Wire, basis	,,	9⅞d.	—	—
Pig Iron—				
Cleveland Warrants	per ton	£4 15 0	—	—
Galvanised steel wire, basis 8 S.W.G.	,,	£18 0 0	—	—
Lead Pig—				
English	,,	£26 0 0	—	—
Foreign or Colonial	,,	£24 7 6	—	5s. 0d.
Tin—				
Ingot	,,	£152 15 0	—	—
Wire, basis	per lb.	2s. 1⅛d.	⅛d.	—
Aluminium Ingots	per ton	£100 0 0	—	—
Spelter	,,	£27 12 6	—	7s. 6d.
Mercury	per bottle	£11 10 0	—	—

Sulphur (Flowers)—Ton £10 15s.

,, (Roll-Brimstone)—per ton £10 15s.

Sodium Bichromate.—Per lb. 5¼d.

Boric Acid (Crystals). Per ton £60.

Sodium Chlorate—Per lb. 3¼d.

Sulphuric Acid (Pyrites, 168°) per ton, £9.

Copper Sulphate.—Per ton £26 15s.

Rubber.—Para fine, 9¾d.; plantation 1st latex, 7¾d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Company.

COMMERCIAL INTELLIGENCE.

RECEIVERSHIPS.

BROTHERTON EDISWAN TUBES AND CONDUITS, LTD.—R. H. Johnston, of 49, Queen Street, Wolverhampton was appointed receiver and manager on June 14th, 1922, under powers contained in debentures dated April 7, 1921.

REEVE AND BAYMAN, LTD.—E. H. Hawkins, of 4, Charterhouse Square, E.C., was appointed receiver on June 13th, 1922, under powers contained in first mortgage debenture dated December 7, 1921.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

ELCO ELECTRIC MANUFACTURING CO., LTD., Bristol.—Registered June 15, £4 500 debentures; general charge. *Nil. February 22, 1921.

FELLOWS MAGNETO CO., LTD., London, N.W.—Registered June 16, £60 000 debentures; general charge. *Nil. August 12, 1921.

STELLA LAMP CO., LTD. (late Harlesden Lamp Co., Ltd.), London, N.W.—Registered June 14, £23 500 debentures; general charge. *——. February 17, 1921.

Private Meetings, etc.

[*Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.*]

W. WATKIN AND SON, LTD. (in voluntary liquidation), 181, Queen Victoria Street, London, E.C., electrical engineers, etc. At a recent meeting of the principal creditors, held prior to the company meeting to wind up, a committee was appointed consisting of Ashby and Sons, Grimwood and Co., H. P. Smith, Ltd., the National Radiator Co., and Woodworkers, Ltd. At the statutory meeting of creditors last week, Mr. A. Quaife, whose appointment as liquidator was confirmed, stated that an approximate statement of affairs presented at the preliminary conference showed that there were unsecured liabilities amounting to £10 903, while a partly secured creditor, the bank, claimed £765 17s. 8d. This creditor held a charge on certain contracts, valued at the same amount, which concerned an electrical job at Aldershot. He, the liquidator, had been going into the figures, and it was difficult to see how this job would work out, but the architect had recommended a payment of between £500 and £600 on account of the contracts, and the War Office, for whom the work was undertaken, had refused to pay a penny, because of the unsatisfactory nature of the work. With regard to the assets, he thought that if they produced in all something like £1 500, or at the very outside £2 000, it was as much as the creditors could expect to receive in the course of the realisation. The company was registered on April 12, 1921, with a nominal capital of £5 000, and the directors were Mr. Sandiford, Mr. Munro, Mr. Bearfoot, Mr. Lewis, and Mr. H. C. Wood. The object of the company was to take over the business of engineers which had been carried on by Mr. Sandiford. The misfortunes of the company seemed to have grown out of the fact that the business, which was originally connected with electrical and general engineering, etc., was extended to embrace building, and the unfortunate part was that this latter branch of the business was not sufficiently understood to enable the directors to cope with the contracts which were undertaken with any hope of success. It was not intended that the business should be in any way continued. The following are creditors: Baxter and Caunter, Ltd., £108; Butterfield, H., £257; Credenda Conduits Co., Ltd., £320; Farmiloe, Geo., and Sons, Ltd., £149; Fell, Anderson and Co., Ltd., £316; Grimwood and de Geus, Ltd., £520; General Electric Co., Ltd., £91; Henley's, W. T., Telegraph Works Co., Ltd., £46; Heywood and Bryett, Ltd., £306; Kartret Engineering Co., Ltd., £433; Morgan and Son, Ltd., £72; Fenwick, J. Owen and Son, £173; Sharman, P. R., £244; Watshams, £105; Woodman, G., £130.

London Gazette.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

Companies Winding Up.

HUBERT D. CARTER (BANGOR), LTD.—Voluntary winding-up to be continued, but subject to the supervision of the Court; G. G. Poppleton, of Birmingham, and A. T. Eves, of Manchester, appointed joint liquidators in place of W. R. Redwood.

Companies Winding-up Voluntarily.

CHASE, A., AND CO., LTD.—A. M. Cole, of Fairfax Road, Teddington, appointed liquidator.

TREDEGARS, LTD.—Norman Bell, of T. Fuller, Carter, Son and White, and B. B. McCallum, of Tansley Witt and Co., 5, Chancery Lane, W.C.2, appointed joint liquidators. Meeting of creditors at the Institute of Chartered Accountants, Moorgate Place, E.C., on Friday, June 30, at 12.30 p.m.

Bankruptcy Information.

GILL, Frederick John, 26, Hardwick Street, Buxton, electrical engineer. Receiving order, June 19. Debtor's petition.

HENSON, Leslie Rowland, 23, Greenlanes, Islington, London, electrical engineer. Receiving order, June 23. Debtor's petition. First meeting, July 6, 11 a.m., and public examination, July 28, 11 a.m., Bankruptcy Buildings, Carey Street, London, W.C.2.

WYNESS AND BALE, 13, Commercial Street, Brighouse, York, electrical engineers. Receiving order, June 23. Creditor's petition.

Notice of Dividend.

GOSS, Frederick Charles, 32, Windsor Road, St. Andrews Park, Bishopston, and 71, North Road, Bristol, electrical engineer. Amount per £, 2s. 6¼d. First and final. Payable, June 30, 26, Baldwin Street, Bristol.

Notice of Intended Dividend.

LUDLOW, Jesse Frederick, and LUDLOW, Robert Redvers, in co-partnership as LUDLOW BROTHERS, 196, Church Road, Redfield, Bristol, electrical contractors. Last day for receiving proofs, July 8. Trustee, F. W. Darley, 36, Baldwin Street, Bristol.

LIDDELL, Robert Henry, under the name of LIDDELL AND McINNES, 4, The Crescent, Carlisle, electrical engineer Last day for receiving proofs, July 14. Trustee, K. J. Hough, 34, Fisher Street, Carlisle.

Dublin Gazette.

Notice is given, that the partnership between BRABANTS, Jules and O'CALLAGHAN, John, electrical and mechanical engineers, 16, Queen Street, Cork, under the style of BRABANTS, O'CALLAGHAN AND CO., has been dissolved by mutual consent, as far as regards J. Brabants. Debts received and paid by J. O'Callaghan, who will continue the business under the present style.

Bankruptcy Proceedings.

ROTHWELL, Herbert, WATSON, Stanley James, and JINKS, Francis Cecil (sued as the VULCO MAGNETO CO.), 11, Long Acre, W.C. In this bankruptcy the Official Receiver has now issued to the creditors a summary of the debtors' joint statement of affairs, which discloses ranking liabilities £2 076, and assets nil. The separate estate of the debtor Watson shows liabilities £34 775, of which £10 317 are expected to rank, and estimated net assets £2 793. In his observations the Official Receiver reports that the debtor Watson has stated that in May, 1910, he was appointed sole representative and agent in the United Kingdom for a German company carrying on business as manufacturers of electric parts, magnetos, etc., and on the outbreak of the war he assumed the proprietorship of the business. In the early part of 1915 he took premises at 37, Sheen Road, Richmond, for the purpose of manufacturing electrical goods required for war purposes. The debtor Rothwell states that in January, 1918, he and another person began business at 11, Long Acre as electrical and mechanical engineers, and carried it on under the style of the Vulco Magneto Co. In November, 1918, his partner retired, and the debtor then took into partnership the debtor Watson, who provided £700, of which £350 was treated as a personal loan. In May, 1919, they were joined by the debtor Jinks, who paid £800 for a one-third share in the business. The first year's trading, to November 30, 1919, produced a small profit, but the trading was afterwards conducted at a loss, and in October, 1920, Jinks severed his connection with the business, and the debtor Watson expressed his inability to provide further capital. The partnership then for all practical purposes came to an end, although no formal dissolution took place. The debtor Rothwell afterwards transacted, but in the name of the firm, what business was done, although he was mainly engaged in realising the firm's assets. Eventually a creditor who had obtained a judgment against the firm presented the petition on which the receiving order was made. The debtor Rothwell attributes the failure and insolvency of the Vulco Magneto Co. to lack of working capital to pay wages and other outgoings, to the firm's inability as a consequence, and also because of the non-delivery of necessary parts to complete certain work on hand, as a result of which there was a heavy trading loss, and to liabilities for breaches of contract and law costs. At a sitting of the London Bankruptcy Court last week, the public examination of the debtor Watson was adjourned and that of his late partners concluded.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Complete Specifications.

173 878 Scott, J. L. Electrical contact makers for use with the steering-wheels of motor-vehicles. (9/10/20.) (Addition to 134 973.)
173 886 Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). Electric regulating systems. (12/10/20.)
173 889 Jhamuotila, K. R. Disposition of safety devices and connexions in multiphase or polyphase generators and other electrical apparatus. (12/10/20.)
152 352 Kominik, O., and Nossic, J. Electric fuses or cut-outs. (10/3/19.)
152 358 Pelizzola, M. Sparking-plugs. (14/10/20.) (Convention date not granted.)
173 905 Baker, P. W. Thermally-actuated electric switches. (18/10/20.)
173 916 Igranic Electric Co., Ltd., and Yerger, C. W. Control of electric circuits. (25/10/20.)
173 922 Railing, A. H., Garrard, C. C., and Wilson, W. Means for interlocking electric switches. (29/10/20.)
173 933 Schmidt, J. (Buckholtz and Co., A. R.). Electric torches for medical purposes. (3/11/20.)
173 934 British Thomson-Houston Co., Ltd. (General Electric Co.). Incandescent lamps. (4/11/20.)
173 948 Bassett, E. Electric iron for domestic purposes. (26/11/20.)
173 950 Fletcher, G. H., and Metropolitan Vickers Electrical Co., Ltd. Systems for controlling electric motors. (30/11/20.)
155 830 Veifa-Werke Vereinigte Electrotechnische Institute Frankfurt-Aschaffenburg, and Dessauer, Dr. F. High-tension electric transformers. (29/9/15.)
156 099 Vogeli, F. Apparatus with electric arrangement for the generation of steam. (18/7/18.)
173 969 Callender's Cable and Construction Co., Ltd., and Watson, J. F. Manufacture of electric cables and apparatus therefor. (31/12/20.)
173 976 Watkinson, J. Resistance switches for controlling the intensity of electric currents. (5/10/20.) (Cognate application 2 114/21.) (Divided application on 173 613.)
173 977 Gundry, W. L. D., and Lord and Shand, Ltd. Lighting gas by electricity. (15/1/21.)
158 245 Koppensteiner, Dr. K. Electric distribution systems. (31/12/19.)
162 642 Siemens and Halske Akt.-Ges. Mercury vapour jet pumps with electric arc. (24/4/20.) (Addition to 157 118.)
173 986 Mead, A. G., and Mead and Jeffery, Ltd. Electric incandescent lamps. (15/2/21.)
174 001 Reodie, L. N. (Consorzio per Elettrotrazione). Means for the suspension of electric contact wires. (15/4/21.)
169 442 Latour, M. Thermionic transmission systems for wireless telephony. (20/11/16.) (Divided application on 19 760/20.)
174 093 Furnival, J. M. Microphones or telephone transmitters. (20/10/20.)
174 094 Lee, F. W. R., Lee, E. R., and Golledge, V. F. H. Thermal switches for electrically-heated apparatus. (20/10/20.)
147 145 San Giorgio Soc. Anon. Industriale. Electro-hydraulic steering apparatus. (17/9/18.)
147 612 Schuchhardt Berliner Fernsprech und Telegraphenwerk. F. Device for strengthening telephone currents and other electrical oscillations. (14/5/17.) (Addition to 147 579.)
147 865 Columbia Graphophone Manufacturing Co. Dies or moulds for duplicating gramophone records and for like purposes. (14/8/16.)
148 182 Ges. fur Drahtlose Telegraphie. Reception of continuous electric oscillations. (15/10/15.)
148 380 Day, A. van T. Electric high-frequency signalling. (17/7/16.)
148 801 Huth Ges. Dr. E. F., and Kuhn, Dr. L. Apparatus for rhythmically influencing electric waves produced by cathode tubes. (3/4/19.)
148 804 Huth Ges, Dr. E. F. Switching arrangement for wireless signalling, particularly for aeroplane sets. (8/9/16.)
148 992 Ges. fur Drahtlose Telegraphie. Electro-magnetic wave-receiving arrangements. (8/2/16.)
149 011 Huth Ges, Dr. E. F. Wireless telephony. (31/12/17.)
149 013 Loewe, Dr. S. Installation for the operation of Röntgen tubes. (5/3/19.)
149 014 Huth Ges, Dr. E. F. Arrangement of connections for generating and receiving electrical oscillations. (2/5/19.)
149 195 Huth Ges, Dr. E. F., and Loewe, Dr. S. Method of connection to produce oscillations with vacuum tubes. (16/7/17.)
149 197 Huth Ges, Dr. E. F., and Rosenbaum, B. Antenna for wireless telegraphy. (14/7/15.)
149 198 Huth Ges, Dr. E. F. Connection for sending and receiving electric waves. (13/10/17.)
149 209 Huth Ges, Dr. E. F. Combined wireless transmitting and receiving arrangement. (15/12/17.)
149 211 Huth Ges, Dr. E. F. Electric discharge vessels. (29/12/17.)
149 214 Loewe, Dr. S. Wireless telephone transmitters. (29/10/18.)
149 215 Huth Ges, Dr. E. F., and Rosenbaum, B. Arrangements for the combined transmission and reception of wireless signals. (28/8/17.)
149 235 Huth Ges, Dr. E. F., Rosenbaum, B., and Loewe, Dr. S. Process for wireless telegraphy and telephony. (18/8/17.)
149 237 Loewe, Dr. S. Thermionic receiving-apparatus for wireless signalling. (18/4/18.)
149 240 Huth Ges, Dr. E. F. Thermionic receiving-systems for wireless and wired wireless signalling. (13/10/17.)
152 311 Loewe, Dr. S. Vacuum tube. (20/4/18.)
174 118 Line, W. J., and Tucker and Co., Ltd, J. H. Mounting clips for electric switch gear. (10/9/20.)
174 134 Taggart, J. Scott, and Radio Communication Company, Ltd. Negative resistance devices particularly for electro-magnetic wave systems and the like. (30/9/20.) (Cognate application 17 839/21.) (Patent of addition not granted.)
174 137 Painter, F., and Idge, G. H. Electric switches. (7/10/20.)
174 149 British Thomson-Houston Company, Ltd. (General Electric Company). Electron discharge devices for use as valves or oscillators. (13/10/20.)
152 355 Haddan, R. (Neumeyer Akt.-Ges. F.). Electric starters for internal-combustion engines. (13/10/20.) (Convention date not granted.)
174 156 Oldham, O., Oldham, G., and Oldham, J. Magnetic locks. (14/10/20.) (Cognate application 32 248/20.)
174 163 Glaser, W. H., Wickens, A. L., and Glaser, Ltd., W. H. Brush-gear for electrical machinery. (15/10/20.)
174 185 Oliver, V. F. M. Device for testing the electric ignition of internal-combustion engines. (19/10/20.)
174 192 Parson, Sir C. A., Bennett, E., and Rowe, H. Searchlight and other projectors. (20/10/20.) (Addition to 152 728.)
174 202 Hadwen, H. E., and Willis, H. Drop electric lamps. (23/10/20.)
153 002 Schaeffer, E. Method of operating vacuum tubes. (26/8/19.)
153 003 Schaeffer, E. Method of operating vacuum tubes. (24/10/19.) (Addition to 153 002.)
174 223 Igranic Electric Company, Ltd. (Cutler-Hammer Manufacturing Company). Electro-magnetically operated circuit-controlling devices. (2/11/20.)
154 582 Betulander, G. A. Call distributing arrangements for telephone plants. (22/11/19.)
174 242 Amberton, R., and Bray, E. N. Loose-handle electric circuit breakers, current limiters, overload releases, prepayment meter switches, and the like. (10/11/20.)
167 446 McKenzie, Holland, and Westinghouse Power Signal Company, Ltd. Alternating current relays. (6/8/20.)
156 496 Eustice, A. L. Renewable electric fuses. (31/3/19.)
174 279 Hodges, H. C. Fusible cut-outs and distribution fuse-boards for electric circuits. (6/1/21).
158 238 Soc. des Ateliers de Constructions Electriques du Nord et de l'Est. Electric systems of ship propulsion and the like. (25/5/15.)
174 298 Taylor, A. R. Means for supporting thermionic valves. (12/3/21.)

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16 199 W. G. Brown. Joint boxes for cables.
16 202 A. M. Taylor. Electric transmission systems.
16 226 E. W. Powell. Detachable filament for wireless valves, etc.
16 243 R. A. Jouaust. Reception of undamped oscillations. (22/6/21, France.)
16 249 G. C. Snijders. Telephone exchange systems. (14/6/21, Holland.)
16 268 Skywing Aircraft Corporation. Electric ignition devices. (1/12/20 United States.)
16 276 British Thomson-Houston Company. Motor control mechanism.
16 277 British Thomson-Houston and H. W. E. Liddiard. Control of electrical machines.
16 284 W. F. M. Rose. Mechanical transmitter for wireless telegraphy.
16 301 H. D. Nyberg. Galvanic cells. (28/3/22, Sweden.)
16 302 Scintilla. Lighting plants of motor vehicles. (13/6/21, Switzerland.)
16 303 Scintilla. Windings of electro-magnets. (9/7/21, Switzerland.)
16 305 W. H. Wilson. Radio communication, etc.

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16 351 A. Jones. Electric furnace.
16 362 W. B. Sayers. Electric conductors.
16 370 M. Plohl. Production of compensation voltage by self-induction and capacity.
16 376 Morkrum Company. Printing telegraph receiver. (13/6/21, United States.)
16 382 A. E. White (Elyria Iron and Steel Company). Electric cutt-welding machines.
16 398 L. Frost and W. Stubbs. Electric heaters. (13/7/21, Australia.)

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16 420 J. B. Tucker. Quick make-and-break switches.
16 434 A. E. Roberts and L. H. Thompson. Hornless cabinets for wireless recorders.
16 442 British Insulated and Helsby Cables, Ltd., and F. Mercer. Rendering line capacity of telephone cables uniform.
16 443 British Insulated and Helsby Cables, Ltd., W. Holttam, and F. Mercer. Elimination of overhearing or cross-talk in telephony.
16 447 W. Gee. Electrical device for giving set speeds to gramophones.
16 448 W. Gee. Revolving disc for electric motor and foot switch for dental purposes, etc.
16 450 A. S. Cubitt. Electric switches.
16 455 E. Curtis. Automatic electric signalling system.
16 472 L. G. Preston and G. Shearing. Signalling in wireless telegraphy.
16 477 Western Electric Company. Electric wave filters.
16 478 Western Electric Company. Automatic telephone switches. (21/7/21, United States.)
16 491 Siemens und Halske Akt. Ges. Telephone systems. (15/7/21, Germany.)
16 492 H. Barkes. Pipe and socket coupling for electric connections.
16 498 H. and O. Lucas. Automatic electric switches.
16 499 H. and O. Lucas. Brush-holders for electric machines.
16 518 Pittsburgh Transformer Company. Polyphase transformers.
16 530 R. S. Clay. Transmitting pictures by telegraphy.

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16 537 W. J. Polyblank. Electric couplings.
16 557 H. North. Electric lighting devices.
16 575 Sir O. J. Lodge and E. E. Robinson. Wireless telegraphy.
16 576 A. Orling, M. Compare and G. A. O'Hanlon. High-frequency selective wireless receiving apparatus.
16 577 A. Orling, M. Compare and G. A. O'Hanlon. Low-frequency selective wireless receiving apparatus.
16 578 A. Orling, M. Compare and G. A. O'Hanlon. Secret wireless intercommunication.
16 591 F. E. Pernot. Electric signalling.
16 614 W. J. Evans and E. F. Joyce. Portable electric boring machines.
16 626 Metropolitan-Vickers Electrical Company, J. P. Campbell, L. Miller, and F. B. Holt. Electrically operated valves.
16 642 Quarzlampen-Ges. Electric heat radiator for therapeutic purposes. (15/6/21, Germany).
16 649 Skywing Aircraft Corporation. Ignition systems. (1/12/20, United States.)

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16 664 F. Lehner and I. Rosenstok. Two-piece glow lamp bulb.
16 665 G. Frieman and A. H. Kirby. Telephone transmitters, etc.
16 668 H. S. Jones. Apparatus for cutting off electric supply at a given time.
16 671 W. T. Turner. High-tension magneto electric machines.
16 677 Veritys, Ltd., and F. W. Thorpe. Anti-vibration fittings for electric lamps, etc.
16 682 Electric Control, Ltd., and O. Ellefsen. Electric transforming machinery.
16 701 S. T. Hosken. Electric signs.
16 702 Norwest Electrical Manufacturing Company. Safety device for electrical apparatus.
16 709 British Thomson-Houston Company (General Electric Company). Insulators.
16 713 A. A. Price. Generating sets.
16 716 P. G. A. H. Voigt. Attachments to valve detectors for wireless telegraphy, etc.
16 717 O. Morduch. Rotating electric machines.
16 718 C. Davis. Wireless direction finding apparatus.
16 733 Peckham Truck and Engineering Company and S. Thomas. Trucks for tramcars, etc.
16 747 Soc. Anon. Electricite et Electromechanique. Electric welding. (11/5/22, Belgium).

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16 757 W. W. Wilson. Electrodes for welding, etc.
16 758 A. R. Angus. Telegraph and telephone devices.
16 776 J. H. Parr. Electromotors.
16 794 T. G. Hodgkinson. Oscillatory electric circuits.
16 796 British Thomson-Houston Company (General Electric Company). Incandescent arc devices.
16 797 L. Vallino. Overhead switches for electric trolley conductors. (18/6/21, Italy).
16 804 Erda Ges. fur Wissenschaftliche Erderforschung, R. Ambronn. Devices for locating masses of dissimilar electric conductivity over the earth, etc. (17/6/21, Germany.)
16 821 Sir C. A. Parsons and J. Rosen. Electric machines.
16 826 Siemens-Schuckertwerke. Electrical metal-vapour apparatus. (18/6/21, Germany.)
16 827 J. C. W. Drabble and L. G. Preston. Receiving arrangements for wireless telegraphy and telephony.

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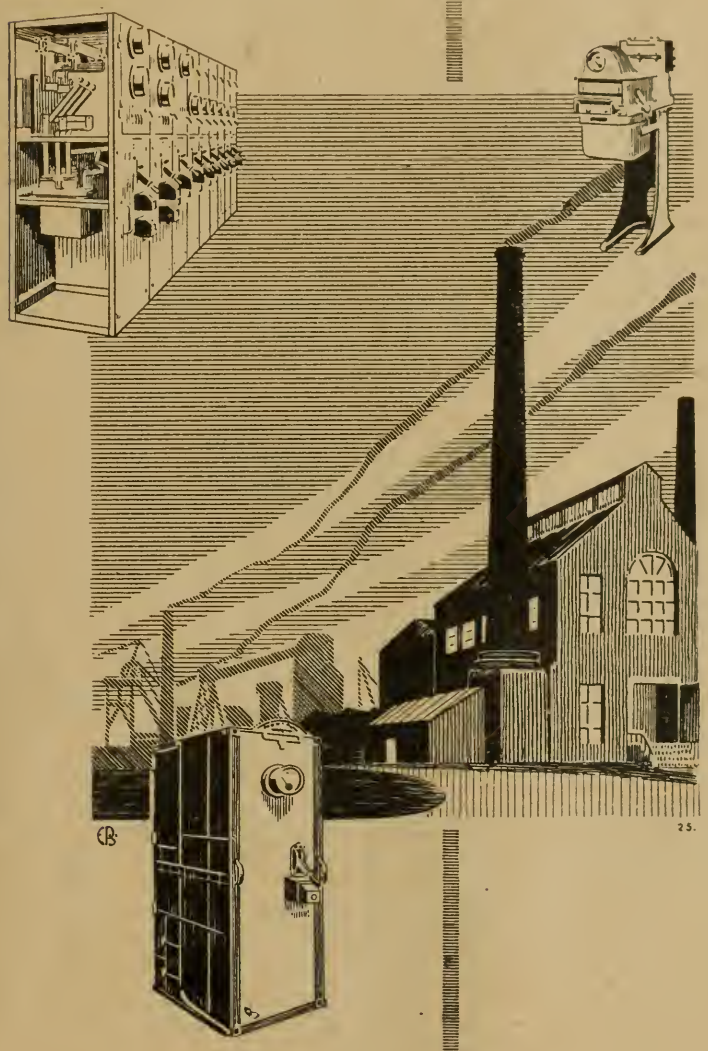

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